Evolutionary Communication

An Introduction

James Lull

ROUTLEDGE

"The insights from evolutionary theory have been very sparsely applied in the social sciences, especially in the study of human communication. And yet this basic feature of human existence—its essence, modalities, and impact—can only be seriously studied from an evolutionary perspective.

This book by James Lull . . . is a 'must read' for students and practitioners alike who want to understand how we became the planet's most cooperative communicators."

—Cees J. Hamelink, *Emeritus Professor of International Communication, University of Amsterdam*

"Engagingly written, explaining a wealth of instances where communication and life itself cross, *Evolutionary Communication* presents a radical new perspective for Communication Studies. Covering ground from how single-celled organisms interact to the wonders of the most recent communication technologies, this is a book of great insight and intellectual courage."

—Eduardo Neiva, *Professor of Communication Studies, The University of Alabama at Birmingham*

"The connective tissue of human progress is communication. James Lull teases out this truism in a fascinating and scientifically rich exploration of how communication evolved and the role it plays in the complexities of life today. It's rare to find a book that combines scholarship and readability. This is one of them."

—Robyn E. Blumner, *President and CEO, Center for Inquiry and Executive Director, Richard Dawkins Foundation for Reason and Science*

"The semiotic approach to communication explains the evolution of living beings and represents the new wave of evolutionary theory."

—Kalevi Kull, *Professor of Semiotics*, University of Tartu, Estonia, and President of the International Society for Biosemiotic Studies

"In this innovative volume, James Lull links the biological and cultural development of human communication with rich contemporary examples and clear terminology that capture the relevance of evolution in the age of the Internet. Accessible to anyone seeking a guide through the key theories and accumulating empirical evidence, *Evolutionary Communication* provides a one-stop resource."

—Klaus Bruhn Jensen, *Professor of Media, Cognition, and Communication, University of Copenhagen*

". . . a comprehensive and accessible book that will provide a much needed resource for instructors who teach communication from an evolutionary perspective. The book weaves seamlessly through an incredible diversity of topics including cultural issues and new technology, all presented mindfully with an evolutionary focus."

—Greg Bryant, *Professor of Communication, University of California-Los Angeles*

"*Evolutionary Communication* is the first major textbook in the field of communication to apply evolutionary theory systematically to all aspects of human communication. As James Lull lucidly explains throughout the book, "Communication is the mechanism of evolution" in all its configurations, manifestations, and applications. The scholarship that provides the intellectual foundations for this book is superb and the writing is elegant. Irrespective of whether you are new to the field of communication or a senior scholar, you will learn a great deal by reading this book."

—Peter Monge, *Professor Emeritus at the Annenberg School of Communication and Journalism*, University of Southern California

EVOLUTIONARY COMMUNICATION

Evolutionary Communication presents the first comprehensive evolutionary approach to the study of human communication.

Presuming no specialized knowledge of evolutionary theory, this reader-friendly textbook explains why and how communication became the determining factor in human development. Drawing from the latest scientific research, *Evolutionary Communication* represents a truly groundbreaking contribution to Communication Studies as a field of study.

Opening up an inspiring new approach for teaching communication, the book can be used as a core volume or supplemental text for courses ranging from Introduction to Communication and Communication Theory to Special Topics and graduate seminars.

James Lull is Professor Emeritus of Communication Studies at San Jose State University, California. Author or editor of more than a dozen books with translations into many languages, Professor Lull is recognized internationally as one of the field's most original thinkers and productive scholars.

Also by James Lull

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EVOLUTIONARY COMMUNICATION

An Introduction

James Lull

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PREFACE

Forty years ago Carl Sagan's public television series *Cosmos* became the first sustained media program devoted to science. Since then, science themes, including evolution and evolutionary theory, have become increasingly present in popular culture. Neal deGrasse Tyson hosted a second *Cosmos* series on public television. His current National Geographic network program, *Star Talk*, is billed as "the place where science and popular culture meet." Public television programs like NOVA explain evolutionary topics, including the principles of natural and sexual selection, DNA and the human genome, and the origin of tools and symbolic forms. For more than 50 years Jane Goodall has made frequent public appearances as the world's leading advocate for primates. Bill Nye "The Science Guy" became a pop culture phenomenon in the 1990s. His work across media platforms continues to influence society today.

The nerdy cool *Big Bang Theory*, replete with science themes and jokes, was the top-rated network television program in the United States until 2019. Cirque du Soleil, Icelandic singer and songwriter Björk, Finnish symphonic metal band Nightwish, and Canadian rapper Baba Brinkman concentrate on evolutionary themes in their creative work. Steven Colbert features science topics and guests on his late-night comedy show. Bill Maher takes a strong stand for evolutionary science on his HBO weekend program, *Real Time*.

So why is evolutionary science denied or not understood by so many Americans and people in many other countries around the world today? Why is science suffering a crisis of credibility, even within the relatively educated American population, at a time when scientific knowledge is ascending to incredible heights?

Increasing scientific literacy has become an educational priority in the United States, but there is plenty of catching up to do. Elementary and high school students in America rank very low among developed countries in science and math. America underperforms internationally in the proportion of college students who receive undergraduate degrees in science, technology, engineering, and math. Many high school graduates arrive at college unprepared to complete degrees in science.

Evolution has proven to be as certain as gravity and relativity. Yet many people in the United States lag way behind populations in other developed countries in their understanding of what evolution is and how it works. Given the disheartening reports concerning science proficiency, it's actually not surprising that so many Americans understand very little about evolution in general and human evolution in particular.

Objections raised by a vocal minority to the teaching of evolutionary science contribute to the problem. For many people, knowledge about the natural world is superseded by personal beliefs. It begins at a young age. Most students at every educational level in the United States hold religious views. Many of them feel they shouldn't have to defend or explain their faith or cultural traditions when science implicitly challenges the claims of their belief system. Parents of some children enrolled in elementary through high school vigorously object to teaching evolutionary theory for religious reasons.

The theory of evolution explains the diversity and complexity of life on earth. Biological science is the primary academic discipline that is equipped to tell the amazing true story. But many biology teachers in America today feel they can't teach evolution as the unifying principle of their field. They fear offending some students' religious sensibilities. To avoid this problem, biology instructors are being encouraged to simply try to get their deeply religious students to become somewhat more open minded about the reality of evolutionary biology.

The scientific establishment itself has contributed to scientific illiteracy. The conventional view held by many scientists has been that their work should not be made too accessible to the public. Celebrity scientists in universities and other institutions have been seen as opportunists and entertainers. Tradition holds that real scientists should be above popularizing their ideas. Instead, they should quietly pump out dozens of esoteric research articles that will be read by specialists. The self-defeating stand against popularizing science has been termed "the Sagan effect."

Narrow mindedness about the role of science to engage the broader public is not acceptable, in the opinion of Jonathan Foley, senior scholar at the California Academy of Sciences, and other progressive voices. Fake science tweets, politicians ignoring and mocking facts, the misrepresentation of scientific research to serve corporate interests, and cuts to federal agencies that are supposed to operate on the basis sound science have created a crisis. Support for science education at every level is needed now more than ever before.

Unfortunately, teaching core subject matter from an evolutionary perspective at the college and university level has also been problematic, especially in the social sciences. Evolutionary approaches to the study of psychology, sociology, history, political science, and economics, for example, have found some space for teaching and research. But even though communication drives organic and technological evolution, an evolutionary framework for the study of human communication is conspicuously absent.

The reluctance to apply established principles of evolutionary theory to subject matter in the social sciences stems in part from overheated discussions in the 1970s about sociobiology, a theoretical perspective that applies knowledge gleaned about lower-order species to help explain human behavior. The contentious politics of the era got in the way of any reasonable discussion about the link between biology and human behavior. Completely apart from its scientific merits, many people in the academic world thought sociobiology represented an assault on disadvantaged members of society.

As the editors of the scientific journal *Nature* point out, biological explanations for phenomena such as gender roles, ethnic and racial differences, homosexuality, and xenophobia were categorically rejected by many academics at the time because they feared such explanations would be used to justify existing inequalities among social groups based on genetic grounds. Academics last century typically looked to cultural factors like politics and economics to explain social class inequalities and other forms of discrimination.

The fears and misunderstandings of that era still linger in some quarters, despite 50 more years of scientific research that clearly demonstrates how biological forces influence evolutionary processes, including our own behavior. However well-intended, political correctness originating in the 1970s created a false dichotomy between natural science and culture as ways to explain the human condition. *Biology and culture interact to create evolutionary outcomes.*

Institutional barriers that have been erected in the academic world also interfere with scientific progress. The most innovative thinking that emerges in any intellectual endeavor takes place across disciplinary boundaries. But the way most colleges and universities are organized discourages the cross-fertilization of ideas. Specialists are marked off by curricular boundaries and set apart physically in different parts of the campus. You won't find departments of communication mixed in with departments of anthropology on campus, for instance, and certainly not with biology. Journals, conferences, and funding organizations also remain separated by disciplinary traditions.

This book helps break that mold by drawing liberally from the natural sciences, social sciences, and humanities. Evolutionary theory brings them together. Two essential facts guide the analysis presented in this book: (1) *Communication mechanisms are fundamental to biology and culture*, and (2) *communication is the motor of evolution.*

I named the book *Evolutionary Communication: An Introduction* in hopes of helping to open up a new way to teach material in communication studies. The book is relevant to every area in the discipline—from interpersonal, organizational, and intercultural communication to rhetoric, media, and information/Internet studies.

Evolutionary Communication: An Introduction is meant to be a conversation starter, not a definitive volume that covers every factor in the complicated way communication drives evolution. It's a textbook, not a monograph. And it's got a point of view. The purpose is to provide one comprehensive foundation upon which an evolutionary approach to teaching and learning can be carried out in communication studies and other social sciences.

Personally, I have always been intrigued by evolutionary theory and have touched on evolutionary themes in several of my previous books. About ten years ago I decided to go straight to the source. I carefully read Charles Darwin's two most influential books, *The Origin of Species* and *The Descent of Man*, searching for what the great naturalist had to say about the role of communication in evolution. That reading set me on a path that led to the present work.

Charles Darwin concluded *The Origin of Species*, which established the empirical and theoretical foundation of evolutionary theory, with an unforgettable and poetic phrase:

> from so simple a beginning, endless forms most beautiful and most wonderful, have been, and are being, evolved.

Now let's think together about how communication makes that happen.

PART ONE
Introduction

1

INTRODUCING EVOLUTIONARY COMMUNICATION

Human beings became natural-born communicators for good reason. Our survival depends on it. Messages circulate inside our bodies to help our internal organs maintain biological stability. We interact with others to navigate our physical, social, and cultural environments safely.

Humans are uniquely complex, creative, and collaborative because we are uniquely communicative. It took a very long time to acquire the extraordinary communication skills we possess and mostly take for granted. Yet most people today don't know much about where our communication ability comes from or how it shaped us into the individuals and societies we've become.

This chapter introduces the overall purpose of the book, briefly describes the major research traditions in communication studies, and explains why evolutionary communication can serve as a comprehensive and inspiring perspective for the study of human communication.

Purpose of the Book

The evolutionary approach presented in the following chapters describes how communication became *the* determining factor in human development and remains so.

We do not survive simply by out-competing our rivals. We succeed because we are motivated and able to cooperate with each other, a process that has been facilitated by communication ability from the very beginning. Microscopic single cells emerged as the first form of life on earth. *The ability of those tiny cells to communicate determined their fate*. Because all living forms evolved over time from those cells, their inborn capacity to communicate was passed on to all living things.

Scientific evidence supporting the idea that communication is the mechanism that drives evolution is clear and compelling. But an anti-science bias has intensified in some quarters today. Science denial forms part of a broader anti-intellectualism driven by an echo chamber of right-wing politics and media, further circulated by social media. Truth and facts are under attack.

Theory and Fact

A sticker placed by county government officials on the cover of biology textbooks in Georgia public schools stated, "Evolution is a theory, not a fact." Until the courts ruled that the stickers violated the separation of church and state clause of the Georgia state constitution, educational policymakers

there intentionally fed a common but misleading stereotype. In popular discourse, "theory" has negative connotations—it's said to be nothing more than speculation or pure conjecture. Everybody has a theory about something or other.

For scientists, theory refers to a kind of thinking that is far more specific and respectable. An established scientific theory represents a well-supported position on an issue that emerges conclusively from the rigorous testing of real-world conditions and relationships. *Theory is not contrary to fact. Scientific theories are based on facts.* The National Academy of Sciences distinguishes fact from theory and applies their definitions to the study of evolution this way:[1]

> **Fact**: An observation, measurement, or evidence that occurs the same way under similar circumstances. Scientific facts have been tested and confirmed so many times there is no longer a compelling reason to keep testing it or looking for additional examples. For instance, gravity only attracts; it never repels. Human bodies are composed of cells. Those are facts.
>
> **Theory**: A comprehensive explanation of some phenomenon that is supported by a vast body of evidence (facts). For instance, the claim that gravity acts on all matter in the universe as a function of both mass and distance is a theory. All living organisms, not just human bodies, are composed of cells is another theory. Established theories allow for testable predictions. For instance, scientists would expect that any newly discovered object would be subject to the same laws of gravity as known objects, or that any newly discovered biological organism would also be composed of cells.

The evidence for evolution is likewise made up of so many observations and confirming experiments that the accumulated facts or overall theory will not be overturned by new evidence. That does not mean that scientific theories are fixed or stagnant. Science is a never-ending process. New factual evidence adds to, modifies, and further clarifies aspects of theory, including evolutionary theory, all the time.

To summarize, facts refer to data; theories are structures of ideas that explain and interpret the facts.[2] Evolutionary theory has been reasoned from so much factual evidence that the theory itself has proven to be true.[3] The Georgia school administrators would have served their students better had they placed a sticker on biology texts that says, "Evolution is an established theory based on facts."

Communication Traditions

This is the first college textbook to approach the study of human communication from an evolutionary perspective. The material presented in each chapter is grounded firmly in scientific research and theory but does not require specialized preparation or course prerequisites. We draw from the natural, social, and information sciences but also from the humanities and arts. So how does the new evolutionary approach fit into the teaching and research that currently defines the communications discipline?

Generally speaking, the academic field of communication studies is divided into two main camps. One camp focuses primarily on the art of human communication, sometimes called rhetoric, and is usually addressed from a humanities' point of view. The other camp emphasizes empirical research based on systematic observations and theories of communicative interaction, a tradition that typically fits into the social sciences. Two more recent categories of scholarship in communication, critical theory and cultural studies, also contribute to theory and research in the discipline, especially outside the United States.

Rhetoric and Media

The ability to influence others through oral communication, especially public speaking and other forms of civic discourse, represents the art of human expression known as rhetoric. Good public communicators master the skills of informative, persuasive, or celebratory speaking much like actors or musicians learn how to perform for audiences.

The rhetorical approach traces its starting point back slightly more than 2,000 years. That's when public oratory began to shape the emerging political state in "ancient" Greece. Many academic departments of communication began as departments of rhetoric or theater. Others began as practical schools of journalism and media, where presentational skills are also emphasized. As we will see in this book, communication has always been performance art, and not just for humans.

Social Science

Social scientists use experiments, surveys, and ethnographic research techniques to analyze interpersonal, organizational, intercultural, and mediated communication. The findings produced by social scientific research can be used to describe and explain how communication influences social interaction.

Social scientific research followed on the heels of the natural sciences about 200 years ago. Social scientific studies of communication have their roots in other social sciences—especially psychology, sociology, and information science. Communication science didn't become a specialized field of study in the United States until the middle of last century.

Critical Theory/Cultural Studies

Contemporary critical theory and cultural studies emerged to emphasize social inequalities and challenge the idea that social science research can be objective. Schools of critical theory originated in Europe and concentrate on power relations in a society. For instance, the original critical theory, Marxism, grew from grave concerns that the working class was being exploited by economic elites in the early stages of European industrialization.

Cultural studies grew out of ground that had been established by critical theory. Cultural studies research also focuses on social class inequalities but broadens the scope of inquiry to include racism and sexism. Both critical theory and cultural studies recognize the central role communication plays in the construction of social and cultural realities. Neither approach uses traditional methods of rhetorical or scientific analysis. Much of the research and writing is politically motivated.

An Evolutionary Approach

Rhetoric, social science, critical theory, and cultural studies have each contributed uniquely to our understanding of human communication and will continue to do so. Communication is an inherently wide-ranging subject that benefits from diverse perspectives. But the time has come to expand our thinking beyond traditional disciplinary boundaries.

To understand how human beings became such exceptional communicators, we must reach back much farther in history than the traditional approaches do in order to properly broaden the scope of analysis. We are part of nature, representing just one species that evolved in our biology-driven world.[4] The natural sciences, especially biology, must figure prominently in the analysis of human communication.[5]

FIGURE 1.1 Biophilia. Humans have an inborn need to connect with nature. We feel an especially strong bond with other animal species. This bond has motivated the construction of wildlife crossing bridges like this one in Banff National Park, Alberta, Canada. Courtesy of jewhite/iStock.com

Nothing in biology makes sense except in the light of evolution. That insight appeared in an essay written by a biological scientist nearly 50 years ago.[6] Extending the biologist's reasoning, *nothing in the evolution of biological forms makes sense except in the light of communication.* Besides shared DNA, what all living organisms have in common is the ability to communicate. Organisms must be able to transmit and receive signals internally; send messages to other organisms; and for social species, coordinate activity. *Communication is the mechanism of evolution.* Without it, no organism or species can exist.

This book explains how communication drives evolution. That perspective opens up space for new ways to do research and develop communication theory. But taking a communications approach also creates a different emphasis in the development of evolutionary research and theory building. Evolutionary theory has evolved in three main stages over time.[7]

The first stage is the **standard theory** of evolution, sometimes called neo-Darwinian theory, or the modern synthesis, which developed early last century. Standard theory merges principles derived from Charles Darwin's original insights about selection processes, which we will explain in the next chapter, with the fundamentals of genetics. Standard theory still forms the foundation for most scientific research about evolution.

But genes are subject to change; they can be rewritten throughout life. Recognizing this reality, the second stage in our understanding of evolution is represented by **epigenetic theory**, or the extended synthesis, which emerged toward the end of last century. The epigenetic approach focuses on how biology and environment influence the expression of genes and behavior, including: (1) the effects of the internal environment of the organism, like stress and trauma, and (2) the influence of the physical environment in which the organism is situated, like temperature, light, and the presence of chemicals.

The third stage for explaining evolutionary dynamics moves through genes, biology, and the physical environment to focus on the content of this book—processes of communication and the making of meaning—semiosis. The **communicational** approach analyzes how sending and

receiving information in all its forms affects evolutionary processes, ranging from the behavior of simple biological organisms to the development of modern technology.

These three theoretical approaches—standard, epigenetic, and communicational—complement each other as explanatory frameworks. Our focus in this book is on communication, but we need all three approaches to create a comprehensive framework for understanding evolution's complexities.

Defining "Evolution"

The fundamentals of biological evolution were first described in the mid- to late 1800s by Charles Darwin in his two classic volumes, *The Origin of Species* and *The Descent of Man*.[8] But it wasn't until the second of those books that Darwin dared to include humans in the theory. Since then many more modifications and additions have been made to further refine "Darwinian evolution."

Biological organisms continuously adapt, change, and diversify over time. But it's not just biological organisms that adapt and evolve from previous forms. Languages and cultures evolve too. All the ordinary material objects that surround us today—books, televisions, cars, knives, or phones, for instance—also descend from and remain connected to earlier objects of the same class while they continue to evolve.[9] Our understanding of evolution therefore must also include the processes and products of industrial and technological innovation. The term generally used to describe the spread of spoken language, written language, culture, and technology is "development."

Biological organisms, languages, cultures, and material objects evolve in ways that can be studied scientifically. But people routinely use the term "evolution" informally, and usually with a positive connotation. Even individuals who are opposed to the very idea of evolution might use the word to describe the improvement of almost anything. Phrases like "Her thinking has evolved on that subject" or "That team has really evolved" are commonplace. And if things aren't confusing enough, evolution has become a popular branding and marketing concept for selling commercial products and services too.

Genes, languages, cultures, and technologies all undergo never-ending processes of change. The definition of evolution we use here must therefore remain general: the gradual development of something, especially from a simple to more complex form.

Keeping Perspective

As we begin this journey into the world of evolutionary communication, it helps to keep things in perspective. There is no simple explanation for something as complicated as evolution. Instincts often compete. Nature is made up of a continuum of life forms, not neat and separate niches. Every living thing is connected to every other living thing, past and present. The categories that scientists have devised to separate them for analysis are necessarily fluid. We see that reflected in our own genetic connection with the rest of nature, especially with the great apes. Within our own species, races, ethnicities, and gender identities do not occupy fixed categories.

The fluidity between categories in nature makes sense because all life forms evolved originally from the same ancient origins. Humans differ from the rest of the natural world—in some ways remarkably so—but we are not superior to it. Throughout this book we will occasionally refer to "non-human animals," but that does not mean they occupy a biological category of lesser standing than our own. All plants and animals, no matter their size or number, evolved to survive and thrive in the environments they inhabit.

We humans are prone to believe that evolution is a grand, progressive ladder, with our kind sitting way up on top. But research into the origins and spread of life forms dismisses that linear

view out of hand. The scientific record of evolution looks more like a tree or bush than a ladder. With every new discovery, the shrubbery gets ever more entangled.[10]

What Lies Ahead?

This book describes how human communication evolved from the simplest forms of life on earth nearly four billion years ago all the way to the complicated challenges and opportunities we face in today's technology-driven global Communication Age.

Communication is about relationships and roles, fleeting and long term, between and among individuals, inside and outside their own species. These relationships and roles are created, maintained, and transformed through communicative interaction. Species evolve in tandem with the forms of communication that make it possible for them to survive, reproduce, and express themselves. Ultimately, life and communication are inseparable.

Reading the Book

In order to make your experience with this book as enjoyable as possible, we will use some language shortcuts so you don't have to keep reading formal, scientific classifications over and over or deal with confusing references to historical periods.

For example, you and I belong to the species *Homo sapiens*. We are not the only species that is classified under the genus *Homo*, or "human." We often use the term "human" too easily. Sapiens is the only living *Homo* species. But several other human species walked the earth before we got here. Most familiar among them is *Homo neanderthalensis*. But *Homo erectus*, *Homo habilis*, and *Homo denisova* are among our important recent human predecessors too. We pay attention to each of these predecessors at various points in the chapters that follow. Each human group is referred to by its scientific name the first time it is mentioned. After that we shorten the names to their specific species, capitalize it, and get rid of the italics. So *Homo sapiens* becomes Sapiens. *Homo neanderthalensis* shortens to Neanderthal. *Homo erectus* becomes Erectus, and so on.

Learning about things that happened thousands, millions, or billions of years ago is exciting. But a few abbreviations will help speed up the reading without sacrificing information in tables and graphs. For instance, rather than use the form "200 million years ago," we'll say 200 mya. Instead of six billion years ago, it will be six bya. Anytime you see "ya," think "years ago." We'll make other adjustments for more recent periods. For example, rather than say "during the nineteenth century," we mostly write, "during the 1800s." That makes it a lot easier to keep track of just how long ago it was.

You will be introduced first to the *basics*—how communication forms the foundation of evolutionary processes. Next, we explore the main reasons *why* we communicate—to survive, reproduce, and express ourselves. The third part of the book describes *how* we communicate—through spoken and written language, technology, and media. The last part explains *what* we communicate—culture, information, ideology, religion, morality, identity, and community—crucial issues that should concern us all today.

Notes

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2

THE BASICS

Our remarkable ability to communicate in extremely complex ways sets human beings apart from all other forms of life on earth. But how did we get that way and why? Were the very first humans born with an innate ability to communicate? And who exactly were those first humans, anyway?

Most of us know very little about how we came to possess the extraordinary set of communication skills we use every day. Fortunately, that gap in knowledge is closing fast. Scientific evidence now makes it possible to understand clearly *who* we are, *where* we come from, *why* we are driven so powerfully to communicate, *how* we developed the communication skills we have, and, to a somewhat lesser degree, *when* those impressive abilities evolved.

Nothing could be more important. We communicate to survive. Communicating effectively gives us a firm measure of control over our individual and collective lives. Our ancestors created language for this very reason. All the communications technologies invented after that serve the same essential purpose. The future success of humankind revolves around our collective ability to communicate effectively and inclusively.

Describing and explaining the true nature of human communication in a clear, engaging, and up-to-date way is the purpose of this book. To accomplish that, we first have to establish a platform for our analysis. In this chapter we examine the basic concepts and processes that make up evolutionary communication. We will describe our planet's first communicators, explore the evolutionary stages of human development, and explain the first principle of evolutionary theory—natural selection.

Beginnings

Let's start with the most central scientific fact: Everything we see around us today has resulted from the gradual accumulation of natural processes that began when life first appeared on our planet nearly four billion years ago. By that time the fiery molten crust of the earth had solidified and cooled sufficiently so that the planet's surface was largely covered by water. Conditions that could sustain life on earth had become established.[1]

The story of organic evolution on our planet, including development of our own species, begins with the first form of life to appear on earth—the **single cell** (**Table 2.1**). Even single cells must be able to send and receive messages in order to exist. *Since the onset of biological time, the force that*

TABLE 2.1 Origins Timeline

3.8 bya	Life on Earth (single cell) begins
2.0 bya	Complex cells appear
500 mya	Fish appear
475 mya	Land plants appear
360 mya	Amphibians appear
300 mya	Reptiles appear
200 mya	Mammals appear
150 mya	Birds appear
60 mya	Primates appear

drives all of evolution is the ability to communicate. By looking at how cells behave, we can recognize the essential components of any contemporary communication process or system, no matter how elaborate. A massive global communicative network exists throughout the biosphere, formed at its lowest level by single cells.

The First Communicators

The first simple cells emerged either from the spontaneous combustion of organic molecules on the earth's surface or more likely from the rise of chemical elements emanating from hydrothermal vents on the ocean's floor. They were **bacteria cells** born in an environment that was rich in chemical resources.

In order to survive and grow, bacteria cells—like all life forms—must be able to interact with their environments and communicate internally (**Figure 2.1**). To do so, cells constantly receive and send electrically charged chemical signals.[2] Cells contain proteins that act as communications media. Receptor proteins pick up signals given off by the cell's physical surroundings, including signals emitted by other cells. This is the process of **intercellular communication**. The proteins then transmit signals inside their own physical structure in response. This second action represents **intracellular communication**.

Signals travel across a membrane that gives the cell its shape and structure. Most signals pass through the cell's integral proteins embedded in the membrane. The signals create pathways as they travel across strings of proteins and bump into each other where the pathways intersect to create **cross-talk**.

Single cells are multilingual and interactive. They interact with other cells externally by using a code that all cell species recognize. They are able to communicate internally because the proteins inside each cell's structure share a different code. The chemical signals that single cell organisms like bacteria send and receive function like words in a nonstop conversation.

Each cell absorbs and combines multiple streams of information in order to respond appropriately to the totality of messages it receives. Constantly reacting to signals coming from their environments, cells search for, recognize, and absorb nutrients that allow them to maintain their stability and grow in size. Other signals cause them to divide into new cells and pass along genetic information. A **gene** is a unit of biological information passed along from one generation to the next that influences some characteristic of the offspring. This original method of organic propagation is **asexual reproduction** or **self-replication**.[3]

The flow of information that takes place inside organisms and from the organism to the environment and back represents the most fundamental communication processes found in nature.

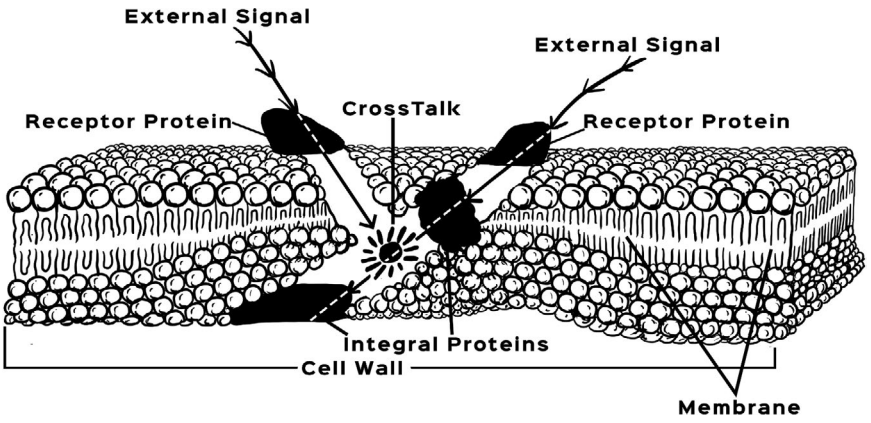

FIGURE 2.1 Cell communication

Given all this, we might say the single cell "invented" communication.[4] But is that the best way to explain what happened? Why do even the simplest living organisms communicate so profusely?

In order to survive, the first bacteria cells must have emerged with an innate ability to communicate. Both the pressure to survive and the corresponding ability to communicate are instinctual and interdependent. "Life" and "communication" are coterminous; they occupy the same boundaries in space, time, and meaning.

Cooperation and Community

The survival prospects of individual cells improve when the cells increase the size of their population. That fact causes cells to cooperate with other cells of the same species to form multicellular groups. Cells create **microbiological communities** that often exist as parts of a larger living organism. How does this happen?

As cells absorb information from their environments, they recognize themselves as identical to or different from the other cells around them. When individual cells of the same species sense they outnumber the cells of other species surrounding them, they join together and act aggressively.[5] Facilitated by electro-chemical signaling, this collective behavior is termed **quorum sensing**. When a bacterial community reaches a critical size, which can be in the millions of cells, bacteria located on the edges of the cluster stop reproducing in order to maintain survivability of the overall group.[6] The ability of an organism to learn and adjust its behavior accordingly begins with the single cell.

By engaging in collective behavior, the cells produce a result that is advantageous for the community of cells but also for each individual cell. This behavior represents a powerful but often overlooked or misunderstood principle of evolution: *Cooperation benefits communities as a whole but also benefits every productive member of the community*. Therein lies the main motivation for individuals of living organisms to form groups. Evolution cannot be reduced to the idea that each individual organism, no matter how big or small, competes with every other organism for competitive advantage. Individual organisms survive by joining together and helping advance a group's interests.

By insuring the viability of the entire **host organism**—any organic body where a community of cells lives—individual cells can continue to increase their numbers. Cell propagation links the viability of the individual cell to the viability of the cell community and to the host organism. Bacteria remain by far the most common life forms on earth, but they represent just one category

of cell.[7] Most other kinds of cell also cooperate to make the functional building blocks of the plants and animals that host them.[8]

Organizing Life

The first cells established the rules for how organic life is organized. Cells reproduce and accumulate in ways that order our physiological universe.[9] Each cell plays a role as the organisms they compose become more complex. Within our bodies the cells that make up our various internal organs recognize the groups to which they belong, so they don't get mixed up. Rather than reproducing as fast as it can, each cell respects the needs of the body as it forms all its vital organs.[10]

Cells are forced to cooperate in order to respond productively to the ecological conditions they inhabit in much the same way that groups of complex social animals, including human communities, work together with shared purpose. Every plant or animal that is alive today or has ever existed inherited the life-sustaining qualities of cooperation and community from the simple cell—the last universal common ancestor, or **LUCA**.

Community and Communication

Communication promotes cooperation. The cells of any organism, plant or animal, must be able to communicate effectively to coordinate their behavior and develop communities. An inability to communicate spells death, a fact that is now being exploited by medical researchers. For instance, in order to defeat bacteria-driven diseases, some scientists are trying to find ways to block communication by infectious bacteria cells. Other research scientists are working to find ways to prevent parasitic plants from communicating in order to stop the damage they do to nearby healthy plants.[11]

Being able to discover and to describe the life-giving link between community and communication in plants and animals, from simple to complex, have been great scientific achievements. But can this knowledge help us understand the far more complicated interaction that takes place between and among human communities too?

The meaning of the English language word "community" derives from the ancient Latin root *communis*, which means "common." The first syllable of the word, *com*, signifies "with" or "together." The second part, *munis*, means "to strengthen," "fortify," or "defend." And in modern Latin, the word *communitas* implies "fellowship." So in modern English usage, "community" means to be strongly and emotionally connected with others like you and that you are willing to defend the group.[12] Individuals who fail to play their part in advancing the interests of their communities are typically expelled or marginalized.

The first part of the English word "communicate" has the same ancient root in Latin—*communis*, or common. The related Latin word *comunicat* means "shared." Thus the essence of the word "**communication**" means to share within a community. From an evolutionary perspective, the primal connection between community and communication becomes clear: Individual organisms—including human beings—increase their chances to survive and reproduce by working together. To work together effectively, people must be able and willing to communicate well. That's not just friendly advice or a common-sense observation. It's a research-supported, fundamental principle based on organic evolution.

The physical characteristics of living organisms evolve along with their communication ability. Social relationships forged through acts of communication evolve too. That close interdependence has allowed us to become good at solving problems within our own groups. Sexual partnerships, families, neighborhoods, sports teams, and businesses all have a better chance to succeed when each individual plays a role that benefits the dyad or group.

But an enormous challenge looms. What are the limits to human cooperation? Can we be expected to communicate *across* communities in order to bond with individuals and groups that differ from our own? Does universal communication ability offer real hope for the future even when prospects for intergroup harmony seem bleak?

We will return to these issues in the last chapter. For now, let's pose a more fundamental question: How could human beings possibly have evolved from simple bacteria cells to become the complex creatures we are today?

Human Development

The simple answer is time. After single cells got the process started, it took nearly four billion years for humans and all the other life forms that roam the Earth to get to where we are today. But only in the past few hundred years have we had the scientific evidence needed to figure this out. Our understanding of the true origin and nature of life grew precipitously when scientists started to gain a much more accurate understanding of historical time.

Deep Time

Scientific breakthroughs more than two and a half centuries ago concerning the age of the Earth made it possible to imagine that complex plant and animal life could evolve from such simple beginnings. In the 1700s a Scottish medical doctor and scientist named James Hutton—sometimes called the "father of modern geology"—put forward the idea that **natural laws** are constant and may have endured for hundreds of thousands of years. His studies of land erosion and sedimentation made it possible for the first time to calculate geological time accurately.[13] Inspired by Hutton's theories, the English geologist Charles Lyell later offered empirical proof that the Earth is much, much older than was previously thought.[14]

Charles Lyell's systematic analysis of geological formations greatly influenced his friend Charles Darwin's thinking about how living organisms change over time. Darwin took a copy of Lyell's book *Principles of Geology* with him on his four-and-a-half-year journey around the world aboard the *HMS Beagle*. What Darwin observed on his voyage—marine fossils wedged into mountain tops in Chile, for example, or the slow growth patterns of coral reefs in the waters of the South Pacific—fit perfectly with what he was reading.

Challenging the commonly held belief that the Earth is just a few thousand years old, these and other researchers began to realize that our planet might be millions, even billions, of years old. With only a minimal fossil record and no DNA to work with, the natural scientists of that era were contemplating the crucial idea of **deep time**. The massive body of scientific evidence produced since then proves their informed hunches were right.

Deep time means our world has a deep history that makes extremely slow, constant, incremental biological change possible. After the appearance of single cell bacteria, the next step in organic evolution was the emergence of complex cells—**eukaryotes**—two billion years ago (**Table 2.1**). Eukaryotes function as the building blocks of the blood, bone, and tissue, from which all living organisms, except bacteria, are made.[15]

It would take about another billion and a half years before the first organism we would recognize today—primitive fish—appeared on earth. Terrestrial plant life took root after that. Some primitive species transitioned out of water onto land millions of years later.[16] Those transitional species gradually developed into amphibians, representing the vital evolutionary link between aquatic and land animals. Eventually, some of the amphibians further evolved into reptiles, and some of the reptiles later became birds.[17] Other amphibian species evolved into mammals—the category of

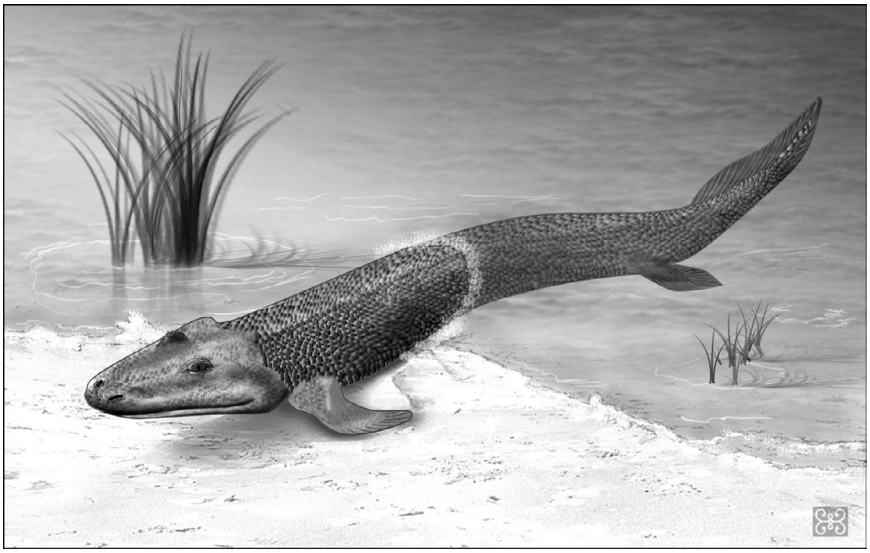

FIGURE 2.2 *Titaalik Roseae.* The first fish-to-amphibian animal used fins to swim in water and crawl across wetland 375 million years ago in what is now the indigenous Nunavut Territory of northern Canada. This species represents a key transition in evolution. Courtesy of National Science Foundation/ Wikimedia Commons

biological ancestors from which our species would descend.[18] It took more than 140 million more years before a species of mammal would evolve into ancestral forms that eventually gave rise to the existence of modern human beings.[19] Some land mammals—notably the ancestors of whales, sea lions, and dolphins—returned to the sea. Some tree-swinging primates became upright-walking humans.

Deoxyribonucleic Acid: DNA

Nineteenth-century geology gave us our first scientific understanding of who we really are. Much later, evolution's genetic footprint—**DNA**—provided the empirical evidence needed to help explain how it all happened. DNA is an acid contained in the chromosomes of all living organisms. It carries that organism's unique genetic information and "instructs" the organism how to grow. Because the DNA of an organism can be detected for nearly seven million years, scientists can estimate the age of most fossilized life forms. Most important, DNA evidence reveals how organisms are related genetically.

Even after evolving for millions of years along separate paths, our genes show that we remain closely connected to the other mammal descendants. For instance, humans share 93 percent of our DNA with the rhesus monkey and 90 percent with common mice.[20] That's why monkeys and mice are often used in laboratory tests for drugs and other products designed for human consumption. But because we all descended from the same origin, we share DNA with *all* living things. The most common comparison made is with chimpanzees, with which we share more than 98 percent of our DNA. But we also share 85 percent of our DNA with zebra fish, 36 percent with fruit flies, and 15 percent with mustard grass. And true to our roots, we still have a 7 percent overlap in DNA with single cell bacteria.[21]

TABLE 2.2 Human Evolution Timeline

60 mya	Primates appear
20 mya	Great apes (ancestral orangutans, gorillas, chimpanzees, bonobos, humans) appear
12 mya	Orangutan line splits off from other apes
7–8 mya	Gorilla line splits off from other apes
5–6 mya	Chimpanzee/bonobos line splits off from other apes
4–5 mya	*Australopithicus ramidus* hominin appears
3–4 mya	*Australopithecus afarensis* hominin appears
2–2.8 mya	*Homo habilis* hominin appears
1.7 mya	*Homo erectus* hominin appears
500,000 ya	*Homo sapiens* appears
300–100,000 ya	Anatomically modern *Homo sapiens* appears in Africa
70–50,000 ya	Spread of last line of *Homo sapiens* out of Africa
40,000 ya	Early modern human (*Homo sapiens*) appears
Today	Humans and other contemporary apes exist as separate species

Primates and Apes

The order of mammals that would become our human ancestors—**primates**—first appeared about 60 million years ago (**Table 2.2**). We certainly don't resemble those first primates much. They were small, nocturnal creatures that look something like small lemurs or mice. These same primates are also the ancestors of various species of ape, monkey, lemur, and other warm-blooded animals that broke off from our common line of descent and evolved separately from us.[22] Most early primate species evolved to live in trees, and many of their descendants still do.

The particular line of ancestral primates to which we belong emerged about 20 million years ago. This is the family of **great apes** that eventually evolved into today's orangutans, gorillas, chimpanzees, bonobos, and humans. We know that all the apes descended from a common ancestor because of the extraordinary amount of DNA we share and by the many structural and behavioral features humans have in common with extinct ape species and with the other contemporary apes.[23] Primates are social creatures, which gives them a strong evolutionary advantage.

Humans did not evolve from apes. We are apes. The ancestor of humans and the other apes was not a monkey but a transitional ancestor that is now extinct. Over the past 20 million years, the ancestral apes slowly broke off from a shared common trajectory into separate species.[24] The other species on our line evolved to become the contemporary apes we know today (**Figure 2.3**).

The first apes to split off from the evolutionary trajectory that would lead to humans were the ancestors of modern orangutans. Ancestral gorillas branched off next. Then chimpanzees. Because ancestral chimpanzees were the last to diverge from our shared evolutionary trajectory, we share more DNA with their contemporary descendants—common chimpanzees and bonobos (sometimes called pygmy chimpanzees)—than we do with orangutans or gorillas. Furthermore, chimpanzees share more DNA with us than they do with gorillas—another good reason why we should not consider our species to be markedly distinct from the other apes biologically.

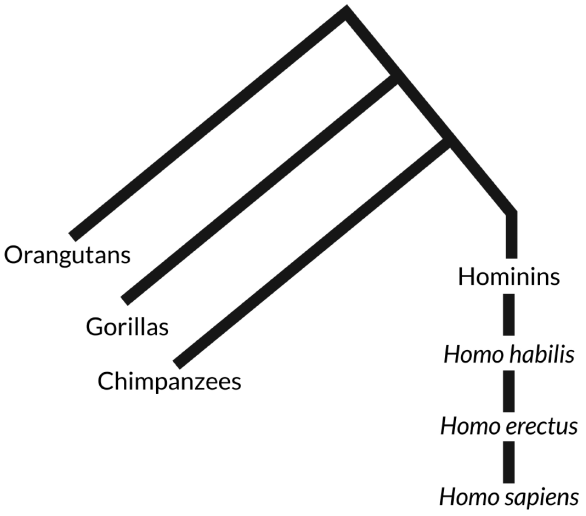

FIGURE 2.3 Stages of human evolution. (adapted from Diamond, J. *The Third Chimpanzee*)

NATURE'S CONTINUUM

Orangutans, gorillas, and two species of chimpanzee (common and bonobos) are categorized with us as great apes. These apes' large size, human-like features, and high degree of genetic overlap make clear we all belong in the same biological category. But the great apes are not the only apes on earth. More than a dozen species of gibbon that live in South and Southeast Asia are categorized as "lesser apes." Gibbons are classified separately because of their smaller size, less similar appearance, and the fact that their DNA shows they split off from the great apes' ancestral line long ago.

Nature's continuum of apes thus extends from gibbons on one end to humans on the other in terms of genetic similarity, appearance, intelligence, and communication ability. But the differences in these characteristics among the various ape species are a matter of degree, not of kind. This fact lays bare an important principle: We should not completely separate ourselves from other animals (or any other life form) in analytical terms. For the same reason we should not uncouple "nature" from "culture" when referring to the ways organisms behave within their lived environments.[25] Contemplating nature's continuum gives us a credible and inspiring way to think about how all of life is ultimately connected.

Hominids and Hominins

We have to distinguish between two confusing key terms. The confusion is caused by the fact that one of the like-sounding terms, "hominid," was previously used in the scientific literature to mean what the second term, "hominin," means now. Unfortunately, if you look at scientific literature or many websites today, you may still see the term "hominid" used where "hominin" would be correct. Making the situation worse, there is some overlap between the terms regarding what they refer to. But the distinction is important, so let's make it clear here.

Hominid refers to all contemporary and extinct great apes. That group includes modern humans, bonobos, chimpanzees, gorillas, orangutans, *and all their immediate ancestors*.

Hominin refers to modern humans *and all our immediate human ancestors*. The confusion arises because modern humans descend from the ancestors of all the great apes *and* from our immediate human ancestors. We are both hominids and hominins. The distinction matters greatly, however, because it marks the difference between the period that led up to and that which followed our separation from chimpanzees in our evolutionary history. To summarize the main difference: All the species in our evolutionary trajectory that lived before the separation from our closest relatives, chimpanzees, are hominids. After that separation, all the ancestral species that lived before modern humans came into being are hominins (**Figure 2.2**).

Our Oldest Direct Ancestors

The oldest certain hominin fossil that researchers have uncovered belongs to "Ardi" (*Ardipithecus ramidus*), who lived 4.4 million years ago.[26] The bones of two others, nicknamed "Lucy" and "Selam" (*Australopithecus afarensis*), represent another hominin species that dates back 4–3 million years.[27] These and other early hominin fossils were discovered late last century in what is now the northern African country of Ethiopia. Recently, researchers unearthed a fossil of another hominin species that lived in the same area more recently—some 2.8 million years ago.[28] This new discovery appears to connect the older hominin lineages to more recent hominin species.

Hominins gradually began to bear a clear physical resemblance to modern humans. They behaved in many of the basic ways we do. Early hominin species escaped predators by swinging in trees like other apes but also developed the ability to walk upright. These species present the first evidence of **bipedalism**, the key bodily characteristic that would distinguish hominins from the direct ancestors of the other apes.[29] Freeing up the arms and hands brought about highly advantageous developments in our ancestors' evolution—especially the ability to make tools and signal with physical gestures, likely the first form of human communication.[30]

The more recent hominin species ate more meat than their predecessors, which added animal protein and calories to the diet. As a result the hominin brain grew larger, which improved social intelligence, awareness, perception, and memory. More developed cognition allowed these hominin species to better survey the environment for clues about finding food, avoid danger, and coordinate their efforts with other individuals.

As hominins got better at exploring and responding to their social environments, they also became more integrated with others and more discerning. Having knowledge about the others in an individual's social network improves one's survival chances significantly.[31] Hominins' social relationships became increasingly elaborate and productive after they started to cooperate more. They worked together to make communal camp sites and formed small groups to hunt and forage for fruit and plants. Hominin individuals exhibited a basic sense of purpose and logic in their practical actions.[32] They began to imagine possible scenarios and rehearse multiple courses of action in their minds. Their motivated and coordinated behavior allowed them to form alliances, exchange more information, and make commitments.[33]

The significant development of hominin cognitive growth and social abilities raises the distinct possibility that these ancient ancestors were the first in our hereditary lineage to use some form of crude vocal prelanguage[34] (**Chapter 5**).

The Genus Homo

The early hominins' descendants became species that make up the genus ***Homo***—the biological classification to which our species belongs (**Table 2.2**). Shorthand for *Homo* is "human." The

stages of human evolution are gradual and overlapping. At least ten human species roamed parts of the Earth before Sapiens appeared.

Homo habilis *and* Homo erectus

Two earlier *Homo* species played vital roles in the evolution of modern human beings. Most evolutionary scientists believe that the immediate antecedents of modern humans are *Homo habilis* (the tool maker), followed by *Homo erectus* (upright human). These African ancestors developed physical characteristics and abilities that proved to be crucial in our evolution as high-functioning biological and sociocultural beings—and excellent communicators.

DNA evidence places Habilis as living from 2.8 to 2 million years ago. Habilis' brain size grew larger than that of earlier hominins. Increased brain size spawned more innovative behavior, especially the use of fire and making of stone tools—the very first forms of technology (**Chapter 7**). Tools could be used to cut up meat, extract marrow from bones, and chop plants into edible pieces.[35] Much greater cooperation between individuals was on the rise.

Some combination of basic communication skills—simple gesturing and crude vocalizing—likely existed by then. Deeper levels of social integration were also becoming engrained into our DNA. Learning how to make and use stone tools required the ability to pass information from one individual to another and from one generation to the next. A powerful motivation for developing communication ability was cultural transmission (**Chapter 9**).

A later species—Erectus—likely inherited a big brain and tool-making ability from Habilis.[36] Erectus lived from 1.9 million years ago to only about 70,000 years ago, overlapping their time on earth with our own species. Erectus migrated out of Africa long before we did. Like Habilis, Erectus maintained campsites, controlled fire, and used tools.[37] But one defining characteristic of the species—a more fully evolved bipedalism—greatly influenced our evolutionary history. Powerful new communication channels opened up after our ancestors permanently stood up and walked on two legs. This empowering mobility became a defining characteristic of Erectus and the species that would follow—Sapiens. Beyond mobility, the erect physical body also contributed to the physical potential for complex speech (**Chapter 5**). This dynamic combination of mobility (or what we would now call transportation) and communication ability remains critical to our cultural development today.

Homo neanderthalensis *and* Homo denisova

At least two human species—*Homo neanderthalensis* and *Homo denisova*—were still alive after Sapiens evolved. And like us, the Neanderthal and Denisovan ancestral lineage originated in Africa. *But our species did not evolve from these species.* Sapiens, Neanderthal, and Denisovan all share a common ancestor. Sapiens are close relatives of Neanderthal and Denisovan, not their descendants.

Neanderthal slowly spread out to the Middle East and Europe beginning at least 300,000 years ago and eventually occupied common territory with our Sapiens ancestors when they arrived in Europe much later. Denisovan were a smaller group that migrated toward Siberia and Asia about the same time. Neanderthal went extinct about 40,000 years ago. Estimates for the demise of Denisovan are not definitive but probably occurred about the same time.

Homo sapiens

So far in this chapter we have traveled through time from the emergence of simple bacteria cells almost four billion years ago to close to where we are today. The immediate predecessors of the

first modern Sapiens began to evolve as a separate species about 300,000 years ago—just a blink in evolutionary time—in various locations across the African continent.[38]

The genetic connection we have to our direct hominin ancestors could not be clearer. We share 99.89 percent of our DNA with the earlier *Homo s*pecies.[39] But as our species developed, we began to diverge from Habilis and Erectus physically and mentally.[40] We got taller and developed thinner bones, with a more lightweight skeleton. Our jaws became flatter and teeth smaller. Our legs got longer, arms shorter, and pelvis narrower than earlier *Homo* species. Our finer skull accommodated a brain that grew twice as large as that of early hominin species. We began to more plainly resemble modern humans during the period from 300,000 to 100,000 years ago.

Our cognitive capacity has evolved over tens of thousands of years to extraordinary complexity when compared to all other mammals.[41] That capacity served as the platform for developing language. All biologically modern humans today have language, no matter where their ancestors settled around the world. *This means that our early Sapiens ancestors in Africa must have been using some form of language before they migrated north.*[42]

The Sapiens line from which non-Africans descend was likely not the first migration of our species out of Africa. The oldest Sapiens fossils that have been found outside Africa were uncovered in what is now Greece and date to at least 210,000 years ago. Others of a similar age have been found in Israel. But a mass exodus from Africa began about 70,000–60,000 years ago and spread throughout the world[43] (**Figure 2.4**). Genetic evidence shows that all non-African Sapiens alive today can trace their history back to one migrating group.[44] Most present-day Africans and others whose DNA reveals unmixed African lineage descended from Sapiens groups that remained on the continent. That is why modern-day Sapiens are genetically nearly identical but variable in appearance.

The Sapiens that left Africa were **hunter-gatherers** who headed north to follow animal migrations, a main source of food. These groups had learned how to work together and communicate effectively in order to successfully find sufficient food to survive. Over thousands of years our nomadic ancestors migrated first into the area now known as the Middle East, then on to what are now Europe, South Asia, East Asia, and the South Pacific. Eventually, some groups traversed

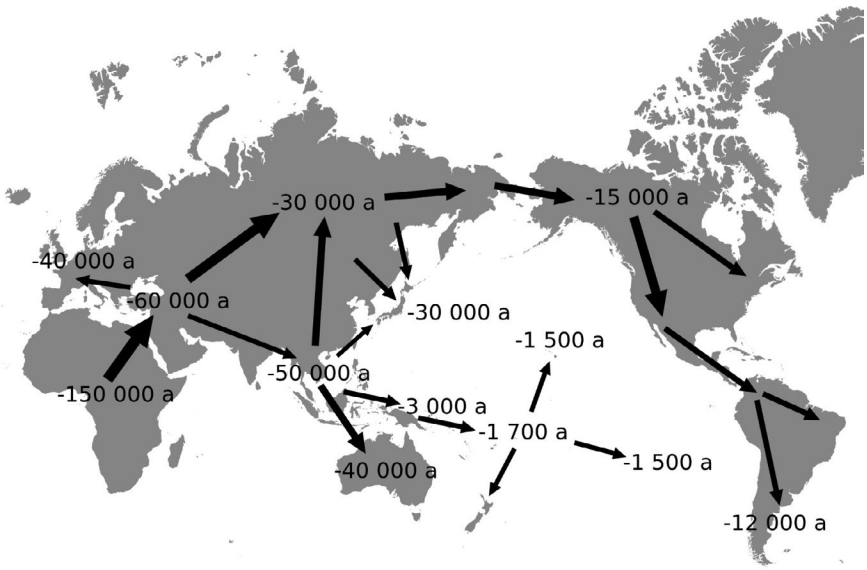

FIGURE 2.4 Sapiens' migrations out of Africa. Courtesy of Wikimedia Commons

the northernmost regions of the globe into Siberia. When environmental conditions allowed, they continued their trek along the Pacific Coast through North America, Central America, and South America.[45]

Driven by changing climates, habitats, and food availability meant that the hunter-gatherer way of life involved eating a wide variety of things. The original **paleo diet** and the constant exercise required by hunter-gatherer culture proved to be healthy and helped our ancestors adapt to new environments, key to our evolutionary success.[46]

For thousands of years, Neanderthal, Denisovan, and Sapiens populations coexisted, crossed paths, and interbred to some degree. That's why people alive today whose ethnic roots extend back to Europe or East Asia contain between 1 and 4 percent Neanderthal DNA.[47] Some East Asians and Pacific Islanders also have up to 5 percent Denisovan DNA.[48]

Our own species represents the last branch of living humans. The scientific name *Homo sapiens* means "wise" or "intelligent" human. The jury is still out on just how wise we've become, but certainly we know more and use our knowledge in more complicated ways than any other species in history. It took a *very* long time for us to get here. But in the remarkable history of human evolution, a vexing question remains: How could simple bacteria cells possibly have evolved into the incredible complexity of organic life we see within and around us today? What evolutionary processes made all this happen?

Natural Selection

Understanding **natural selection** helps explain how all the plants and animals that have populated the Earth in the past and present came into existence and survived in one form or another.

Over the course of deep time, the environmental changes that have taken place on our planet have been monumental. In just the past 200 million years, the Earth's surface has been besieged by shifting continents, climate change, volcanic eruptions, glacial flows, and direct hits from meteors, among other catastrophic events. The key factor to survival has always been the ability of life forms to adapt to changes in the environment. Those organisms and species that best tolerate the environment, resist disease, use resources well, and repel predators or enemies are the ones most likely to survive. How so?

Genetic Mutations

The physical features and traits of an organism are expressed by its genes. Lots of genes make up a living organism. About 30,000 genes make up the **human genome**, for example.[49] Genes are instructions encoded in the parents' DNA that determine many aspects of the offspring's physical traits, like eye color.

When an organism reproduces, it transmits its genes to its offspring. But passing genes from one generation to the next is an imperfect process. Some irregularities, or **mutations**, appear. The mutations are random. They have no prior purpose, and usually don't fit a pattern. Genetic mutations cause unpredictable differences in the physical traits of the offspring who inherit them.

Because a mutation represents an irregularity, we might think of it as necessarily a bad thing. Indeed, some mutations can be very harmful. For example, a common mutation in humans causes normally round red blood cells to be shaped like a crescent. The bulky shape of crescent-shaped cells significantly slows down the flow of blood through the arteries. The result is a disease called sickle cell anemia. It is also true that some harmful bacteria and viruses in our bodies constantly mutate in ways that give them new defenses against vaccinations and treatment. Still other mutations have no particular negative or positive effect. For instance, mutating genes might cause a

species of flower like the yellow moss rose to produce a few orange blossoms. A common mutation among mice causes an innocuous white band to appear around the animals' dark-gray bodies.[50]

Adaptive Mutations

In some situations, organisms that inherit mutant DNA actually do better than organisms that receive unaltered genes from their parents. For instance, we know that a change in the environment can threaten to destroy an entire species. But a threat to existence can also make some genetic mutations advantageous in the long term. This can be true even for simple animal or plant life. Imagine, for example, that a huge population of algae has been living for many generations in a freshwater pool. Then some natural disaster happens that turns the fresh water salty. The vast majority of algae die out because their genes had evolved to keep them alive in fresh water. But a few lucky algae had randomly inherited mutant DNA that allowed them to adapt to a new life in salty water.[51]

The surviving algae then produce offspring that are better suited to the challenging new environment. Their numbers grow, and over time the population stabilizes. Eventually, a new saltwater species of algae evolves. The same challenge would confront the fish, frogs, water snakes, insects, and all other life forms that inhabited that freshwater pool. Nature "selects" those individual organisms that are best equipped to survive. An **adaptation** is any inherited characteristic that helps an organism survive and reproduce in its environment.

Cooperating Genes

Organisms thrive through teamwork, beginning with genes. Each gene is selected for its capacity to cooperate with other genes that in combination help advance the survivability of the individual organism and the species.[52] Groups of mutually compatible genes naturally arise. For instance, genes that determine the size, speed, and coloring of a predatory animal like a snow leopard blend together to maximize the survivability and reproductive potential of the whole animal where the animal lives.[53] Most of the snow leopard's offspring will carry genes that reflect the same positive attributes and traits their parents have. Offspring that don't get the favorable genes are less likely to survive.

That's how nature selects winners and losers in a never-ending process of aimless self-organization.[54] Individual organisms whose genes happen to be poorly matched to their environments starve, get eaten, or die without mating.[55] This brutal truth exemplifies what is meant by "survival of the fittest." But to repeat the key theme: Survival requires more than simply outcompeting rivals. Cooperation among individuals within and between species plays an equally important role in their evolutionary success.

Group Selection

The physical and behavioral traits selected by nature exist at the level of the individual organism and, in some cases, at the level of the group. Social insect colonies, like ants, seem to have a collective mind and purpose.[56] The degree of cooperation and communication within the group makes the difference between life and death in competition between groups, especially if they battle for limited resources in close proximity. In these situations, better-organized competitors win out over groups of uncooperative, poorly communicating individuals.[57]

Ants behave as a **superorganism** when they compare possible nest sites, process food, battle competing ant colonies, and defend their colonies against other species.[58] Animal groups whose members restrain themselves individually—for instance, birds that do not produce so many offspring that would deplete a food source—also exhibit a survival strategy at the group level.[59]

Individual organisms form groups in order to increase their chances for survival. Animals living in open spaces—the vast plains, the skies above, or unprotected waters—group together to make themselves and their progeny less vulnerable to predators. Grouping forces predators to expend more energy searching for prey. A large group is more difficult to find and attack than scattered lone individuals or small groups traveling across a widely distributed area. Individuals also move as groups for protection at the moment of attack. To stay alive, the zone between predator and prey should be as large as possible.[60] Individuals situated in the middle of the pack enjoy the best prospects for survival.

Evolution by Natural Selection

The classic early research on evolution took place 600 miles off the coast of Ecuador in the Atlantic Ocean nearly 200 years ago. Stepping across the rough surfaces of the rugged Galápagos Islands, the young naturalist Charles Darwin was intrigued by the diversity of life he saw there, especially the birds. For many years after he returned to England, Darwin tried to understand why the size and shape of the beaks of mockingbirds and finches he collected differed significantly from one island to the next.

The biblical claim that animal species have existed in the same form from the beginning of time was commonly assumed even by most scientists of that era. But Darwin thought there was

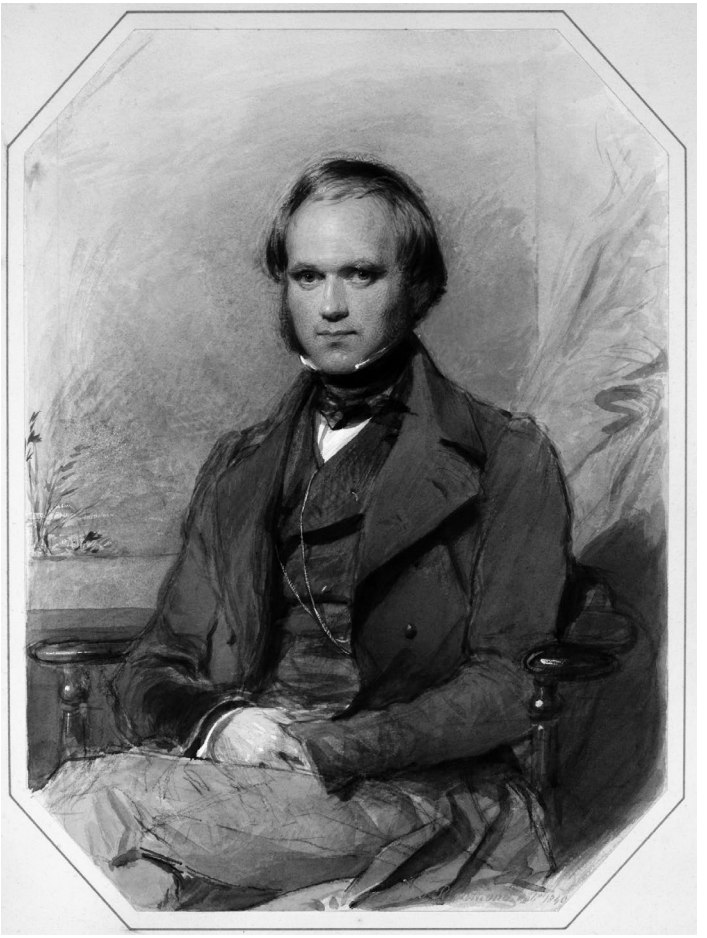

FIGURE 2.5 Charles Darwin. Courtesy of George Richmond/Wikimedia Commons

another possibility. Did some natural process gradually transform ancestral mockingbirds and finches by altering them in ways that increase their chances for survival on the islands where they live? Did their physical characteristics fundamentally change when they established themselves on another island? Could the original birds have evolved over time to become several new species?

Darwin noticed that each bird's beak was remarkably well suited to the task of consuming the type of food that was available on the particular island where the bird lived. For instance, broad, sturdy beaks on birds that inhabited some islands were good for breaking and eating nuts. Thin, sharp beaks on birds living on another island were better for extracting and eating insects. Genetic mutations had produced birds with physical characteristics that were advantageous in their particular environments. Birds that adapted well to their environments were the ones most likely to survive and reproduce. Eventually, the number of birds on each island increased to the point where they became separate species—meaning that they cannot successfully mate with each other.

Speciation

Mutations create healthy genetic diversity within a species. Nature then selects the organisms that have the most favorable genes for life in the environments they occupy. Those populations grow over time. New species emerge as the modified descendants of earlier species in the economy of nature.[61] This is the endless process of **natural speciation**. For instance, as some fish evolved into amphibians and some reptiles turned into mammals, the genetic instructions encoded in their DNA also changed.[62]

The speciation process can produce dramatic outcomes. For example, dinosaurs evolved from small creatures into some species, like *Tyrannosaurus rex*, that got as big as a city bus. Then, over millions of years, some carnivorous dinosaurs evolved to become more than 10,000 species of bird that inhabit the Earth today. In the long journey from reptile to bird, many transitional species appeared, including feathered dinosaurs.[63]

Evolutionary change within a species results from the gradual buildup of adjustments made by individual organisms as they interact with other organisms and with their environments, all of which are also constantly changing. The algae whose genes allowed them to survive in salt water and the birds that were born with the right beaks unconsciously adapted to their new environments. Favorable mutations that appeared in some algae and birds were acted on by natural selection. Those traits then spread throughout the population because they enhanced reproductive success. The biological changes eventually became hardwired into the DNA of the population.

But we should not think that plants and animals adapt only as an unconscious defensive reaction to changes taking place in local environments. All mobile animal species—from the tiniest insects to enormous elephants and whales—instinctively range widely and are under constant evolutionary pressure to adapt. They take advantage of their biological capabilities as they search for food and reproductive partners while avoiding predators.[64]

Advantageous physical characteristics and traits endure. For instance, despite the differences in their beaks, all the Galápagos birds retained a common basic anatomical structure; it is still difficult for most human observers to tell the species apart. We see the same kind of evolutionary residue in birds today, only over a much longer time span. Birds have the same long, strait legs and feet with three skinny main toes they inherited from dinosaurs beginning 230 million years ago.

Humans have retained some physical peculiarities that evolved to be useful in the past but are no longer necessary—wisdom teeth, body hair, male nipples, and the appendix, for instance.

FIGURE 2.6 Flying squirrel. Some species of tree squirrel developed the ability to glide long distances to escape predators, forage for food, and conserve energy. Over time, the squirrels' flank membranes grew fuller and fuller. Responding to environmental demands and opportunities, the cumulative effects of random mutation followed by natural selection have produced more than 40 species of flying squirrel. The physical structure of the animal is the same as the ancestor of all mammals. Courtesy of shabeerthurakall/iStock.com

Artificial Selection

Evolution results from the accumulation of many small changes over time and leads to the gradual emergence of new species. Genetic variations among individuals give one or the other a competitive advantage. Generation after generation those tiny advantages are passed down until the species eventually changes.

Speciation can also be directed and speeded up artificially by humans. Plant and animal breeders routinely create new species by fusing desirable traits from two or more individual organisms into a hybrid. That's the principle behind genetically modified food, for example. Roma tomatoes were created by scientists in Florida who crossed the Pan American tomato with the San Marzano tomato to get a fruit with the right texture for making catsup and tomato paste.[65] Domestic dogs were gradually bred into existence from a species of wolf more than 20,000 or 30,000 years ago—but still share 99.8 percent of their genes with them.[66] They behave much the same way—the crouching invitation to play, for example—and are often confused with each other by humans. Today mating options for "purebred" dogs can be further controlled by breeders to get the desired conformation and temperament.

The Roma tomato and domestic dog represent examples of species produced by **artificial selection** that was undertaken to fulfill human wants and needs. Artificial selection can be beneficial in many more important ways. Zoo officials use genetics-based breeding programs to keep populations of diverse animal species alive and healthy. Even tiny cells—the building blocks of all living things—can be isolated and controlled artificially in order to create productive new proteins. Speeding up evolution this way can produce life-saving drugs and biofuels and reduce the environmental impact of industrial processes.

Human Adaptation

Geographical mobility is a prime cause of speciation. No single species has spread out farther geographically and adapted better to local conditions over time than human beings.[67] Our ancestors were constantly pushing geographical limits to the very ends of the Earth. The widespread distribution of our species is reflected in the physical appearance and cultural behavior of ethnic groups around the world. But if we're all of the same species, why do noticeable differences among us show up?

The biochemical response humans have to the presence of ultraviolet light in various parts of the world provides a good example of why differences show up. People who live in Africa or have relatively recent ancestors from there have darker skin. That's because ample pigmentation is necessary to protect the skin from the intense African sun, probably an evolutionary hedge against skin cancer.[68]

All humans have the same number of cells that produce melanin, the pigment that makes skin dark. After some of our ancestors left Africa, their skin color gradually lightened as the need for sun protection decreased in other parts of the world. Middle Easterners have less pigmented skin than Africans. Europeans' and East Asians' skin tone is even lighter. Nordic people are lighter still.

Everyone must protect their skin. But everyone also needs Vitamin D, which is assimilated by the body through exposure to the sun. A biological tension exists therefore between the need to protect our bodies from too high exposure to ultraviolet light and the need for Vitamin D, which is absorbed from the same source. Dark skin protects the skin but limits Vitamin D intake. Light skin lets more sunlight in but makes the individual more susceptible to skin cancer. A biological tradeoff takes place. The genes that determine skin color have been selected over many generations for their survival value in the various parts of the world where humans have settled. Miniscule genetic differences account for the physical differences.

The same principle of physical adaptation applies to the loss of hair on our bodies as we evolved. We have much less body hair compared to hominins and early *Homo* species. The loss of body hair provided an evolutionary advantage for our ancestors because it allowed them to run cooler over long distances. This adaptation made it possible for our ancestors to outpace and capture prey.[69] But some human lineages have benefitted from body hair and tougher skin that was inherited from intermixing with the Neanderthal. Those genes have been preserved in Sapiens because they proved to be beneficial for populations that migrated into the cold north from Africa long ago.[70]

The cumulative effect of our migratory histories and adaptations are reflected not only in physical characteristics, like skin color or hair, but also in our social behavior and cultural traits. Natural selection rewards intelligence, fast learning, and good decisions to the point where these qualities become genetic tendencies. Genetic influence on distributed populations is a sensitive issue, which will be taken up in greater detail in **Chapter 12**.

Evolutionary Planes

Biological evolution has two primary planes—inherited and environmental. Each plane has its own axis of possibilities but is also linked to the other plane.

The **inherited plane** refers to the passing of genes from parent to offspring. Gene combinations determine certain aspects of the physical appearance of the offspring, like eye color. They can predispose organisms to certain diseases. An individual's genetic makeup is that organism's **genotype**.

The **environmental plane** refers to how the evolution of plants and animals is influenced by the way an organism's genetic makeup interacts with its habitat. Characteristics that result from the

interaction of genes with the environment include height, weight, and skin color. These kinds of observable features make up an organism's **phenotype**.

We must be careful not to regard the mode of transmission between the two planes as totally different. Among sexual species, genetic information passes from parent to offspring in sequences of DNA and transmission takes place only once—at the moment of conception. Once the seed is planted, nature does the rest of the work. Success of the offspring depends largely on the physical tolerance and nurturing qualities of the parents, especially the mother.

ADAPT TO SURVIVE UNTIL . . . .

Because we have a superior ability to move around the Earth in search of new lands and natural resources, and because we possess sophisticated tools that can be used to conquer other species, modern humans greatly affect the long-established order of living environments. The result has been the extinction or near extinction of many animal species.

At present our planet hosts nearly nine million animal species, although only about a million have been catalogued. The Earth also supports nearly 300,000 plant species.

The loss of natural habitats due to the gradual spread of human groups into new territory means that some loss of animal life is inevitable and lamentable. But part of what's happening is absolutely deplorable and preventable. The worst cases involve rare and beautiful animals that are killed for sport or profit. We see this happening in the slaughter of whales (for oil); elephants (for ivory); tigers, alligators, and crocodiles (for skins); rhinoceros (for horns); and ocean-going green turtles (for eggs), among many other examples. Buying and selling prized animal parts is conducted routinely in many parts of the world and on the Internet.

Living organisms have defense systems that protect them in conditions where humans don't intrude too heavily. In some situations, animals evolve without fear of natural predators because there are none. For instance, on the Galápagos Islands small sharks, iguanas, and many bird species can all be approached by humans very closely because the animals fear no predation.

The country of Ecuador (to which the Galápagos Islands belong) and the United Nations World Heritage Site program protect the vulnerable Galápagos species against exploitation by humans. Before strict regulation was put in place, Japanese whaling fleets and other seafaring adventurers slaughtered unsuspecting seals, sea turtles, and birds on the Galápagos Islands for food and trade.

A similar history took place on the islands of New Zealand many centuries ago. When East Polynesian settlers first arrived on the islands in the 1200s, they encountered the flightless moa—a huge species of bird that resembled an ostrich. The wing muscles of moa had deteriorated over time in New Zealand because they had no mammal predators to fear. Upon their arrival, humans easily killed the helpless moa for food, rendering them extinct.

Living organisms can usually adapt to survive until the ultimate predator—the human being—arrives. A single species, Sapiens, has the potential to cause mass extinction. That's why concentrated efforts by the governments of individual countries; the United Nations; and nonprofit organizations, like the World Wildlife Federation, the Charles Darwin Foundation, and the Wildlife Conservation Center, are so crucial to the sustainability of life on earth.

Not Just Natural Selection

Natural selection refers to the evolutionary success of both sexes of a given species in relation to the general conditions of life. Those individual organisms, groups, and species that are best equipped to compete and cooperate are the ones most likely to survive.

But not all aspects of evolution can be explained by natural selection. For example, sometimes a particular organism will randomly produce an exceptional number of offspring. Consequently, that DNA will be overrepresented in a population. This disproportionate representation does not reflect selection; it's just an advantageous accident for those genes. This is a case of **genetic drift**.

Other physical characteristics and behaviors appear as the by-products of natural selection, not direct adaptations. This type of evolution is the **spandrel**.[71] For example, blood happens to be red because of the biologically productive interaction between iron and oxygen. The red color itself was not adaptive. Spandrels exist in technology too. For instance, cell phones were not created to be flashlights or collective visual signaling devices. But today when the house lights dim and the performer on stage calls for it, everyone in the audience at a concert, sporting event, or religious gathering can turn up the brightness on their phones and wave them in unison to create a solidarity ritual. A simpler technology—the cigarette lighter—had been used for the same purpose before.

Approaching Sexual Selection

Certain biological traits are inherited genetically. Mutations lead to a recombination of genes that produces variation in those traits among the offspring. Some of the new variations confer more **fitness** than the others. In natural selection, fitness refers to the capacity to survive in a particular environment.

But survival means much more than warding off immediate death. Fitness has another meaning. *To avoid obliteration, the organism must also spread genetic traces of itself onto the next generation, forging another link in the evolutionary sequence.* **Sexual selection** refers to the process whereby individuals in a species choose mates by evaluating their fitness as reproductive partners.[72]

Communication plays a crucial role in how humans and other animals evaluate and choose potential reproductive partners who display fitness. For that reason, a detailed discussion of the powerful ways sexual communication influences human evolution is presented in **Chapter 3**.

Plants and Animals

Millions of living organisms inhabit the Earth, with many more waiting to be discovered. Scientists assign newly discovered organisms into biological categories, starting with a fundamental distinction made between plants and animals.

Making that seemingly obvious decision isn't always easy. Plants and animals share about 50 percent of their DNA on average. They broke away from their common ancestor only slightly more than a billion years ago. Some plants behave like animals. For example, the Venus Flytrap and the Pitcher Plant are predatory and carnivorous plants, consuming everything from insects to small rats. Other plants have a sense of smell, move in reaction to light and sound, or defend themselves by releasing chemicals when threatened.

Some animals—the Malayan leaf frog, deadleaf grasshopper, and Indian oakleaf butterfly, for example—survive by mimicking plants. The Stick Bug (or "Walking Stick") looks like a twig. Coloration of the Viceroy Butterfly mimics the toxic Monarch Butterfly, discouraging predators.

Some organisms cannot be classified as either plant or animal. Fungi—including yeasts, molds, and mushrooms—inhabit a separate classification. Astonishingly, some organisms function as both

plant *and* animal. For example, the Mesodinium Chameleon crawls along the bottom of the sea near Denmark. These tiny creatures eat plants, causing the small animals to turn into photosynthesizing plants temporarily and then transform themselves back into predatory animals looking for more plants to eat.[73]

Plant Communication

Throughout this book we analyze various forms of animal communication, especially that which characterizes interaction among the great apes, our closest relatives. But vital communication goes on in the other side of the biological spectrum too.

Just 20 years ago most botanists did not believe plants communicate with each other. Now robust plant communication is an accepted scientific fact. Like animals, plants evolved in ways that maximize their chances to survive and reproduce. To do so, plants send and receive messages along pathways inside their own cellular structures and use a variety of media to interact constantly with their environments, including other plants.

Wood Wide Web

A leading pioneer scientist of plant communication—Suzanne Simard, professor of forestry at the University of British Colombia—discovered that trees communicate with each other mainly by means of an extensive underground network of roots and fungi.[74] She calls the Internet-like subterranean connection that links trees together the "wood wide web."

The familiar phrase "the acorn never falls far from the tree" reveals a fascinating fact about plants. They have families. For example, trees can distinguish their own roots from the roots of other species and from other unrelated trees of the same species.[75] Mother trees nourish and protect their kin. They do so by selectively emitting chemicals that feed and defend the young trees with which they are related. They grow only to a height that allows the offspring to get enough light to grow properly.[76] By allowing enough space for an entire stand of kindred trees to flourish, the survival potential of each individual tree is increased.

Clearly, the evolutionary principle that individual organisms do best when they act together as a community applies to plants.[77] Connected at the root, forests act as botanical super environments. Trees interact productively within their families and species, but also with other organisms.

Plants communicate in order to accomplish the following goals:[78]

- To send alarm signals to other individuals of their species when attacked by drought or disease.
- To pump nutrients to the roots of wounded, diseased, or decapitated trees in order to maintain thick growth so they won't all die from sun and wind.
- To warn each other of threats by toxic chemicals and diseased neighboring plants.
- To inform bees and other pollinators that nectar is available.
- To summon predator insects that are beneficial to them.
- To discourage harmful insects from attacking.
- To protect their kin.

How Plants Communicate

To accomplish many of their goals, plants work together in a symbiotic relationship with fungi and other organisms. Fungi penetrate the roots of trees and other plants. Long threads of fungi act as

communication channels by relaying chemical compounds and electrical signals sent by plants to the root systems of other trees and plants. The fungi also filter out pollutants in the roots of trees to which they are connected. In return, the fungi receive vital nutrients from the plants to which they are attached.

Plants use another channel too. Many plants reproduce by releasing scents into the air or producing brightly colored flowers that attract pollinators. Others emit chemical substances that attract predator insect species in order to ward off harmful species.

Plants survive and thrive because they interpret their own health and nutritional state, assess external conditions, and respond in beneficial ways. They communicate to coordinate their activities in response to changing conditions of the light, water, and temperature in order to guide the plant's cycle of growth, flowering, and fruiting.[79] Some of a plant's cells multiply and grow in a direction that bends the organism toward light. Cells in the roots reach for water and nourishment in the soil.

Plants can do such beneficial things because they have evolved senses that guide their behavior intelligently. For instance, plants respond to touch. They branch out until they contact the tips of neighboring plants. During big storms, tree tops whack each other in ways that slow down the whip-like motion, keeping individual trees from falling over. They repair injuries by sending sealing agents to cover the wounds. Root tips avoid toxic substances, stones, and overly saturated soil as they spread out. Plants smell toxic substances in the air and send out distress signals.[80] Plants can taste chemicals underground and the secretions of insects above ground and respond accordingly. They respond to sound vibrations to spur germination and growth spurts. Plants sense cold weather and perceive the length of days, so they know when to drop their leaves to protect themselves in winter. Like us, plants have photoreceptor cells that direct them toward sources of light.[81] And plants have memory; they store information and learn from experience.

Throughout modern history, human populations have steadily encroached on the territories and daily lives of plant and animal species. Plants struggle to maintain their health and reproductive potential just as animals do. Both have had to adapt effectively and evolve rapidly to survive massive human urbanization.[82]

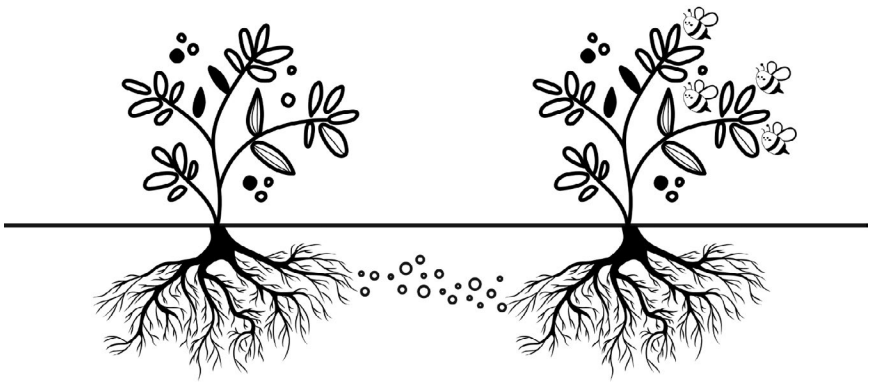

FIGURE 2.7 Plant communication. Plants send chemical signals to each other through threads of hair-like fungi that connect their root systems and to other species through chemicals released in the air. Scientists are learning how to manipulate the complex conversations plants have with microbes, soil nutrients, weather, and pests to avoid famines.

Animal Communication

We cannot sufficiently discuss animal communication and its relevance to human social interaction in a single section of this book. Entire volumes have been published on the ways animals communicate. We refer to many of these sources in forthcoming chapters, and we've already described some examples of animal communication in this chapter. Animals communicate to survive, reproduce, and express themselves, just like we do. These motivations make up the essence of evolutionary communication, to which we turn in the next two chapters.

Chapter Summary

The foundation of human communication is biological. No organism has been able to survive without successfully sending, receiving, and processing information internally and externally. Beginning with simple bacteria cells nearly four billion years ago all the way to the complex organisms that inhabit the Earth today, communication makes the evolution of life forms possible.

Individual organisms compete but also cooperate in order to survive and reproduce. The need to cooperate motivates attempts at communication, which become more advanced as time goes on. Biological and cultural communities assemble and grow by means of effective communication that takes place between and among the organisms and the environments they inhabit.

An enormous breakthrough in scientific knowledge took place about 200 years ago, when British geologists discovered that our planet is much older than was previously thought. The vastness of deep time makes extremely slow, incremental evolution possible. When we look back toward our origins, we find simplicity—the roots of life. When we look toward the future, we see endless speciation—branches and twigs that represent the millions of plant and animal species alive today.

Humans and other contemporary apes descended from primates that lived 60 million years ago. After ancestral orangutans, gorillas, and chimpanzees broke off from our shared ancestral trajectory, our first direct ancestors—the hominin species—appeared. Hominins evolved into the various species that comprise the *Homo* genus. The species to which we belong—Sapiens—emerged in Africa beginning about 300,000 years ago.

The variety of animal and plant life we see around us today was created by random genetic mutation, followed by the natural selection of favorable varieties. Individual organisms that adapt well to changing conditions are more likely to survive than those that don't. In this way, living organisms descend with modification through time from one evolutionary stage to the next. The evolution of animals and plants results from an interactive combination of genetic heredity and environmental influence.

Natural selection shapes the gene pool of an entire species. Genetic drift and spandrels also explain some aspects of evolution. The other primary evolutionary process—sexual selection—determines which particular individuals within a species are most likely to send their genes forward to the next generation.

Like animals, plants communicate intelligently to increase their survivability and reproductive potential. They form Internet-like networks where they exchange chemicals in reaction to the challenges they face as individuals, family members, and members of a larger population. Human urbanization has forced many plant species to adapt to unwelcoming environments.

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PART TWO
Why We Communicate

3

SURVIVE AND REPRODUCE

In this chapter we start to explain why human beings began to communicate with each other in the first place. We seek to answer the question, what lies at the root of human communication? Our unmatched skill as communicators evolved for good reasons. This chapter describes the first two of three primary motivations that compel humans to continually engage each other in communication—sheer survival and the drive to sexually reproduce.

Survival

How did early humans survive? Were the ancestors of modern humans natural-born predators who simply out-competed other animals in the quest for food? Some anthropological research suggests that our early ancestors not only slay and ate other animals but devoured their own kind as well.[1] But what if that analysis was wrong? What if mortal beings were at first not predators, but prey?

Unfortunately for our ancestors, the abundance of scientific research reveals that the first humans were likely the prey of cunning and powerful predators, not dominant predators themselves. Teeth marks on human bones found in South Africa, Ghana, China, and elsewhere indicate that early humans were attacked and devoured by fierce predators—saber-tooth tigers, leopards, hyenas, even huge birds.[2]

Furthermore, we weren't carnivorous at first. All apes evolved primarily as fruit and plant eaters. Modern humans and chimpanzees eat animal flesh but neither has any particular biological adaptations for catching and eating animals.[3] Moreover, apes remain prey today. Chimpanzees are routinely preyed upon in the wild by carnivores including hyenas, wild dogs, lions, and leopards. Orangutans and baby gorillas are attacked by tigers and leopards.

Defensive Communication

Humans must remain wary of predators today too. Nature lovers, farmers, loggers, poachers, and rural residents all over the world have to watch out for large carnivores when venturing into the wild. In order to avoid death when confronted by bigger and more powerful beasts, humans must win the contest of wills by communicating dominance. For example, wildlife authorities tell hikers and campers that upon encountering a mountain lion, they should establish and maintain constant

eye contact with the cat. The person should stand up tall, even hold a jacket above the head, so as to appear very big and make loud sounds. The individual should never crouch, hide, or run away—as a fearful creature might do—provoking a chase response.

COMMUNICATING TO DEFEND

The struggle to survive causes people to innovate, including their communication behavior. Consider what has taken place in the world's most dangerous region for natural predation—the densely forested delta of the Ganges and Brahmaputra rivers between India and Bangladesh. Man-eating tigers killed more than 600 people there late last century, and predation by vicious felines in similar areas of Asia and Indonesia continues to strike fear in people today.[4]

Authorities in the dangerous Indian delta region have greatly reduced the number of tiger attacks by employing a brilliant communication strategy. The officials issue plastic masks to groups of people who travel the area by boat. The masks are worn on the back of the head. They feature large bulging eyes that signal awareness and ferocity to predators on the prowl. Because the big cats want to attack by stealth, they become discouraged by the apparently ever-alert group and move on to better prey. The masks serve the same defensive purpose as conspicuous eyespots on the wings of butterflies that keep birds away. Protruding, brightly colored eyes on the red-eye tree frog startle snakes and birds to the point where they won't attack. Eyespots near the functioning eyes of oyanirami fish turn away underwater predators.

FIGURE 3.1 Defensive communication. Courtesy of Arindam Mukherjee

In communication studies we learn that defensive communication takes place when someone in a group feels threatened or anticipates being threatened by someone else. That individual may then expend energy to be seen more favorably, figure a way to win a disagreement, dominate others, escape punishment, or avoid or mitigate a perceived attack.[5] Evolutionary theory tells us that while we may develop strong individual differences with other people in our groups, any person's survival ultimately depends on the group being able to defend itself. Survival is a group project facilitated by communication ability.

From Hunted to Hunter

The vast majority of prey is no physical match for their predators. So how was it possible for early humans to evolve from vulnerable prey to dominant predators—from the hunted to the hunter?

Some scientists believe early humans became successful predators when their cognitive capacity expanded, and they acquired new survival skills and technologies—especially the mastery of fire

and making of simple tools.[6] Other researchers argue that catastrophic climate change and migrations forced humans to innovate in every respect just to survive harsh environments at various stages of our history.[7] Both these developments brought about key evolutionary adaptations, but they alone could not have altered our position in the food chain. Something else must have happened to account for the extraordinary success of human evolution.

Cooperative Communication

Humans became the dominant species in the animal kingdom primarily because we developed a progressively adaptive system for imparting information and exchanging thoughts. *Our ancestors invented ways to communicate effectively because working together greatly improved individual and group prospects for survival.* Being hunted forced us to cooperate and live in cohesive groups. **Cooperative communication** refers to passing information and exchanging messages in order for organisms to achieve a mutually beneficial objective.

As social animals, we have to be able to communicate effectively in order to create and maintain our connections with others. Humans exchange information much more regularly and on many more topics than any other species. But life-or-death pressure to share information provokes communicative action among much lower order life forms too. The medium that triggers cooperative communication is a reflex bred into the organism's DNA. The simplest forms of cooperation and communication require little cognition.

Animal Cooperation

Working together is a survival strategy. All animals cooperate and communicate in some way within their own species, sometimes in spectacular fashion.[8] Lions work together by taking up "wing" and "center" positions in the chase to bring down large animals like zebras or buffalo, providing more meat than each individual lion would be able to capture alone. Orca whales coordinate attacks on seals and cooperate to stun and eat fish. Bottlenose dolphins herd fish into unprotected locations. Wolves maintain eye contact with each other when chasing elk to find and pursue the vulnerable ones. Cuban boa snakes hunt in packs and work together to block the escape route of prey—bats.[9] Even some fish recognize each other, work together cooperatively, reason, and employ tools (**Chapter 7**).

Chimpanzees coordinate their behavior to hunt monkeys and other sources of food. By constantly monitoring each other's movements, they determine their own role in the hunt. Those chimpanzees that participate get to eat after a successful hunt, but the one that captures the prey typically gets the most and best meat. Because chimpanzees and other primates have relatively large brains, they are more socially complex than other animals. That allows chimps to organize in order to defend their territory collectively.[10]

To survive, chimpanzees need to get along well with other chimps and develop trust. They communicate to make those necessary connections. Chimpanzees have best friends, with whom they regularly share snacks, form friendship alliances, help each other to achieve goals like climbing over obstacles, and groom each other.[11]

Signaling Cooperation

To communicate is instinctual. So are particular ways to communicate. Many forms of communication are genetically coded for the senders and receivers of messages and are innately performed the same way by all members of a species.[12] *Cooperation is built on top of the instinctual communication system.*

The classic example of cooperative communication among lower life forms is the way honeybees excitedly signal each other when they discover food. The nature of the food, direction of the food source, and its distance from their location are all communicated by bees returning to the hive. They do so by using movements that resemble a dance.[13] The rest of the colony responds to news of available food by further transmitting the information within the hive.[14] True to evolutionary form, honeybees act in a way that preserves the survival of their entire colony, not just themselves individually.

A **signal** is a physical action or event that communicates a message. Any action that is characteristic of a species' behavior serves as a signal in their communication system. The signal is productive only when it evokes the right response. For that to happen, the signal must be given clearly by the source and interpreted correctly by the others to know how to react to the message. Throughout the animal kingdom, **communication fidelity**—the precision with which a message is sent and received—is key to survival.

Returning to our example, honeybees returning to the hive signal the others with a "waggle dance" to indicate how close or far away a food source is from their location. The waggle refers to the movement of the bee's abdomen, which can be as rapid as 15 distinct movements per second. The movement is fast when a food source is close. The bees dance more slowly to indicate when a long flight will be required to retrieve the food. This information signals how much energy will be required to retrieve the food. The characteristic figure-eight pattern of the dance points in the direction of the food source.

The movement of the returning bee also emits the identifying odor of the pollen, which serves as another piece of information the bees can use to mount a successful trip. Other honeybees in the colony interrupt the dance if they've experienced trouble at the same food source, like the presence of a spider or other predator.[15]

After locating the food, the foraging bees commit information about the food source to memory and call on their stored knowledge for subsequent trips, adding another dimension to the

FIGURE 3.2 Honeybee waggle dance. Courtesy of Leonard Emereychuk/iStock.com

insects' communication system.[16] The system thus combines "public information" (signals given off to others in the dance) and "private information" (each individual bee's information recall). The bees' remarkable communication behavior is encoded in their DNA and passed on to subsequent generations.

The honeybee dance is an example of an **analogical code** because the speed and direction of the bees' movement bear an actual relationship to the idea being communicated (location of the food). When the bees dance, they reference an entity—food—that exists a long distance away. Being able to refer to things not physically present—long thought to mark a key difference between humans and other animals—does not make us unique communicators.[17]

Africa's vervet monkeys have a more complex signaling system. The monkeys vocalize different alarm calls depending on what kind of predator they are trying to avoid at the moment. Leopard calls warn fellow monkeys to run up into trees. Eagle calls provoke them to look skyward. Snake calls prompt the monkeys to stand on two legs and survey the ground around them.[18] The calls of the signaling monkeys evoke a representation of something in the mind of the monkeys that hear them. They imagine a class of predator, assess the situation, decide what to do, and act.

Warning others this way is risky for the monkeys because audible signaling can attract the attention of predators. The more exaggerated the signal, the greater the risk. It is not absolutely certain the monkeys intend to warn others or are simply trying to discourage an attack with their predator-specific sounds. Regardless, the benefits must offset the risks of audible signaling or the behavior would not have evolved.[19]

The cooperative model in nature reflects an evolutionary principle of particular interest: Assessment of the costs and rewards of group survival depends on actions of individuals that are reflected in their communication behavior.

Human Cooperative Communication

Expanding patterns of social interdependence that gradually developed among our early ancestors gave rise to human cooperative communication.

Evidence of the collaborative hunting of large game by humans appears in the fossil record of an early *Homo* species dating back 400,000 years. Individuals exchanged information about the prey they stalked and experimented by hunting in teams where individuals assumed diverse responsibilities. Early humans also worked together to make tools and weapons that were used for hunting.

Primitive cultures did not develop solely as male-dominated groups whose only incentive for cooperating and communicating was to hunt and consume animals or establish and defend territory. Early humans also evolved to raise offspring cooperatively. Child rearing was and is undertaken not only by the birth mother but also by other family members, distant relatives, and neighbors. Throughout history effective communication has built bridges between nuclear families and other potential care givers.

None of the participants in cooperative child-raising communicates more persuasively than babies and infants. We instinctually respond alertly to the sound of crying babies, even if we aren't the parents. The baby's cry switches on an automatic survival response.[20] As babies grow to become toddlers, their disarming behavior encourages people to share, work together with strangers, and become more attentive to others overall.[21]

Humans differ from other primates in part because of our high degree of sharing and caregiving. For example, when we have information about something desirable (like a non-present food source), we often call others' attention to the desired object.[22] Our closest ape relatives—bonobos and chimpanzees—don't do that. They wouldn't understand gestures or looks that inform them where something might be hidden, even if those signals were given.[23]

FIGURE 3.3 Cooperative hunting. Courtesy of Nicolas Primola/shutterstock.com

Cognition

Enhanced communication ability began to influence the human evolutionary trajectory in ways that separate us from the other apes. But a brain that is capable of **complex cognition** must be in place before advanced forms of cooperation and communication can evolve.[24] The human brain eventually evolved to become three times larger than that of the other apes. The large brain size has made it possible for humans to learn from each other and utilize resources in ways that are not equaled by any other species.[25]

Under constant pressure to survive, our ancestors gradually got better at all three necessary elements: thinking, cooperating, and communicating (**Figure 3.4**). This interacting combination of abilities allowed our ancestors to adapt successfully to the various environments they inhabited.

Five central characteristics of a shared cognitive infrastructure must be present for human cooperative communication to succeed:[26]

(1) *Norms of cooperation*: members of a group must feel meaningfully connected with each other to the point where cooperation among members is expected.
(2) *Shared goals and communicative intentions*: in specific situations where group members can benefit from cooperation, the individuals involved must at least implicitly agree on goals for their collaboration.
(3) *Joint attention and common ground*: individuals must be able to imagine and physically focus together in practical terms on a task. Group members must also share common ground, especially cultural knowledge, to confidently interpret what each individual is attempting to communicate in the coordinated interaction.
(4) *Cooperative reasoning*: individuals must share the logic they use in their collaborative communicative actions. They must be able to determine the overall reasonableness of what they are doing and figure things out together.
(5) *Communicative conventions*: individuals within a community must share an overarching understanding of the normative nature of what they are doing and why.

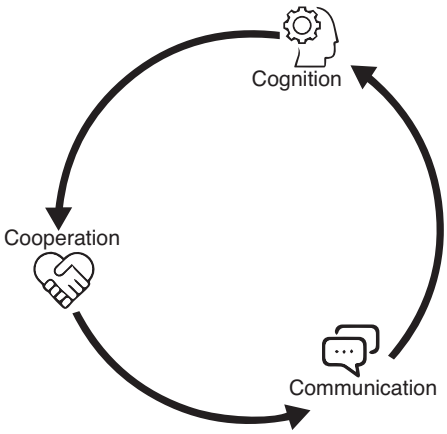

FIGURE 3.4 Human cooperative communication

The last stage (5) represents a collective reflection on all the elements of human cooperative communication described in 1–4 above. This model applies to all forms of cooperative interaction at all times in human evolutionary history.

Collaborative behavior begins among infants one to three years old. Children engage with others to coordinate their efforts toward a joint goal, commit to the goal until all participants get their reward, divide the rewards fairly, understand their own and each other's roles in the activity, and help their partners when necessary.[27]

Transformative Communication

For all living organisms, cooperation was born of necessity. To survive, animals have to recognize, adapt to, and interact with other individuals of the same species. Cooperative behavior can then be imagined and acted on from a shared sense of sociality. The instinct to collaborate arose because individuals recognized that working together improved their survival chances. Whatever raw cognitive ability our early ancestors possessed was now applied to solving problems with others. The brain rewards this behavior by producing oxytocin, a hormone that promotes trust and cooperation, which allows people to live together for the common good.[28]

All organisms are born with innate communication ability, so our ancestors had to direct that ability toward a goal. To do so, individuals had to represent their thoughts to others clearly and persuasively. Receivers of messages had to be able to draw inferences from what was being represented to them. Improved communication led to more sophisticated collaborative endeavors and more complex ways of communicating in an unending co-evolutionary spiral.[29]

Speech became interactive for reasons of sheer survival. In the process, the crucial idea of **receiver-centered communication**—where the sender of a message adapts to the listener's knowledge base, reasoning ability, expectations, and perspective—was born. Key to bringing sender and receiver together in communication behavior at any stage of development for any living creature is **salience**—the importance an issue has to both parties.

The origin of receiver-centered communication among humans can be traced to the social behavior of our hominin ancestors. Individuals who possessed valuable information—like knowing where a predatory animal was hiding or discovering a new source of water—got the attention of their peers. That information was salient. Over time the most alert and talented communicators

became *de facto* leaders. The need to communicate salient information eventually drove the development of language. Language ability grew to extraordinary levels because it allows individuals to better send and receive messages that are crucial for individual and group survival.

Our ape relatives—chimpanzees, bonobos, gorillas, and orangutans—have considerable intelligence. They understand that other apes have intentions that motivate their behavior. They can delay gratification, be persistent in obtaining a goal, avoid distractions, change plans as needed, and tolerate short-term difficulties in order to gain a reward. They cooperate spontaneously in a hunt for food. But apes have not advanced from individual to **joint intentionality**—where small groups work together with common purpose over a variety of tasks.[30]

For this reason the great apes' communication skills have not evolved beyond a limited range of vocalizations and nonverbal actions like kissing, embracing, patting on the back, and touching hands.[31] Apes have no apparent sense of group identity or related feelings of shame, guilt, or pride. They maintain preeminently high levels of individual self-interest even in their most cooperative behaviors. Clear differences in cognitive and behavioral complexity help explain the divide between humans and the great apes in forms of social organization.

Reflexivity

As communication modalities and codes evolved in social groups, humans increasingly saw themselves reflected in the responses of others, leading them to more fully recognize their capacity to affect the actions of others and be affected by them.

The pressure felt by our ancestors to collaborate created a dual way of thinking. A cognitive structure that embraced individuality with other-directedness emerged. Joint goals and individual responsibilities were implicitly identified. Individuals had to be reflexive—capable of critically monitoring their own role in an interaction, interpreting what other individuals are thinking and doing, and regulating their own thinking and behavior accordingly. Each interactant had to at least realize that the other person has the potential for independent thinking and differing points of view. And when individuals disagree, they could try to solve the problem by talking and negotiating.

By observing events unfolding around them, our ancestors became capable of **inferential reasoning**—the ability to draw conclusions and make logical generalizations about the wider world.

With this ability, Sapiens evolved to have the capacity to put their own situation into perspective and infer what others know or don't know and what they might do or not do—**theory of mind**.[32] Some recent research suggests that the great apes may also have the basic ability to comprehend what's going on in the mind of others.[33] That's another shared trait between humans and our close relatives. But the unique complexity and flexibility of human communication allows us to uniquely focus on, reflect upon, and openly criticize everything around us—even the way we communicate. No other animal communicates about how it communicates.

Cultural Foundations

Whether represented as tool-making, chest-thumping predators or other-directed, trusting caregivers, human evolution requires a high degree of social cooperation that could only have been facilitated by speech and language. No communication? Then, no cooperation. No cooperation? Then, no culture.

Driven by each individual's need to feel safe, cooperation and cultural development require interpersonal trust. Early humans identified common goals and developed norms and conventions for behavior because they believed they belong together. Thus, tribes were born.

A growing sense of "we" based on the principle of joint intentionality came into being. That shared motive was acted on by individuals who communicated with each other to reach their common goals.

When successful, those social behaviors became normative. Collective cooperation, amplified and extended by nuances in communication ability, became the foundation of culture (**Chapter 9**).

A significant increase in the degree of social cooperation and the structural interdependence that cooperation creates underlies every major transition in human evolution. That's how societies and civilizations have been created. The emergence of large and cohesive cultural groups over the last 10,000 years represents a pivotal chapter in the story of human evolution.

The fact that human adults are capable of knowing that individual people see the world from different perspectives encourages language development, which makes the creation of advanced human civilizations possible. Language allows people to coordinate complex tasks, like hunting, raising offspring, creating social systems, and transmitting culture to subsequent generations. But how were our ancestors physically able to communicate their intentions and coordinate their actions? For joint action to take place, individuals must be able to signal each other, at least in some rudimentary way.

Physical Adaptations

Exactly what early humans did physically to communicate their intentions and coordinate their actions is difficult to know. Gestures and spoken language are not preserved in fossils. Still, the best theory holds that pointing and pantomiming (mimicking behavior like throwing a spear or making the characteristic actions of an animal hiding in the bush) were the first forms of human communication.[34] Other species, including bonobos, dolphins, ravens, African hunting dogs, wolves, and even some fish, gesture to direct the attention of their companions for hunting.[35] Domestic dogs gesture too. When they roll a ball toward your feet or bark and run to the door, you know what they want.

Physical gestures by our early ancestors likely proved to be effective for signaling joint intentions and actions. Complex cooperation does not require speech. But gestures alone could have advanced collaborative behavior only so far.

Fortunately for us, over enormous expanses of time the human anatomy evolved in ways that allowed our ancestors to make sounds that eventually became speech. Small changes in the genes that make up the anatomical basis for complex spoken language separate modern humans from our hominin ancestors and from the other apes.[36] After we stood up as bipedal hominins, the larynx gradually descended, opening up the vocal tract so that individuals could utter a wider variety of sounds. The tongue could now move more freely. Teeth got smaller, creating more space for articulation. Oral cavities became bigger and more resonant, enabling the production of differentiated and rapid vocalizations.

Six speech organs—the larynx, soft palate, tongue root, tongue body, tongue tip, and the lips—evolved to function together. They produce the sounds of complex human speech (**Table 3.1**).

Physical adaptations facilitated much greater variety in sound production, which, together with cognitive development, led to increased linguistic complexity. The fossils of *Australopithecus afarensis* hominins Lucy and Selam, who lived four to three million years ago, reveal that the hyoid bone located at the base of the tongue—crucial for speech production—was intact among our ancestors of that era. Humans are the only primates to have voluntary control of their larynx. That puts us at risk of choking but allows us to physically form the sounds of speech. Hearing and cognitive decoding skill must have improved in tandem with articulation ability. It is not only the ability to produce complex vocalizations but to recognize and interpret a wide range of utterances that makes human beings so different from all other animals.[37]

In human evolution every major advance in human cooperation was preceded by the development of a new form of communication.[38] Language and other means of symbolic expression became crucial resources for sheer survival. Communication ability became the main advantage for sexual reproduction too. We wouldn't have language if it didn't make survival and reproduction possible. Sexual reproduction is the second reason we communicate, and the subject to which we now turn.

TABLE 3.1 Human Speech Organs (adapted from Pinker, S. *The Language Instinct*)

Organ	*Description*	*Function*
Larynx	The voice box; contains vocal folds enveloped in mucous membrane	Vibrates to create and amplify sound waves
Soft palate	Fold of skin at back of roof of mouth	Regulates air flow through mouth and nose, modifying texture of vocalization; closes off nasal cavity to project speech through mouth
Tongue root	Muscle at bottom of tongue	Anchors tongue body to jaw
Tongue body	Main part of tongue	Shapes wide range of sounds emitted by larynx; requires flexible muscle memory
Tongue tip	Pointed end of tongue	Functions with tongue body and lips to create particular sounds, especially consonants
Lips	Upper and lower	Alters resonance of speech sounds through compression and release

Reproduction

The very first forms of life on earth—single cell bacteria—grew in size and increased their numbers by directly copying their own genetic material. Some worms, snakes, and tiny freshwater creatures called hydra still require no partner to procreate.

But slightly more than a billion years ago, **sexual reproduction**—where genetic material is transferred from one organism to another of the same species—evolved. The vast majority of life forms reproduce sexually. Sexual reproduction came into being because it has clear advantages for the health of both organisms and improves the efficiency with which an organism can spread its genes onto subsequent generations.[39]

All sexually reproductive organisms are driven instinctually to procreate, including, among humans, homosexuals, infertile people, and those who choose to have no children. But not every single organism in nature has the same opportunity to mate. Of the pool of individuals who make up a given population, some stand a better chance than others to procreate.

Sexual selection by animals has two intertwined meanings. The first meaning refers to the actual behavior where a reproductive mate is selected by another. Animals choose mating partners based on the quality of potential candidates' attributes and traits. An individual organism gains reproductive advantage by appearing to be especially attractive to individuals of the other sex.[40] The second meaning of sexual selection refers to the evolutionary outcome of sexual reproduction. The genes of the individuals that are chosen go forward. Those genes have been selected sexually.

Sexual Communication

Males throughout the animal kingdom aggressively seek out mates for sex. But in most cases females control sexual reproduction because they choose their sexual partners.[41] The males that are most likely to find mating partners are the ones that can demonstrate superior fitness—a robust and healthy physical condition and behavioral qualities that are likely to produce viable offspring. By selecting particular mates, the females of most species determine which males' genes will be preserved in the next generation. Sex binds males and females together because it perpetuates the genes of both sexes.

When choosing a mate, the female of the species cannot directly inspect the genetic profiles of her male suitors to evaluate their candidacies. Instead, she will attempt to mate with those individuals that can most effectively display qualities that promise to produce excellent offspring. *It is*

not the actual fitness of the male that is chosen but how well the appearance of fitness is communicated. Male creativity and extravagance are rewarded. Poor communicators reproduce less.

The female selector works out courses of action or inaction by assessing available mates. But sexual selection always remains an informed guess rendered from communicated clues that may or may not reflect the best possible choice. An honest representation of the male candidate's qualities usually benefits him and his potential reproductive partner. His ability to effectively communicate those qualities and her ability to select wisely provide the best solution for both. But females of all species must be wary. Males can be very skilled at deceptively advertising their qualities.

To Call and Charm

Males call and try to charm females. A male's striking physical appearance and activity level can reap reproductive rewards. In the animal world these attributes include the shine of the skin, quality of the fur, energy displayed in a courtship dance, graceful movements of the body, enchanting song, body heat given off, symmetric feathers, luxurious plumage, distinctive scent, richness of color—any and all traits and modes of adornment that can be displayed.

Birds are particularly good at showing off their qualities. They display brightly colored feathers, combs, wattles, protuberances, horns, air-distended sacks, top knots, and plumes for sexual purposes.[42] They sing, dance, spread their wings, and flutter. Some birds tap out messages of seduction with their beaks.[43] Male bower birds decorate their impressive nests (their "bowers") artistically to attract reproductive partners.[44]

Males of other species strikingly exhibit qualifications in ways that reflect their physical traits. Male crocodiles splash and roar while emitting a musky odor.[45] Fish and salamanders display their brightest colors during breeding periods. The saltwater species Corvina make the loudest fish sound ever recorded—louder than a rock concert at 177 decibels—to demonstrate fitness.[46] Male lizards display flexibility by doing deep push-ups. One species of spider choreographs a multimedia show of song and dance. Frogs croak out territorial claims and call potential mating partners. Rain forest monkeys show off their strength, cleverness, and agility by drumming frantically with sticks.[47] Lightning bugs flash intermittent signals. Male flies, crickets, crabs, spiders, and grasshoppers display coloration, ornamentation, and sound that evolved for the purpose of attracting females.

FIGURE 3.5 Frigate bird. The bird inflates his eye-catching but inconvenient throat pouch to attract females during mating season on the Galápagos Islands, Ecuador. Courtesy of Fominayaphoto/shutterstock.com

Not all males can flaunt a massive rack of antlers like a bull moose or a luxuriant mane like an African lion to win mating partners. They can't all flash huge teeth, long necks, or sturdy jaws. Many must rely on less majestic forms of sexual signaling. That's where brilliant colors, feathers, songs, dances, odors, and ornaments—sometimes in combination—serve as sexual signs. The timing and rate of physical movement, frequency and volume of sounds and calls, and dogged persistence in the face of rejection can all produce reproductive success.

Cooperation Displays

Because joint intentionality functions as a survival strategy, female evaluation of potential sexual partners can also reflect the degree of cooperation that is communicated by the male. Because of long gestation periods, females cannot produce the same number of offspring that males can. This reproductive asymmetry means that females have more to lose in terms of child care.

For this reason, "family man" social skills on the part of desiring males can win sexual access. Grooming and sharing food are common tactics among primates. Nest building is rewarded, even underwater. Puckerfish prepare a complex undersea nest to attract potential partners. Sharing is a good sign. Balancing sponges picked up off the ocean floor on their noses and delivering them as gifts to a female demonstrates a male dolphin's strength and domestic potential.[48] Warning the female of impending danger, even deceptively, can be effective.[49]

Monogamy is rare in nature.[50] The vast majority of males never win a female's permanent affection or loyalty. The pressure males feel to communicate well in order to copulate is enormous. Males' characteristic aggressiveness represents a desperate and dangerous drive to be chosen for sexual reproduction. The males not only have to impress potential mating partners. They also have to stave off other males with whom they compete and, for some species, show they can defend their females and potential offspring. They must demonstrate fitness and dominance.

FIGURE 3.6 Penguin. A male Magellan Penguin in Patagonia announces he has prepared a perfect home for a potential mate and offspring. Males attract mates not only by their physical appearance but by demonstrating an ability to prepare a clean and appealing burrow. Courtesy of Yevgenia Gorbulsky/shutterstock.com

Dimorphism

As a general rule, stereotypical male physical and behavioral characteristics became dominant throughout the animal kingdom because they are desired by females.[51] Over time female choice of mating partners has created striking physical differences between the sexes of most species. Because of this, males and females gradually became **dimorphic**—of contrasting physical forms. Males generally became bigger, more colorful, more ornamented, and more physically active. In the few species where the reproductive strategy is reversed, the females became closer in size and more brightly colored and ornamented than the males.[52] In these cases, males judge females by their physical attributes and take better care of the offspring when the female is judged to be attractive.[53]

When females refuse to mate, males typically escalate the intensity of their sexual displays.[54] The inflation of sexual signals accumulates over time to mark sharp physical differences. For instance, the vibrant colors of male birds and polyphony of their songs stand in stark contrast to females' smaller size, less brilliant coloring, and lack of interest in singing. Other physical and expressive characteristics of males of various bird species—longer tails, animated courtship, and louder songs, for instance—evolved in response to female preference.[55] Those species where males and females look and behave similarly—geese, penguins, pigeons, owls, parrots, and macaws, for instance—are the most monogamous.[56]

Mating Rituals

To initiate a mating ritual, the female of a species characteristically sends messages of sexual availability often just by her conspicuous presence. The female's presence can put her at high risk from predators. The male responds to the female's presence with his message of biological fitness. The female then turns the message she receives into a meaningful sign through an instinctual inference; if the sender makes an impressive display, he must be fit.

Females select mating partners by appraising the totality of messages they receive. Often overwhelmed by suitors and at risk for the ever-present possibility of deceptive messaging by the male, females have to be discerning interpreters of the sexual signs. They must be able to resist male actors' sales pitches in order to eliminate the less qualified candidates.[57] In some species, females signal acceptance before consummating sex or just fly or run away.

Sex in the wild is dangerous. No organism wants to attract the attention of potential predators. A trade-off between selection processes is evident. Natural selection molds organisms in ways that blend in with their habitats so they are less likely to be detected by predators. But sexual selection produces flamboyant shapes and colors in males for the purpose of attracting mating partners.[58] That's why males evolved to become more physically conspicuous in environments where the fear of predators is weak or nonexistent.[59]

Despite the potential hazards, males don't want to conceal their special qualities. Females don't want the message senders to hide their talents either. For example, the huge, colorful tail feathers that are displayed by a flightless male peacock restrict his ability to flap his inefficient wings and run away from predators. But the brilliant tail demonstrates biological fitness in a most impressive way. The desired male attribute—magnificent feathers in this case—increases genetically until the trade-off with predation becomes too great. At some point the most conspicuous candidates become the most vulnerable and eventually die off.

Fitness gradations throughout the animal kingdom can also be very subtle. Small variations in body movement can finely distinguish the best candidates for sexual selection.

Male physical conformation and sexual signaling have evolved to be so extreme because competition among males for access is fierce. The powerful weapons that males of some species develop

(for example, giant tusks, horns, antlers, or claws) serve not only to impress the female but to intimidate competitors.

Competition for females can turn violent. Male contenders desire reproductive success but generally not at the expense of their physical well-being. Ritualized communication often solves the problem. Opponents in fights over females often turn physical combat into an exchange of signs. The weaker animal backs off. The stronger animal doesn't continue the fight because he has already won. The message "I'm better than you" was effectively delivered, so there is no need for the victor to waste time and energy.

Human Sexual Selection

When he created the original "relationship status" feature on Facebook, Mark Zuckerberg, then a college student, took advantage of a fundamental evolutionary principle: Above all else, sexual desire and reproductive potential drive social interaction.

Today's Internet traffic confirms that evolutionary truth. Less constrained by geography and tradition, the digital environment offers limitless opportunities for people to meet each other. Some social media sites get right to the point about sex. Others promise romance, even marriage potential. Dating sites that specialize in particular ethnicities, age groups, religions, lifestyles, and marital statuses have grown popular.

Some people invent multiple personalities in order to create and maintain various relationships across a range of sites.

The physical human body publicly advertises crucial modes of fitness—state of health, aesthetic qualities, dexterity and physical skills, creativity, and stamina among them. The ways men and women present themselves online and offline sends vital signs to potential mates but also to employers, colleagues, family members, neighbors, and clients, all of whom even unconsciously render consequential judgments of physical fitness and sexual attractiveness.

Sex and Gender

Sex refers to biological differences between males and females determined by an individual's chromosomes, hormonal profiles, and external and internal sex organs. **Gender** describes personal characteristics that a society or culture considers masculine or feminine. Both play central roles in human sexual selection.

In nature, the process of sexual selection remains essentially the same for nearly all advanced animal species: Females choose partners from attentive males who send messages of biological fitness and personal excellence. But nature's norm doesn't apply to humans in such a straightforward way.

Men typically assert greater influence than women over the terms of sexual life and reproduction, especially in tribal and other deeply traditional societies or sects. Many marriages are arranged by male-dominant families. Dowries are paid, and girls are sold. Bigger payments are made for females that are young, healthy, and presumably more fertile. In some cultures, failure to produce children is grounds for divorce and refund of investment. Women in many parts of the world don't have equal access to education, voting, property ownership, even freedom of movement or expression. Even in more modern societies, some religious groups cling to sharply demarcated roles for men and women. The media in Western societies often portray women as sex objects or defined by gender-based roles.

For these reasons girls and women are on display as much or more than boys and men as candidates for human sexual selection. The actual form of display differs from culture to culture, and factors that signal attractiveness change over time. Still, the underlying universal criterion for female

sexual attractiveness is reproductive potential even in cases where actually producing children is not desired by either partner. That's why such great emphasis is placed on a female's youthful appearance, health, and personality throughout the life span.

Three general categories of female reproductive value emerge from research. These are *physical features* (such as an able body, smooth, clear skin, lustrous [not gray] hair, white teeth), *behavioral features* (including high energy, attentiveness, lively movement, kindness, cheerfulness), and *reputation* (knowledge gleaned from others about details such as age, health, behavior, and prior conduct).[60] These factors all represent positive qualities for successful childbearing and child-raising potential.

Males use a variety of tactics to assert their reproductive potential.[61] Masculinity-enhancement props include guns, tattoos, piercings, death and devil imagery, and the ability to handle alcohol and other drugs. Displaying animal body parts, especially the heads and skins of big beasts slain on safaris, demonstrate predatory credentials—animal and sexual. Warrior stereotypes—military fighters, gang members, American football players, professional wrestlers, misogynistic rappers and rock stars, even belligerent politicians—aggressively represent sexual capacity. An Internet-driven extension of male exhibitionism is a subcategory of sexting—photo-sharing private body parts. Some males attempt to signal sexual prowess by sending digital selfies of their penises, often unsolicited, to heterosexual or homosexual receivers—a display that overestimates the arousal potential that senders believe it to have.[62]

The contrasting pitch, timbre, and volume of typical male and female voices intensify sexual attraction. A deep and resonant male voice connotes confidence and authority—an indication of masculine fitness. The softer female voice signifies "not male," a reliable indication of childbearing potential.

Ovulation

Most animals engage in sexual activity only when the female signals she is receptive and fertile. Female animals communicate ovulation to prospective partners by physical signs, including the swelling and coloration of the buttocks, genitals, or breast, and by scent or changes in vocalization or movement.

Human female ovulation and that of some other primates is not easily detected, even by the female herself. Because of this, maximizing reproductive potential means having sexual contact even when the female is not in the fertile period of the month.

Still, sexual communication changes during the menstrual cycle, especially in the signs females may even subconsciously give off to encourage prospective sexual partners.[63] During the few days when women are ovulating, they are more likely to favor a highly masculine body type, facial features, body scents, and more dominating behavior. These inclinations do not show up when women are not ovulating. The adaptive value of the switch from more to less sexually attractive may have functioned as a combination of adaptive traits—the sperm donor for genetic quality of the offspring and the caring husband and father for nurturing the child or children.

Roots of Gender Difference

Evolutionary history explains why the gendered nature of everyday life appears so universally.[64] A fundamental division of labor between the sexes developed and spread among primitive groups because it proved to be evolutionarily advantageous. Sexual dimorphism and gendered social roles helped foster particular kinds of cooperative interaction between males and females that were expedient for surviving environmental challenges.

Our hominid ancestors emerged originally as sexually androgynous creatures, with largely undifferentiated biological and social roles. Behavioral differences we think of today as gender stereotypes started to evolve when our ancestors began to reproduce ten to six million years ago. Mating competition eventually made males physically larger than females and less vulnerable to attack. The instinct to protect themselves and their progeny forced males to excel outside their immediate surroundings, a trait that persists in almost all societies today.

Sexual selection assumes differences in the roles of males and females as mating partners, starting with physical differences in the human sex organs, which were gradually adapted to fit together. Male and female social roles later became differentiated too. Each sex had something to offer the other. Males provided reliable sources of food and physical protection for the female and offspring. The female guaranteed that the male's genes will be passed on to the next generation.[65] Even the origin of bipedalism can be traced in part to the fact that freeing up males' hands allowed them to gather and carry food back to females in the group. Males and females developed reciprocal traits that included trading food for sex, a behavior that is also present among other primate species.[66]

Males evolved not only to supply food and reproductive promise for females and themselves, they also participated in a behavior that is rare among animals yet central to most mammals—parental care.[67] A constant male presence in the raising of offspring evolved to become an important social asset for humans and other complex species. Females recognize this quality. When evaluating potential reproductive mates, females often consider the male's ability to provide financial and other material resources for her and the offspring.[68]

In cultures throughout the world, most males place great value on the relative youth and physical attractiveness of females. Females generally are less concerned with appearance and more interested in the willingness of males to invest resources—food, shelter, territory, protection, and parenting.[69] These gender archetypes descend from our evolutionary past and help us understand how we got to where we are as women and men today. Although the preferences are universal, the stereotypical gendered behaviors do not prescribe how any individual woman or man *should* act or predict how they *will* act.

Cooperative Reproduction

Greater cooperation and improved communication between males and females over the millennia increased the prospects for sheer survival and for the reproductive success of both sexes. Males and females developed a particular kind of "we" intentionality. Both sexes recognized their own intentions and the intentions of the other and found ways to work together to accomplish their shared objectives. Behavior associated with joint intentionality evolved to become one primary criterion for sexual selection.

Sexual Desire

When people find themselves attracted to another person sexually, they aren't simply plotting a way to capture a mate in order to send their genes forward to the next generation. Reproductive success may be the underlying motivator of heterosexual attraction, but reproduction is but one motive for sexual behavior in the modern world. In many societies men and women act upon their sexual desire for reasons including curiosity, physical pleasure, peer pressure, to release tension, and for developing intimate short-term relationships.

What drives people to have sex when they can't or don't want to reproduce? The simple explanation is that sex is very pleasurable for most people. Our bodies evolved in such a way that when the nerve endings of our sexual organs are stimulated, they send signals to the brain that release

chemicals we experience as intense pleasure.[70] These biological adaptations produce a kind of euphoria even when sexual activity cannot lead to sexual reproduction.

Our needs were shaped in the wild and continue to be felt subjectively even if they are no longer needed for survival and reproduction. Gay and lesbian sex has no direct biological reproductive consequences. Many heterosexual women maintain active sex lives after menopause. Men with vasectomies can't conceive children but don't lose sexual desire. Birth control methods free partners to enjoy sex with less fear of pregnancy—in seeming contrast to the idea that we evolved to produce offspring. And of course for most people, the sex drive is part of far more complicated relationships that include feelings of romantic intensity and deep personal attachment.

The powerful emotions that are felt in a deeply loving relationship with or without children can create a sense of personal stability and security that is evolutionarily beneficial for the individual and society.[71] This fact applies to heterosexual and homosexual unions. Homosexual behavior contributes to the strengthening of the larger community because it helps create and maintain social bonds that help keep society stable.[72] That was the fundamental argument supporting the right of gays and lesbians to marry in the United States and many other countries.

Homosexuality is also common among animals. Our closest cousins—bonobos—engage in multiple forms of sexual behavior in order to develop friendships and alliances and promote overall group solidarity.[73] Sex is natural in all its forms.

IS EVOLUTIONARY THEORY SEXIST?

No human being has ever been born purely male or female. Our distant ancestors emerged as genderless creatures, with undifferentiated biological and social roles. The essential unity of humankind is inscribed into our very bodies. As Charles Darwin himself asked, "Why else would men have nipples?"[74] So why is evolutionary theory sometimes thought to be unfairly biased against women?

The division of labor between the sexes that developed and spread among social groups followed physical differentiation because it proved to be evolutionarily advantageous.[75] Gendered behavior helped foster particular kinds of cooperative behavior that became expedient for confronting environmental threats. The essential division of labor that arose among early population groups—men hunted large game, while women gathered small game and planted and harvested food—may have even allowed our species to survive and thrive while the less gender-differentiated Neanderthals went extinct.[76]

Males' conspicuous aggressiveness should not be considered as either a sign of superiority or a character flaw. It represents nothing less than a desperate and dangerous drive to be chosen for the biggest game in town—sexual reproduction.

Gender disparities have been reduced significantly—but certainly not eliminated—in modern cultures.[77] The social movement toward achieving greater gender equality has become a survival strategy consistent with evolutionary theory. Economic, political, and cultural development depends on cultivating greater opportunities for girls and women, especially where the rights and opportunities for females lag behind.[78]

Evolutionary theory should not be blamed for inequalities that pervade gender relations. The theory reveals something important about *how* sex-role differences and injustices in our species came about; it didn't create them. Moreover, human evolution is not fully determined by our genes or by our cultural histories. As modern individuals and societies, we can choose to overcome the gendered expectations instilled in us by our pre-modern past.

Chapter Summary

Evolutionary pressure forced primates and other advanced species to form social groups and cooperate. Our ancestors were able to transition from being prey to becoming predator in the natural world because they found ways to work together effectively.

Levels of cooperation increased steadily as these early humans invented more complex ways to communicate. Collaborative behavior required that our ancestors recognize joint goals, create joint attention directed toward mutually beneficial tasks, and take joint action. Facilitated by ever-improving cognition, cooperation and communication dynamically co-evolved. Adaptations to our speech organs made it possible for our ancestors to produce a wide range of sounds and ultimately develop spoken language.

As we communicate to survive, we also communicate to reproduce. Humans and other living organisms "survive" by transmitting their genes to future generations. In order to attract reproductive partners, animals must be able to communicate their genetic qualifications.

Throughout the animal kingdom, males demonstrate their fitness by communicating their appearance and ability. Females evaluate available males through processes of sexual selection. For species like birds, the males' ability to make appealing sounds, move nimbly, or become brightly colored develops over countless generations in response to female criteria for sexual selection. Human sexual selection is made much more complicated by gender roles that are influenced by culture. Because humans can choose courses of action, gendered behavior need not remain fixed in ways that are passed down by evolutionary pressures of the past.

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4

EXPRESSION

Complex human communication developed under the intense pressure we feel to survive and reproduce. But there's much more to evolutionary communication than that. Not every message we intentionally send, unconsciously give off, or interpret can be explained by the demands of natural or sexual selection.

Recognizing that multiple factors contribute to evolutionary pathways, we will now describe the third main driver of evolutionary communication. This is the innate need to express ourselves for reasons that cannot be explained by natural or sexual selection alone.

Human expression refers to processes by which we transform our thoughts and feelings into symbolic representations that are communicated to others.[1] Our ability to do that has been enhanced tremendously over time by the development of communications media beginning with language. People creatively use the range of **expressive media** available to them—from their own bodies to sophisticated communications technologies—to make their thoughts and feelings known. We do it naturally; expression reflects the innate drive we have to communicate.

This chapter divides into five sections. First we consider the factors that make expression instinctual and highlight the importance of freedom of expression. Second, we explore the aesthetic dimensions of expression and the invention of early symbolic forms. Third, we take up how human expression has been turned into cultural products. Fourth, we describe the main elements of a semiotic approach to communication. The last section explains why stories became essential forms of evolutionary communication.

The Expression Instinct

The expression instinct is rooted in a universal mindset. All higher order animals express themselves emotionally. Modern human societies have made expression a positive priority and legal right.

Expressive Needs

The logic of the classic Maslow hierarchy of needs corresponds positively with evolutionary theory and evolutionary communication.[2] We communicate in the first instance to acquire and manage food, water, and rest—our physiological necessities. Communication facilitates the quest for personal safety and social belongingness, which lies in the pre-self core of every

human being. The need for love and sexual consummation can only be satisfied through communication. By enabling us to interact thoughtfully and reflectively, complex language helps fulfill the self-esteem and self-actualizing needs that appear at the top of Maslow's hierarchy.

The need to express our feelings becomes evident from the moment life begins.[3] When babies sense their mother has left the room or when a child's body is disturbed by hunger, cold, noise, or unfamiliar stimuli, the infant alerts caregivers by signaling fear.[4] Recognizing and responding to an infant's cries runs deep in Sapiens' evolutionary history. Our ancestors and hominin relatives likely soothed and healed each other by humming and singing, incorporating these communication forms into their survival skills.[5]

For adults in Western countries, the *inability* to express oneself is frequently interpreted as a symptom of psychological or physical illness. Therapeutic techniques that employ expressive media—music, art, dance, psychodrama, and creative writing, for instance—are widely used in psychological counseling and rehabilitation. Even late-stage Alzheimer's patients express delight in listening to, dancing to, and singing along with their favorite music.

Expressing Emotions

Our physical bodies—especially our speech organs, facial muscles, and overall dexterity—give humans a vehicle for the widest range of emotional expression in the animal kingdom.[6]

But we shouldn't overestimate the differences in emotional experience and expression between human and other animals, especially the higher order species. They go through meaningful experiences, thoughts, and moods, just like we do.[7] Beginning with the work of Charles Darwin, scientists have known that many mammals, especially primates, express emotions including anger, love, grief, courage, timidity, shame, and more complex feelings such as jealousy, suspicion, emulation, and gratitude.[8] Darwin was so committed to this idea that he wrote a book titled *The Expression of Emotion in Man and Animals*.[9]

As dog owners know, canines send messages of physiological need, affection, dominance, territory, and sadness. Chimpanzees grin, laugh, and chastise each other. Chimps also use subtle facial expressions—the arch of an eyebrow, the curve of a lip—to express their feelings and react to situations.[10] Monkeys make sounds like human laughter and sometimes smile when pleased.[11]

We recognize animal emotions like these because they resemble our own. We cry, scream, and jump with delight like other primates. We might playfully display our canine teeth to express ferociousness or hiss at someone with no intention of making an attack.[12]

Freedom of Expression

Expression is so basic to our common humanity that it is considered to be a right in modern societies. Formal recognition of freedom of expression and the individual autonomy associated with it originated nearly three centuries ago during the Enlightenment in Europe and has contributed to the world's civilizing process since then.

In 1909 the influential American sociologist Charles Horton Cooley outlined how he thought the "new media" of the time (books, magazines, and newspapers) would improve society.[13] He said print media would speed up human communication, allow wider access to information, and create a permanent record of our social history. But Cooley's greatest praise was for media's ability to help people "express" a broad range of ideas and feelings.

An Individual Right

Article 19 of the United Nations' Universal Declaration of Human Rights claims:

> Everyone has the right to freedom of opinion and expression; this right includes the freedom to hold opinions without interference and to seek, receive and impart information and ideas through any media and regardless of frontiers.[14]

The United Nations' Declaration of Human Rights affirms that expressive rights should be linked to the basic human rights of every individual. The document speaks of the right of "every*one*" to seek, receive, create, express, and receive ideas through channels ranging from basic movements and vocalizations of the human body in local contexts to manipulations of high technology in global communications. The United Nations has declared access to the Internet to be a human right.

Human expression is given direction by each individual's social and cultural circumstances. The United States' Constitution grants American citizens great latitude in all forms of expression, including the right to have meaningful access to ideas and opinions expressed by others. This basic principle is guaranteed by the constitution's First Amendment and has been upheld legally for many years. Similar assurances are promised in the political constitutions of most nation states around the world. Even the People's Republic of China includes freedom of expression in its constitution, although in practice individuals suffer from state censorship and have only limited access to the Internet. The rise of authoritarianism in many countries has brought with it a dramatic crackdown on free speech, including the jailing and assassination of many journalists and bloggers (**Chapter 10**).

Self-expression Values

The payoff for expressive freedom is tangible when executed. Nations that provide access to information and communications technology and support advanced education for girls and boys, women's rights, personal freedom and choice, tolerance, and inclusion rank highest in social and economic progress.[15] Individual people benefit too. They experience greater overall happiness and satisfaction when their societies transition from **survival values** centered on repression and control to **self-expression values** that promote tolerance, creativity, and personal freedom.[16]

Understanding Expression

Sexual reproduction motivates human and non-human animals to find increasingly clever and effective ways to communicate. It's worth the effort; the best communicators reap the benefits. Creative, expressive individuals of all sexual species attain a high degree of success finding mates and passing their genes on to future generations.[17]

Among members of our own species, contemporary writers, artists, journalists, broadcasters, film stars, and musicians appeal because they have proven to be excellent communicators of ideas and feelings—favorable qualities for sexual selection.[18] A vivid imagination, creativity, artistic talent, and stylish self-presentation depict expressive qualities that many individuals find attractive and desirable to pass on to their progeny. Celebrity status enhances the attraction.

Animal Expression and Beauty

Male Túngara frogs attempt to impress potential mates by singing well. If the female doesn't like what she hears, she quickly moves on or shoves him aside. Male mandrills, a species of old world

monkey that boasts a brightly colored blue-and-pink snout, circle behind an available female and produce a creative variety of soft sounds, hoping to win her elusive affection. Male hooded seals try to win mating privileges by inflating a large heart-shaped, rose-colored, balloon-like pouch directly from their nostrils and desperately flapping it around, hoping to win a nearby female.

An especially extravagant courtship display is performed by male bowerbirds in Australia and New Guinea. These artful suitors build large nests from sticks and decorate the entryway with flowers, berries, snail shells, bottle caps, plastic cutlery, and anything else they can find that they think might attract a mate.[19] Because females throughout the animal world prefer colorful and vigorous male candidates, bowerbirds don't limit their artistic endeavors to decorating their bowers, however impressive they may be. A well-choreographed one-male show is added to the mix. When a female makes herself available, the male bowerbird performs an elaborate dance. As he makes prolonged eye contact with the female, his pupils swell and shrink rhythmically. He bobs, flutters, and puffs out his chest. If the female seems interested, he crouches in front of her, rises slowly, and positions one wing in front of his body like a bullfighter's cape. To close the deal, he convulses his entire body in front of her. If this elaborate display succeeds, the birds copulate for two or three seconds and go their separate ways.[20]

Sexual selection explains why extravagant coloration and complex courtship behaviors like these have evolved. But selection processes alone do not fully account for the exceedingly beautiful appearance and behavior we observe in animals everywhere. Charles Darwin himself was amazed by a world full of gorgeous birds; magnificently colored butterflies; and many mammals, reptiles, and fish that display brilliant colors.[21] He marveled at the enchanting songs of birds. Darwin inferred from what he saw that the core elements of aesthetic taste must be universal because nature abounds with beautiful forms.

The mere existence of stunningly beautiful animal species at first represents the culmination of choices made in sexual selection. Over thousands and thousands of years, the more beautifully adorned males have been continuously preferred by females.[22] Originally, female choices must have been only coincidental with beauty. Later, their choices became centered more on aesthetic differences because the functional element had been already been fulfilled.[23] For instance, no advantage would accrue to a female bird for selecting a reproductive partner that happened to have a particularly pleasing symmetrical patch of bluish-green feathers on his wings. The random patch could only be interpreted as a sign of beauty. Her choice would be based on aesthetic quality, not pure utility.

As Darwin thought, animals are agents of their own evolution and appreciate beauty for its own sake. Birds and butterflies are beautiful to themselves.[24] Females choose males that display the most striking palates and patterns of color, size, and symmetry of the body. Some are impressed by special features like the top knot on a bird or the cheek pads of a male orangutan. When selected, those pleasing features are transmitted genetically to male offspring. The striking results of aesthetic selection also show up in cases where both males and females turn out to be beautiful—hummingbirds and angelfish, for example.

Other natural influences interact with aesthetic attributes to shape sexual selection and make the animal world beautiful. Ecological context plays a role. For instance, strongly polarized ultraviolet sunlight creates a reflection on the eye-catching fins of male Mexican swordtail fish that attracts females but is not visible to predators. The attraction is created by the way the male's body interacts with elements of nature that make him both beautiful and safe. Similarly, female guppies prefer males that happen to have orange patches because they look like the nutritious fruit of orange trees, a local food source. Nature shapes males into optimum physical attractiveness within the limits and opportunities that exist in their habitats.[25]

COMMUNICATION AT THE ZOO

Most zoos provide good basic information on the role of communication in the lives of animals. For instance, an exhibition at the St. Louis Zoo explains that the tropical South American Sunbittern bird intimidates predators with a frontal display that reveals markings on its wings that appear to be huge eyes. Sunbittern chicks practice this behavior instinctively at three weeks of age. Another placard informs visitors that India's Lion-tailed Macaques use facial expressions, body postures, and social grooming to communicate with each other. The Bronx Zoo in New York describes how giraffes position their necks to express fear, panic, anger, and submission. Bronx Zoo visitors also learn that African Wild Dogs lick each other and run around together in a frenzy to create a pre-hunting mood. Characteristic communication is featured on placards at zoos to help visitors understand how a particular species survives, reproduces, and expresses itself.

Besides the St. Louis and Bronx Zoos, other excellent zoos in the United States include San Diego, Omaha, Memphis, Denver, Columbia, S.C., Miami, Ft. Worth, Toledo, Cincinnati, Houston, Dallas, and the Brookfield Zoo in Chicago.

Encountering the New

We do lots of things that don't promise a direct evolutionary payoff. Sapiens' expressive potential is animated by our eagerness to innovate. We instinctually explore new things. Discovery is a big part of life. And we want to have fun.

Neophilia is a personality trait characterized by a strong attraction to new things and experiences. Individuals who enthusiastically seek novelty are ready to explore unfamiliar situations, take risks, and enjoy extravagance. They don't automatically follow norms, rules, or expectations.[26] Neophiliacs exhibit flexible and original thinking where creativity is dominant.[27] Of course, not everyone has the same drive for novelty and change. The genes we inherit and the cultures where we live influence our appetite for the new.

Searching for something new has led to the discovery of new lands, technologies, medicines, and many other important things. In that sense neophilia is crucial to survival, helping to propel individuals and groups forward. But the drive for novelty and change does not just line up neatly with the basic selection processes. Novelty and expression comingle.

Seeking novelty brings about surprises. From an evolutionary standpoint, surprise can be threatening—like running into danger or suddenly getting bad news. But surprise can also be intriguing and rewarding—like hearing the enchanting sounds our ancestors created when they first blew into an early musical instrument they created—a small flute crafted from the bones of birds. Because novelty and surprise can threaten, small doses of surprise, like the sounds emitted by the bone flutes, are most likely to elicit a positive response.[28]

Pursuing Beauty

The need to express ourselves for aesthetic reasons became inherent in human nature.[29] Because Sapiens developed multiple ways to communicate, we also acquired the desire and ability to create beauty in many forms.[30] The visual arts, music, dance, and fashion exist prominently in almost all human societies.[31] Artful expression brings so much beauty, joy, pleasure, and wonder in and of itself we should not think of it as an evolutionary adaptation or by-product.

FIGURE 4.1 Stone hand ax. Courtesy of Wlad74/iStock.com

Take the case of the hand ax, the first stone tool invented by our Habilis ancestors, perhaps drawing from earlier species in our line of descent. Hand axes were characteristically shaped into an elongated form that could be gripped and manipulated for cutting and chopping meat and plants (**Chapter 7**). Our ancestors designed the tools to be functional. But over long expanses of time, hand axes became more than useful tools. Differences in the quality of workmanship that went into making hand axes became evident. Some hand axes were more aesthetically pleasing than others.

The hand ax became an artistic medium that represented the personal qualities of the tool maker. Being able to select the right kind of stone and make the surfaces of the tool even and symmetrical (universally preferred dimensions of beauty) signaled fitness on the part of the craftsman. A beautifully crafted hand ax represented planning ability, fine motor control, creativity, and hard work. Males who could produce beautiful axes also became outstanding candidates for sexual selection.[32]

The instinct to shape hand axes into beautiful forms was compelling. The appeal of beautifully crafted tools remains evident today. Some people take pride in simply owning blade tools—knives, machetes, hatchets, and swords, for example—where an exquisite design and superb workmanship are valued for reasons that exceed their functionality. The aesthetic qualities of many other beautiful objects—Italian sports cars, Japanese ceramics, or the latest Apple iPhone, for instance—transcend their functional value too.

In the world of material goods that are made by humans as in nature, beauty is the rule, not the exception. Beauty is a communicated quality that can be inferred from perceptions "of the

beholder." Each element of a beautiful object serves as a sign of aesthetic excellence or is criticized for lacking excellence, when the object is perceived as a totality.

Communicating Excess

Our natural attraction to beautiful things and the extraordinary range of communication skills we possess have led to artistic excess in the production and consumption of all kinds of things.

Opulence, flamboyance, and other displays of immoderation are driven by the expression instinct. Think of the extraordinary displays that have been launched just in the realm of popular music in recent decades—from Little Richard, Jimi Hendrix, Elton John, Prince, Marilyn Manson, and David Bowie to Lady Gaga, Nicky Minaj, the samba-soaked spectacle of Brazilian Carnaval, bling-draped rappers, and any death metal band.

Communication Arts

Art, broadly defined, is "everything we don't have to do."[33] Yet art represents forms of human expression that manifest deep intrinsic value. Some communication behavior evolved for no reason other than it's just enjoyable.[34] Evolutionarily, that may in fact be something we *do* have to do.

People wouldn't seek new experiences or experiment with aesthetics if the behavior wasn't gratifying. Art for art's sake began early in our cultural history. Communicating just for fun became psychologically rewarding and motivating. Each technological advance has generated new ways to engage in creative play. The number and variety of art forms that Sapiens have created throughout history, the ways we enjoy them, and the high priority we give them in daily life reveal just how important it is to communicate for the fun of it.

Early Symbolic Expression

Making music, dancing, composing poetry, painting, tattooing, and piercing were common among human populations long before the mass media and culture industries made them popular. Members of early cultures disfigured, scarred, punctured, pierced, stretched, and painted their skin as a primary medium for bodily expression—and many individuals and groups still do.[35]

Apart from their own skin, the first surfaces painted by our ancestors were the walls of caves as far back as 100,000–75,000 years ago. Sticks of red ochre—iron oxide that is mixed with clay or sand to make bright shades of red, orange, or yellow—were used to mark the walls of a cave system in South Africa. These coloring sticks served as the first tools used to decorate surfaces external to the human body.

The South African caves also contained perforated, polished, and colored shells that were strung together to be used as ornamental beads for necklaces or bracelets.[36] Similar decorative shells have been discovered in Israel and Algeria.[37] The cave markings and jewelry indicate that early humans were not only making tools and speaking some form of simple language before leaving Africa, they were creating simple art.

Primitive art, jewelry, decorative clothing, and music kept pace with social and cultural changes as Sapiens migrated into new territories. Increased production of various symbolic forms took place concurrently and independently throughout the world. For instance, similar types of aboriginal art found in Australia and North America—completely unaffected by each other—both date from the same period. People everywhere were developing reflective awareness of themselves and their surroundings and expressing those feelings artistically.

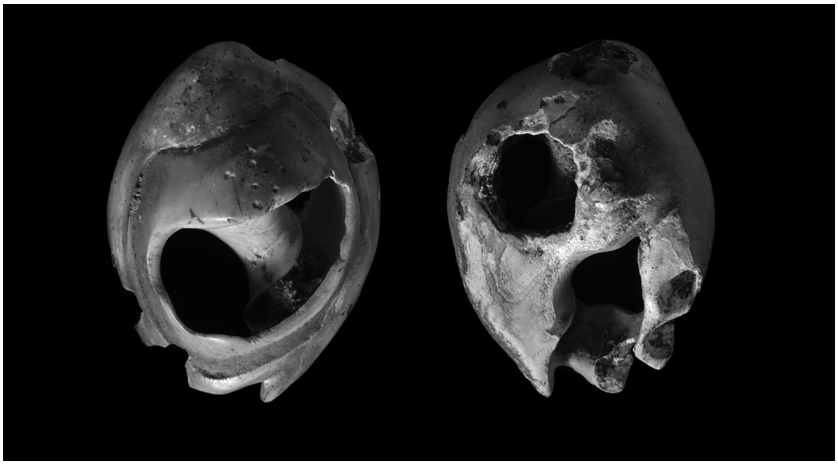

FIGURE 4.2 Shell bead ornaments. Courtesy of Ian R. Cartwright, Institute of Archaeology, Oxford University

Representational Art

The first attempts at external symbolic expression—the cave art in South Africa—did not portray identifiable objects. Painting or sculpture that is clearly recognizable for what it claims to be is representational art. The most impressive and well-preserved evidence of early representational art was made by our human ancestors who reached Europe 70,000–50,000 years ago. The artwork appears in caves in southwestern France, northern Spain, southwestern Germany, and northern Italy. The cave art includes images of horses, bison, and deer alongside more exotic creatures like mammoths, rhinoceros, and mountain goats. Some European caves also contain small figurines made of stone and bone, ivory sculptures, clay statuettes, jewelry, and primitive musical instruments. Beads and pendants made from shells, stone, amber, and mammoth ivory were fashioned by early populations into buttons, necklaces, bracelets, and decorative clothing.[38]

Early modern humans also used natural materials, like leaves, hollow sticks, and stones to make musical instruments. Evidence of more advanced music-making was uncovered along with the painting, jewelry, and sculpture in Europe dating to roughly 35,000 years ago.[39] Flutes were made by poking holes in animal and bird bones. More durable wind instruments were fashioned from bone and ivory.

Sexual Symbolism

An ivory statuette unearthed in Germany is one of the most important forms of early representational art.[40] A nude "Venus" sculpture was carved to dramatically emphasize her sexuality—huge, protruding breasts; big buttocks; and an extremely enlarged vulva. This sculpture represents the first symbolic objectification of the female body. Even the original mobile symbolic forms fashioned by humans—the perforated shell necklaces discovered in Africa—likely surfaced in response to the competitiveness of sexual selection. We get a strong confirming message from early art about the signifying power of sexual expression in human culture.

Commodifying Expression

Like shells turned into jewelry tens of thousands of years ago, nature's resources today can be transformed into material objects that appeal to our reproductive and expressive instincts. Common commercial products and the massive sphere of entertainment resources that surround us today make up what is commonly referred to as popular culture.

The adjective "popular" is often contrasted with "elite" forms of expression like fine art, classical music, or gourmet food. This distinction helps explain differences in cultural taste between and among social groups today. Popular culture typically refers to things like hit TV shows or movies, famous recording artists and their music, professional sports, even inexpensive lines of clothing or fast food. But the term "**popular culture**" also reflects the fact that artifacts and styles of human expression develop originally from the creativity of ordinary people. Thus popular culture comes from people; it is not just sold to them.

Modern industrial capitalism has greatly expanded the range of popular resources that are made available for sexual signaling and human expression generally.[41] From facial scarring, bodily disfiguration, and the feathered headdresses of indigenous tribes to steamy music videos, fashion statements, and social media, many symbolic forms reflect a dominant human drive: attracting and holding the attention of others.

Popular culture evolves on multiple levels. Individual popular culture items (like a TV show), genres (like rap music), and technologies (smartphones, for instance) all evolve in dynamic relation with each other. Then, spin-offs are made by copying successful television series, movies, websites, apps, music genres, fast-food restaurants, and countless other cultural forms. Spin-offs invariably retain something from the original. For example, American football is a spin-off from English football. Television reality shows originated as in-home documentary programs on public television. Burger King got the idea from McDonalds.

Spin-offs frequently travel across media platforms. A video game or comic book spins off into a blockbuster movie, for instance. Technologies spin off too. FM radio developed from AM, satellite TV from cable TV, which had spun off from over-the-air broadcasting (**Chapter 8**).

What happens in the evolution of popular culture closely parallels what drives change in the biological realm. Like organic mutations, some spin-offs catch on with the public, while others die off.

Emotion

Give people access to information and technology, and they will create, communicate, share, learn, and find new ways to enjoy their lives more. But it is the need to express ourselves—not the presence of the latest technology—that drives the process. Emotion lies at the heart of expression. Sapiens have long been inventing and using "technologies of mood" beginning with simple language, music, and primitive visual art.[42] The expressive capacity of the tools we use to create and communicate today extends long preexisting tendencies.

The culture industries and popular media, even the first daily newspapers, became successful when they were able to effectively connect symbolic imagery to human emotion. Love, hate, fear, hope, joy, sadness, disgust, and more—all the emotions play well on the media.

The writers, directors, producers, and financial backers of television, video, film, and social media and contributors to entertainment-based websites like YouTube all depend on the ability of their productions to excite the emotional potential of audiences. Intense emotional realism appeals across media platforms and genres. Horror films, disaster movies, reality shows, and soap operas, in particular, are written and edited to maintain high levels of emotional tension throughout the viewing

experience. Pornography became an especially popular pay television and online genre because it can bring viewer excitement to the point of ecstasy and orgasm.

Technological Enhancement

It makes sense at times in life to distinguish between what's "real" and what isn't. For instance, sometimes children have to be assured that a movie they are watching or a nightmare they just had is not real—it didn't actually happen.

But our brains don't distinguish between mediated and unmediated experience.[43] We feel the full range of emotions from mediated content, including what we see and hear on computers, because we process these experiences as real. The extraordinary technical quality of digital communication technology intensifies the realistic effect. For instance, organic LED television and DTS or Dolby surround sound produce stimuli that exceed the normal unmediated viewing and listening experience. But reading fiction can also provoke a profound emotional response, even when we are fully aware of its contrived nature.

Symbolic Creativity

Habilis and Erectus did not possess our level of intelligence or innovative ability. They made only simple tools. They may have created ways to communicate through gesture and vocalization, but they had no symbolic culture.

Among our most recent hominin relatives, the Neanderthals had comparatively big brains and basic social abilities. They had the same kind of hyoid bone in the voice box we have that makes speech possible and probably communicated with simple vocalizations. They created primitive visual art. But Neanderthals never developed the ability to express themselves more fully.

Neanderthals' limited communication skills likely contributed greatly to their demise at the same time that ancestral Sapiens, who lived close to and intermixed to some degree with Neanderthal populations in Europe, continued to evolve. Ultimately, greater expressive ability gave Sapiens an evolutionary advantage. *Being able to use symbolic resources creatively allows us to improvise—a mindset and behavior that continues to be crucial to our physical, psychological, social, and cultural well-being.*

The power of human expression explodes from the creative ways we use the communication resources available to us. Our flexible mode of thinking allows us to be creative communicators.[44] **Symbolic creativity** refers to the capacity to inventively represent, transform, combine, and generate meaningful forms of communication by manipulating signs.

To understand how symbolic creativity manifests itself in social interaction, we turn to the field of semiotics to explain key terms. After that, the persuasive force of symbolic creativity will be described as expressions of symbolic power.

Semiotics

The semiotic approach to communication begins with a biological way of thinking.[45] We cannot understand human communication without knowing how other animals, even simple organisms like bacteria cells, communicate.

Semiotics focuses on the meanings that are produced by encoding and decoding signs—the way messages are produced and interpreted. A special vocabulary has been created to describe how this happens. You've already come across some of these terms in this book. You probably use some of the terms in your day-to-day conversations. But we need to develop a precise understanding

of what each term means and how the ideas they represent made it possible for complex human communication to evolve.

Sign

Signs function as the essential units of communication. A **sign** stands for, refers to, or represents something other than itself in a particular context. Anything can function as a sign so long as one condition is fulfilled: If *X* stands for *Y*, then *X* is a sign of *Y*.

For instance, a glob of black tar that washes up on an ocean beach is a sign. Someone walking along the beach notices the tar and interprets its meaning. Tar on a beach? How did it get here? The beachgoer looks up and identifies a giant offshore oil platform as the likely source.

No message was intentionally sent, and no receiver was designated. Yet something was definitely communicated. The person who noticed the tar gave it meaning by drawing an inference from available clues. In semiotics, the individual (human or other organism) that infers meaning from a sign is the **interpretant**. The tar was the **signifier**. Pollution and its source were **signified**. Drawing inferences from signs like this represents the process of **signification**. *Signs come alive in the context of their use.* The glob of tar became meaningful when it was noticed and interpreted.

Signs don't have to be visual, and they are often intentionally produced with a clear destination in mind. For example, when a dog barks at the front door, it's giving a sign to its owner it wants to go outside. We use the term "sign" often in everyday life as we look for signs of interest, signs of progress, or signs of illness and disease. After a local business shows signs of economic distress over time, the owner may hang a physical sign on the front door to announce they are going out of business.

Some kinds of signs are accessible to all animals—the mere presence of a predator, for example. Other signs occur only in the cultural worlds of humans—putting two hands together, resting the head on the hands, and closing the eyes to signal "sleep" or "sleepy," for instance. We draw an **inference**—a logical conclusion—when we interpret what we think a sign means.

We inevitably encounter multiple kinds of signs, of which there are three main types. Consider these different kinds of signs: (1) A predatory animal crouches in the position of imminent attack; (2) the sky darkens and the air becomes still; and (3) a checkered flag is waved as a race car crosses the finish line.

The first example reflects a *natural relationship* between the sign and the event it represents. The crouch forms the first part of a potential attack. Some action must be taken in response. The second example represents a *cause-and-effect* relationship. Rain is likely on the way. Humans and other animals take cover.

The third example, the checkered flag, signifies "end of race" but only to those who know the **code**—the way a system of signs transmits meaning to a community. Different colored flags (mainly green, yellow, red, white, black, and checkered) are used in automobile racing. Some of the flag colors are embedded in similar systems of meaning. Green, yellow, and red indicate the same thing for driving that takes place off the racetrack—go, caution, and stop. In racing, a white, black, or checkered flag represents a situation that is specific to the sport. Interpreting these signs correctly requires understanding the rules of automobile racing. Rules make up a *conventional code* that regulates a system of signs.

The flag code used in automobile racing is based in part on meanings that inhere in another code—semaphores that control traffic on city streets. That code also emerged from previous codes. The flow of trains on tracks was regulated before automobiles hit the road. Red was adopted for trains to signal "stop" because it has the longest wavelength of the primary colors, making it visible at long distance. Red blood also has a long natural history that signals "danger," a natural

relationship code. White was originally chosen for train traffic to mean "go," but a white semaphore could too easily be confused with stars at night and caused accidents. Green was finally chosen to mean "go" because it is easily visible and contrasts with red on the color spectrum. Yellow was selected to warn "caution" because it projects a particular visual quality that is also easy to see during the day. For the same reason, school buses and signs near schools are painted yellow.

Communication is made up of interconnected signs created from the natural world. The flag racing code was derived from the logic of street semaphores, which was based on the railroad semaphore system. But infused into all levels of these sign systems is an inborn dialogue between culture and nature—the color red naturally indicating danger, the rejection of white because it can too easily be confused with starlight, and the naturally bright and reflective properties of the color yellow.

Signs are resources. Communication potential lives in each sign. A sign bursts with meaning when it is interpreted and "begs" for more opportunities to signify, especially when it can be combined into complex codes. Like biological organisms, signs and sign systems evolve over time.

Symbol

A symbol, like all signs, stands for something other than itself. But symbols are a special kind of sign that becomes meaningful by agreement. Refreshing our example, racing flags are symbols. They make sense because they are imbued with imposed meanings that are widely recognized by users of the racing flag code.

Symbols are aggressively social. The potency of symbols is unleashed by the power of the expressive instinct we share with other animals. But Sapiens' unmatched ability to create and play with complex sign systems explains why we can rightly be regarded as the symbolic species.[46]

Because all types of signs project meanings that can be inferred, they all function to symbolize something. For that reason, we will use the terms "sign" and "symbol" interchangeably throughout this book to mean "stands for" or "represents."

Symbolic Form

Signs exist in physical form. For example, the meaning of a racing flag can be accurately interpreted by users of the racing flag code first of all by recognizing the contours of the symbolic form—the familiar shape of a flag. Users simultaneously interpret any flag's colors and the pattern in which they are displayed. Arranged in a different pattern, the same colors would suggest other meanings.

The context in which a flag is deployed also provides clues about its meaning. Still, the meaning of a symbolic form can never be completely self-evident or uniformly understood. Every sign is subject to interpretation. For example, a national flag could represent "home" to some people and "enemy" to others.

A **symbolic form** thus refers to (1) the physical medium through which specific symbolism is displayed, and (2) the various possible meanings that inhere in the content of form. *The form and the content of symbolic displays cannot be separated.*

Symbols often intrinsically suggest **intended interpretations**—what the source wants the symbol to mean. For instance, national flags symbolize the values and traditions of nations. To burn a flag is to burn down those values and traditions.

Symbolic forms are multisensorial. They can be visual, like a cave painting, print media advertisement, photograph, film, or television program. In the audio realm, a national anthem, police siren, or popular song function as symbolic forms. Digital technologies reproduce previous forms and have created a world of their own forms—selfies and social media posts, for instance.

Signal

Sometimes confused with signs or symbols, a **signal** is a physical action or event that communicates a message. The signal does *not* refer to the content or meaning of a message. In communication theory, signal functions as a verb. For example, the third base coach in baseball signals the batter what to do by making a series of physical gestures. Each individual gesture is a sign. The series of gestures are interpreted according to a code that is known only to that team.

Code

Signs can stand on their own or form part of a code. Using a code presumes prior knowledge. The code encompasses everything the source and the receiver know beforehand about the content of the message. That knowledge unlocks the meaning of the message. This quality of code applies to all animals, not just humans.[47]

Two basic types of codes exist. The signs that make up an **analogical code** bear actual resemblance to the idea being communicated—a continuity among representations, facts, or events. The phrase "your hands are cold as ice" connects a present condition to a known state. A **digital code** represents just the opposite. Instead of resemblance and continuity from one sign to another, a digital code functions as a discontinuous and binary opposition between representations, facts, or things. Digital codes are arbitrary and discrete—they bear no relation or similarity between the sign and what they refer to. Specialists who work with digital codes—software engineers, for example—must learn the code with which they work. But what they produce—Internet content, for instance—becomes accessible to anyone with access and functional literacy with a computer or smartphone.

Symbolic Power

Symbolic forms are extremely pliant. They can be created, combined, and manipulated to serve the purposes of a wide range of individuals and institutions. **Symbolic power** refers to the use of symbolic forms to influence the course of social action and events.[48] Compared to hard power exerted by physical force or economic influence, symbolic power represents influence exercised in the domains of ideology, language, art, and culture—sometimes called soft power.

Hard power and soft power are not mutually excluding. Possessing substantial economic resources allows major institutions to mount influential campaigns fueled by symbolic power. Repeating symbolism establishes and reinforces ways of thinking. For instance, highly recognizable logos, rituals, styles of architecture, and customary forms of dress have been used by religious organizations to spread their beliefs since their inception (**Chapter 11**). Corporate power is built on the persuasive impact of symbols. Advertising and public relations companies orchestrate image-driven campaigns to win customers for their clients. Political parties and candidates campaign in symbolic form. Governments drill their subjects with visual propaganda. The travel industry stimulates island fantasies. The ability to exercise symbolic power is not limited to institutions that already have influence, although they maintain a tremendous advantage.

Grassroots organizations, volunteer groups, schools, small businesses, splinter political parties and candidates, and alternative social movements can also draw attention with the right symbolic forms. For example, the now widely recognized rainbow flag that represents individuals and groups who identify with LGBTQ+ was created by an aspiring artist living in San Francisco in the 1970s.[49] The first few copies of the flag were hand sewn and displayed by the artist

himself. The distinctive design of the rainbow flag caught on as people began to think of it as emblematic of their gender identity. *The symbolic power of the flag derives from social action that was set in motion by its presence.*

The rainbow flag became culturally familiar around the time that the most powerful communications medium of the era—commercial television—started to include entertainment programming with gay characters in sympathetic central roles. Favorable representation of gays on mainstream media eventually led to accelerated political action and widespread acceptance of the legal rights of homosexuals in modern Western nations. The flag and the television programs interacted in the public mind to increase the power of each.

Appropriation

Before the rainbow flag was created, another symbolic form was used to represent gay culture. This was the symbol used early last century by the Nazis to identify and persecute gays in Europe—a pink triangle. By claiming the pink triangle for themselves decades later, gay activists performed an act of **cultural appropriation**—making use of something for your own purposes by changing or adding to its meaning, sometimes in direct contradiction to the meaning that was originally intended.

Music is a symbolic form that easily lends itself to radical reinterpretation. Changing the lyrics of a famous song to fit a situation is a common example of how music can be appropriated. Music technology can also be radically repurposed. For example, the distinctive fuzz tone produced by an electric guitar—a common feature of rock music—was originally made by manipulating the instrument to create a sound not intended by the guitar maker—distortion. Distortion now has been mainstreamed, and various fuzz pedal accessories are manufactured to allow guitar players to create multiple effects.

Digital communications technology greatly expanded opportunities to appropriate symbols and equipment for alternative purposes. When some computer users believed they could not adequately express their feelings on digital media with words alone, they took advantage of a readily available resource. They created the original emoticons by creatively misusing characters on the standard computer keyboard. Mixing various punctuation marks together produced the original smiley face and dozens of other simple emoticons. Those unique symbols soon evolved into an abundant world of emojis. An entire subset of computer language rose from the bottom-up to become mainstreamed at the global level.

Hybridization and Indigenization

The inherent plasticity of symbolic forms allows people to innovate in ways that suit their purposes. Symbolic forms are routinely creatively synthesized, altered, re-contextualized, divided, and added to other forms. **Hybridization** refers to mixing symbolic forms to create something new.

We do it all the time. For instance, a hybrid visual image can be created by using editing software to superimpose one digital photo over another. Food is imminently adaptable. A Korean chicken burrito, pad Thai taco, or sushi pizza mixes traditional recipes with multiple foreign influences to create Asian fusion hybrids. Hybridization is fundamental to the evolution of popular music. Rhythm and blues, rock and roll, country-western, trip-hop, and symphonic metal, for instance, turned hybrid experimentation into well-known genres.

Religion also represents a particularly rich symbolic environment that is ripe for creative intervention. For instance, some Asian-Americans have adapted Christianity's iconography to suit them

ethnically. Catholic Vietnamese immigrants in California creatively repackaged the emotionally evocative image of Mary—an iconic figure in Catholicism. Typically represented as a European-looking woman in North America, the immigrants have given her facial features on statuary and paintings that reflect an Asian appearance. Of course, Mary was originally a Middle Eastern Jewess, who didn't resemble a European or North American either. The symbolic creativity exercised by Asian immigrants in the United States began with a form that had already been creatively hybridized.

Similarly, Jesus Christ often appears as a light-skinned Caucasian in places where light-skinned Caucasians live. The black saints of northeastern Brazil have been created to look like the descendants of African slaves who live there. **Indigenization** refers to a process where cultural materials—not just religious iconography but any symbolic form, like music, or any material form, such as food—are adapted to fit local culture.[50]

HYBRID HERO

The power of symbolic forms often develops on the heels of sentimental mythologies and legends. For example, the biographical story of Jesus Christ was turned into a narrative that forms the basis of the religion that claims the largest numbers of followers worldwide. Part of Christianity's widespread appeal rests on the personality of Christ himself as portrayed by his biographers in the Bible and elsewhere. Jesus Christ was recognized as a true champion of the poor and downtrodden.

Christopher Columbus set foot on the soil of what would become Venezuela on his third voyage to the New World in 1498. The lush countryside and presence of loosely organized and peaceful indigenous tribes led Columbus to believe he had discovered the mythical Garden of Eden. Throughout Latin America, a lasting effect of the Spanish conquest of Venezuela is the dominant presence of the Roman Catholic Church.

The full complement of Catholic symbolism and ownership of landed property has helped keep the image of Jesus Christ alive in Venezuela. But at the turn of the twentieth century, a new heroic figure emerged from the verdant Andean countryside.

FIGURE 4.3 Doctor José Gregorio Hernandez. Courtesy of the author

Born in a village far away from the major cities, José Gregorio Hernandez graduated from medical school in Caracas and continued to research his specialty, bacteriology, in Europe. But instead of capitalizing on his qualifications and growing fame, Dr. Hernandez returned to Venezuela to roam the rural areas, on horseback or on foot, to attend to the needs of the poor. He introduced modern forms of medical treatment and prescription drugs into the villages.

Hernandez charged nothing for the services he provided to the poor and paid for their medicines out of his own pocket.

Doctor José Gregorio Hernandez was struck by a car and killed walking to a pharmacy to buy drugs for his impoverished patients. Since the time of his death until today, many people in Venezuela and nearby Colombia pray for Dr. Hernandez to heal them from serious physical ailments. He has been recognized posthumously for many miraculous recoveries. Some people claim to see him in near-death experiences. Others swear he appears on X-rays.

To honor the legendary doctor, some people put a ceramic or plastic figure of him attached to the Christian cross, as shown in the photograph. Combining the traditional significance of the cross with the cultural power of a heroic local figure multiplies the imagined spiritual impact of both. This special kind of hybrid form represents **syncretism**—the combining of different symbols of belief to create a new symbolic form usually associated with religion.

The Vatican opposes this kind of hybridity because it threatens institutional control over the symbolic meaning of the cross. But making hybrid forms provides a way for people to show their feelings and work out their differences. In this example, hope that is provided by religious faith fuses with the healing power of medical science to create an inspirational hybrid.

Figurine statues of Dr. José Gregorio Hernandez can be purchased online from amazon.com. They often appear in homes and on the dashboards of cars, taxis, and buses throughout Venezuela and the rest of Latin America.

Social Uses

Symbolic forms are created and circulated to serve the interests of their originators. How they are interpreted by individuals, however, is less decided. Some people conform to the interpretation that is intended by the source (like, "buy this product"), some resist the intended interpretation, while others become confused, conflicted, or show no interest.

In any case, the influence of communication never ends with the first exposure. We talk with others about what we saw on television yesterday, share posts and photos on social media, and sing songs together that we learned independently. Some exposure to symbolic forms is shared in real time (like watching a sporting event in a group); other times it is delayed (like viewing and commenting online to an existing YouTube video), often long after it was originally received.

Symbolic forms can never be used up and never go away completely. With their constant forward motion and broad diffusion, symbolic forms generate an endless chain of communication.[51] Their dynamic and undetermined nature makes symbolic forms open to many possible interpretations and uses. Those interpretations and uses reflect the biases and needs their users bring to the experience. For example, consider the many ways people of differing religious, gender, ethnic, national, and political positions might interpret the presence of a woman wearing some version of the *hijab*—the veil worn by Islamic women when in the presence of males outside the immediate family. Where the interpretation takes place—the context of expression and interpretation—greatly influences the feeling that is taken away.

Stories

Facebook incessantly pleads with members of its online community to "Add to Your Story," thereby increasing revenue-producing traffic on the social media site. Facebook is appealing to the primordial attraction we have to stories. It starts early in life. Infants beg their parents to tell them a story at bedtime. During free time at home and school, children make up stories and creatively act out stories they get from media. We remain attracted to and influenced by stories for the rest of our lives.

Compelling language and the dramatic nature of stories stoke the imagination and turn narratives into powerful agents of cultural socialization. Cultural traditions are composed of stories. Romanticized, often fictionalized, narratives shape our views about the nations, religions, and other imagined communities to which we belong. In legal proceedings, the best story wins the case. News accounts are constructed, packaged, and promoted as stories.

But as Facebook's marketing strategy shows, we do more than just consume stories. We also like to create, share, and discuss stories. Every individual has a story to tell. By mentally constructing the ongoing story of our lives, we can re-imagine and interpret past events in a favorable light. That revisionist narrative can make us look good to others. But it also helps us maintain our own psychological well-being.

Sapiens are storytelling animals.[52]

Patterns

The brain looks for patterns in order to make sense of what's going on around us. That's how it protects the organism from danger and advances its interests.[53] The information that is communicated in stories reveals patterns in our lived environments. Identifying those patterns helps us organize and understand the experiences we have. The constant search for patterns naturally turns into a hunger for more and more stories. Especially when something dramatic unfolds, people ask, sometimes desperately, "What happened?" They want to know the story.

Stories evolved to occupy an important place in all cultures because they proved to be functional in practical terms. For example, by passing information along through simple stories, our ancestors could teach each other how to do things, build a sense of community based on tradition, and give detail and richness to the lives they share. Stories also became a captivating way to spread gossip, which allowed cultural communities to identify and ostracize uncooperative individuals.

Creation myths, afterlife fantasies, and countless other cultural legends were communicated as stories (**Chapter 11**). The specific content of any type of prehistoric oral communication cannot be determined. But research shows that some oral stories derived from interpretations of cave and rock art images that were created as long as 100,000 years ago. The content of those stories remained largely intact as our ancestors migrated around the world—from Eurasia to North America, for instance, or from north to south inside Africa.[54]

Some cultural myths were triumphant tales of survival, where a man pursues or kills one or more animals. The night sky was then used as a resource to illustrate the cultural mythology. Storytellers turned the slain creatures into constellations, affirming the validity of the narrative.[55]

Stories share structural similarities across cultures. Good stories commonly revolve around conflict and struggles to triumph over difficult situations. The more impossible the problem, the more engaging the story becomes. How the protagonist solves the problem becomes the dynamic element of the story and typically ends with some kind of resolution that inspires introspection—the "moral of the story."

Adaptable Stories

From the oral tradition, through print, electronic, and now digital media, each advance in communications technology spawns new ways to create and experience stories. The expanded amount of leisure time available now and the nature of today's personal communications technology make it easier than ever before to tell and consume stories.

We still use some stories for the reasons our ancestors created them. But because stories provoke the imagination, connect to our emotions, and help stimulate fantasies, we also turn to communications media ranging from books to social media to simply find stories for entertainment value. Still, our primal instincts never completely leave the stage. Enjoying stories always does more than combat boredom. Even engaging with fiction is a way to learn things and practice life skills through vicarious experience.

Stories fall into **genres**—categories that differentiate narratives by their content, such as romance, action, comedy, science fiction, and nonfiction. Many genres have universal masculine or feminine appeal that reflects association with gendered social roles.[56] Story preferences held by adults conform largely to the different kinds of stories boys and girls make up as children during playtime.[57]

Most television programs, films, and song lyrics take the form of a story. Even unscripted sporting events become stories. The sporting event first unfolds spontaneously before audiences. Later, the "recap" tells the story of what happened at the event. Side stories develop around teams and players. Radio sports talk hosts then embellish the events and side stories with their own commentaries. The hosts invite listeners to comment on the narrative, adding another layer of narrative creativity to the developing content.

Stories in Speech

Effective speakers know that stories can be highly persuasive.[58] Facts alone generally don't convince skeptical listeners. What often matters to many people is not evidence or logic but a compelling story, even just a clever anecdote if it confirms their biases.[59] Telling a story also allows a person to connect with their audience and helps them remember what's being said, especially when the information being presented is highly detailed.

Storytellers

As Sapiens spread throughout the world, some tribal members emerged as exceptional oral communicators. The anointed storytellers probably were men.

The early storytellers displayed great imagination and ability with language (**Chapter 11**). They stirred emotions and mesmerized listeners by spiriting them away from the here and now, just as capable storytellers do today. Tribal storytellers were the first communicators who could entice their listeners to **suspend disbelief**—to treat an implausible narrative as if it were real.

The ability to captivate and charm audiences also made ancient storytellers prime candidates for sexual selection, the same way many contemporary professional communicators—actors, musicians, politicians, and preachers, for instance—gain passionate adoration today. The implication is clear: Communication skill itself seduces, even when the apparent intent is pure expression.

Chapter Summary

Evolution proceeds as a chaotic mixture of behavioral responses to various pressures and opportunities. From the gestures, grunts, and groans uttered by our hominid ancestors through spoken

languages, music, cave art, jewelry, and writing all the way to the obsession we have today with digital media, humans communicate in order to survive and reproduce.

But what motivates us to communicate is not limited to the two basic evolutionary priorities. Our repertoire of evolved communication skills has given us extraordinary ways to meet the full range of our emotional needs too. Sometimes we express ourselves just for the fun of it. All higher-order animals do it.

Freedom of expression is crucial to physical health and mental stability and is considered to be a legal right in most parts of the world. Those countries that support the right of citizens to express themselves freely benefit in material and psychological ways at the social and individual levels.

Expression leads to beautiful outcomes. Animals appreciate beauty for its own sake. Like us, higher-order animals also have a sense of aesthetics. Beauty is produced in part as the result of the choices we make as we seek new experiences and create art.

The instinct to express ourselves led to creation of the first symbolic forms external to the body—cave paintings and shell jewelry. Representational art and musical instruments followed. Sapiens' enormous talent for symbolic expression eventually led to the creation of global popular culture.

Sapiens' special ability to invent and use symbolic resources creatively makes us the symbolic species. A special vocabulary helps us identify and analyze the elements of communication. Signs are the fundamental units. Symbols are a special kind of sign that requires knowledge of a shared code to use and interpret effectively. A symbolic form is made up of the physical medium and the meaning it contains.

Symbolic forms are routinely manipulated in ways to exercise power and influence social action and events. They can complement and reinforce hard power resources, like economic power, or be used in alternative ways, sometimes against hard power influence. Because symbolic forms are pliable, they can be appropriated for uses that were not intended by their originators.

Like the motivating influence behind all forms of communication, our love of stories is rooted in the essential struggle to survive and reproduce. Stories reveal patterns in our social worlds and proved to be functional in practical ways to our ancestors. Storytellers naturally became valued members of our ancestral tribes, and their valued roles are carried out in culture today in multiple ways.

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PART THREE

How We Communicate

5

SPOKEN LANGUAGE

No one has to encourage us to speak. We do it instinctively.[1] The powerful motivation to communicate with our **conspecifics**—other members of our species—originates in the distant stages of our evolutionary past. Our early ancestors first signaled each other with simple gestures to survive (**Chapter 2**). But how did we ultimately develop our greatest and most distinctive skill—high-level language ability?

Complex biological systems arise when random mutations are acted on by natural selection. Favorable variations persist. Language evolved much the same way. Random genetic mutations fortuitously created the physiological and behavioral possibility for our African ancestors to utter sounds through their evolving vocal tracts.[2] **Speech** refers to vocalizations made with the purpose to communicate. Those basic sounds were refined and expanded into structured systems of communication that are based on words—spoken and written **languages**. Over hundreds of thousands of years, the ability to use language became hardwired into the human genome.[3]

From the beginning, it must have been clear to our ancestors that whatever work was required to improve communication ability was worth the cost. That idea has proven to be true; complex language ability has led to all the advances our species has made. The impressive technologies we have created make it clear that the search for new and better ways to move information around and connect with other people continues to be a powerful motivating force.

The first rudimentary forms of language emerged in tandem with other basic social behaviors in Africa before our Sapiens ancestors left the continent—at least 200,000 years ago.[4] Since then, every cultural group on earth has developed a spoken language. Even most speaking- and hearing-impaired individuals can exchange messages by means of sign language, the gestural substitute for speech. The innate drive to communicate reflects a bedrock principle of human evolution: Complex communication ability benefits individuals and the communities in which they live. Because we can exchange ideas, clarify, negotiate, and compromise through language, enormous human populations are able to live relatively peacefully in very close proximity to one another.

Although the ability to speak is universal, the languages we learn to speak differ considerably. Our globetrotting forebears spread out in vastly different directions. They refined their nascent language ability in ways that responded productively to challenges they faced in the various geographical and cultural contexts the groups inhabited. Language made it possible for Sapiens to adapt over time to changing conditions and prosper.

In this chapter, we first discuss animal communication and how it differs from human language ability. We then focus on the main stages of language evolution—pre-language, protolanguage, and developed language. Next, we outline the main theories of how language is acquired and developed. Finally, we explain the crucial role of conversation in human communication and show how gossip and argumentation emerged as social behaviors that require language ability.

Animal Communication

Like humans, animals think and feel. They have intentions, preferences, and moods. Their communication patterns reflect their various emotional states.[5]

The biological, emotional, and behavioral affinity humans have with animals led Charles Darwin to speculate that our earliest ancestors may have incorporated "natural sounds," including the "voices" of animals (hisses, barks, whistles, screams, bellows, chirps, and hundreds of other sounds and physical expressions), into their emerging communications behavior.[6]

Darwin reasoned that our ancestors probably mimicked the sounds and movements of animals and added their own "instinctive cries" and "physical signs and gestures" to create the first pre-languages. This is a reasonable conclusion to draw for at least four reasons. First, animals and humans instinctually vocalize to increase their chances to survive and reproduce. Second, the calls of primates and the emotional vocalizations of human pre-language are both controlled by the same parts of the various species' brains.[7] Third, like us, primates and many other animals have the right physical apparatus—vocal chords, throats, and mouths that evolved to produce a differentiated range of sounds with sufficient volume. And fourth, we still imitate animals in our communications behavior.

Indeed, mimicking animal sounds may have helped shape some of the first utterances made by our ancestors. They could have imitated the sounds of nature (animal calls, but also conditions like rain or wind) to refer to those things. Some linguists believe language emerged when our ancestors merged two main types of animal communication they imitated: the *expressive* (emotion-based) element of language from melodic sounds, such as birdsong, and the *lexical* (content-oriented) dimension of language from animal communication, like alarm calls sounded by monkeys.[8] Even today we imitate animal sounds and movements to express various emotions, and sometimes we do it just for fun—even between species. We might bark back at dogs and meow at cats, for example. We whistle bird calls.

Despite all the similarities, researchers have not been able to conclude with certainty that our progenitors' first attempts to make language were spurred primarily by imitating animals. But what about animals themselves? How do animals communicate?

For any organism to communicate, two basic things have to occur. First, the intended receiver of the communicated signal—friend or foe—must be able to see, hear, or otherwise be able to physically pick up the message and correctly decode the meaning. Second, the received message must provoke behavior that is adaptive for one or both of the participants.[9] Some tangible benefit must result: For instance, the shriek of a terrified animal scares off a predator, the melodious call of a songbird leads to a successful mating, and the roar of an alpha male silverback gorilla intimidates potential rivals.

By these criteria, animals communicate. The primary channel used by the vast majority of animal species, however, is not visual, vocal, or tactile but the chemical-material foundation of scent—the sense of smell. Chemical pheromones that give off a particular odor are not cast randomly into an environment; they are shot intentionally by their glands into a targeted space for a specific purpose.[10] Think skunks, for instance. Or, in order for a queen bee to maintain her rule over the hive, she must produce a sufficient amount of pungent pheromones that triggers a behavioral response

so that bees entering hives in which no relatives live are killed.[11] But pheromones also can be used to attract, not just repel. Sexual reproduction is the usual motive. For example, the urine of adult male orangutans emits a musky scent that marks their territory as off-limits to other males, while it attracts sexually receptive females.

Many mammals make fine discriminations by smelling, like mothers distinguishing the odor of their infants from others.[12] Smell dominates as a communications channel among lower level species too. For example, the scent of various butterfly species identifies family members while attracting mates and avoiding predators. Ants' long and sensitive paired antennae are used to smell food and kin. Several species of fish live in nests composed of mixed paternity, where kin are sorted out and protected by scent.[13]

Vocal Channels

Vocal channels are of special interest to us because we use spoken language for much of our own communication. Many animals make sounds with a distinct purpose—to defend territory and resources, call and charm potential reproductive partners, intimidate competitors, warn of predators, navigate through water, signal biological needs like hunger, express joy and other feelings, and strengthen social ties, among other reasons.

Many lower- and higher-order species produce distinctive and meaningful sounds. For example, gorillas use many different vocalizations to represent various moods. Dolphins announce themselves with sharp signature whistles. The roar of lions can be heard miles away. Underwater "songs" of some whales are recognizable for up to 100 miles. Elephants' deep vocal rumblings travel for miles with the purpose to maintain constant family contact, defend friends, and coordinate movements of the group.[14]

When North American prairie dogs detect hawks, coyotes, humans, or other threats in their environments, they make highly differentiated alarm calls that are specific to the threat in order to warn their cohorts.[15] African vervet monkeys interpret various alarm calls and take appropriate evasive action (getting high into trees to get away from leopards, looking skyward to avoid being picked up by an eagle, and looking down to find a dangerous snake slithering nearby).[16] Saki monkeys in the jungles of Peru shriek loudly to warn their compatriots when a wildcat appears nearby but also to deter the cats from pursuing the hunt.[17] This means the monkeys understand they have two separate "audiences" for their vocalizing—their own kind whom they warn, and the cat whom they attempt to discourage from continuing the hunt by announcing the monkeys are aware of its presence.

Many mammals and birds recognize alarm calls made by other species and react in ways to avoid danger. For example, when predator birds, like hawks or eagles, fly over an open space, songbirds chirp loudly in a distinctive way that sweeps contagiously through the area. Other species of bird, squirrels, and other wildlife hear the alerts and dive into bushes.[18] Humans also respond to sounds made by other species. A dog's bark, horse's whinny, or rooster's alarm call signals an intruder may be near. Geese squawking overhead tells sportsmen the annual migration is underway. A cat lets you know when it's hungry.

Groups of some higher-order animals emit sounds with particular dialects or accents, indicating cultural differences. When moved to a new location, captive chimpanzees modify the grunts they make to match the sounds uttered by local chimps in the new setting—an adaptation that is akin to adopting a local accent.[19] Killer whales and sperm whales emit purposeful sounds that have dialects peculiar to their own social groups and don't communicate with individuals outside their clans.[20] Many bird species have regional dialects. Young songbirds taken away from a natural parent adopt the song of the foster parent and pick up local songs from the time they are in the egg.[21]

All these cases reveal how in some respects culture can override genetics in some aspects of animal communication.

Some seals, bats, and parrots imitate a wide range of sounds, including human language. In captivity, dolphins mimic computer-generated whistles and label objects likes hoops and balls. Killer whales, beluga whales, harbor seals, and elephants have been taught to say "hello" and "bye-bye."[22] But none of these animals understands the meaning of what they are saying. Teaching animals to communicate using Sapiens' language has been most successful with apes, who have complex communication systems of their own.

Apes

Because the great apes are our closest biological relatives, we should expect that they engage in some communication behavior that resembles our own. Indeed, they do. In the following sections we will briefly describe the communication channels and abilities of the great apes in ascending order of their genetic relation to us—orangutans, gorillas, and chimpanzees.

Orangutans

Dominant male orangutans make long, rumbling mating calls that travel great distances through the trees of Southeast Asian island rainforests. They purposefully bellow in a particular direction to signal females to move in that direction for a sexual encounter. Males make different calls, lasting as long as four minutes, to establish home territory, repel competitors, and coordinate seasonal movements for food resources.

In the wild, orangutans make a loud "kiss squeak" sound by smacking their lips together in order to discourage approaching predators or to signal discomfort when annoyed. Some of them cup their hand around their mouth to amplify the sound, making individual sounds bigger than they actually are. Other than humans, the orangutan is the only species that is known to modify vocalizations this way. Not all orangutans do this, so using the hand to affect sound is culturally learned.[23]

One female orangutan that was born in the wild but studied in captivity learned how to click her tongue, whistle, and utter vowel-like sounds when she calls human attendants to give her food. The sounds she makes may resemble some of the first kinds of vocalizations made by our hominin ancestors.[24]

Typical of all apes, orangutans also use visual channels to communicate. They encode messages by positioning and moving their bodies in distinct ways and by using facial expressions to signal playfulness, threats, warnings, or calming. Captive orangutans use a variety of hand gestures to communicate with their handlers much like the game of charades humans play.[25] They modify or repeat the gestures depending on whether or not the person with whom they are attempting to communicate responds appropriately. These orangutans also interpret the response they get and indicate to their human interlocutors how well they are doing in understanding the message that was sent. One captive orangutan, Chantek, was taught 150 words in American Sign Language and understood some spoken English. He was taught to clean his living space, use a toilet, make simple tools, and direct a driving route by car to a Dairy Queen near his home, a tasty reward for performing his linguistic and domestic duties well.[26]

Gorillas

Perhaps the most famous communicating ape was Koko, a female western lowland gorilla born in the San Francisco Zoo, who also learned to use basic American Sign Language.[27] Koko's sign

language training began when she was one year old. By age four, the gorilla had developed a vocabulary of nearly 200 words and showed an ability to use language creatively.

The rate at which Koko learned new words equaled that of human infants through the first four years of life. Before she died in 2018 at age 46, Koko could understand and sign more than 2,000 words. She could sign for basic needs, like food and water, and indicate emotional and evaluative states, such as sad, love, good, and sorry. Koko also was able to use signs to represent more abstract concepts, such as obnoxious, fake, and polite. Because she learned sign language simultaneously with the words spoken out loud, Koko was able to recognize and respond to spoken language, even when she just overheard comments spoken between human attendants.

In the wild, gorillas vocalize to communicate within their groups and warn of the presence of outsiders.[28] Researchers have identified between 16 and 22 different meaningful calls. Two communicative behaviors that are typical of gorillas have been sensationalized in movies. One is a male charging and screaming, hooting, and grunting to scare away a threat—an alarm call. The other is a silverback male standing on back legs, beating his chest, roaring, hooting, and thumping the ground, vegetation, or an unlucky bystander. The silverback is demonstrating physicality in order to impress females and discourage rival males.

Adults grunt to discourage others from taking food when they're eating or when they wake up from naps. Gorillas make a belching sound to acknowledge each other's presence. They make distinct grunts and whimpers during copulation. Infant gorillas make a laughing or "chuckling" sound when they play. Gorillas often make a rhythmic, musical sound ("mwahh mwahh mwahh") when they sit around happily eating in the absence of threats.

Gorilla's vocal communication channels are complemented and reinforced by nonverbal gestures, including facial expressions, eye movements, grooming, and huddling together, to build a feeling of community.[29]

Chimpanzees and Bonobos

Chimpanzees and bonobos represent a special case of animal communication. Beginning as early as the 1930s, the popular press reported that chimpanzees have the ability to decode and learn some elements of spoken language and to recognize visual symbols presented to them by humans. People everywhere were intrigued by research into chimpanzees' apparent facility with language.

Most research on chimpanzee communication was conducted in laboratories. In some other studies, chimpanzees were raised from infancy like children in the researcher's home. Most of the studies didn't focus on the ability of chimpanzees to learn and speak a human language like a child would. Instead, the research concentrated on the animals' ability to manipulate symbolic materials (flash cards, plastic models, images on a screen) that refer to real world objects when hearing the name of the object spoken.

With a lot of training, chimpanzees are able to associate various symbols with things in the real world—like pointing to a picture of an apple to refer to an actual apple. One famous captive bonobo, Kanzi, learned more than a thousand symbols this way and recognized many words spoken by humans in a laboratory.[30] In addition, Kanzi and other bonobos have learned how to use a keyboard to form some two-word sentences out of symbols. Those behaviors led Kanzi's research team to conclude that the difference in basic communication ability between bonobos and humans is just a matter of degree.

The idea that language proceeds along a continuum from apes to humans is called **continuity theory**.[31] However, when chimps identify the correct symbols in the laboratory, they are likely just memorizing vocabulary with no real understanding of what the words or symbols mean—much like the way dogs or circus animals can be trained to do tricks by voice command. And while

FIGURE 5.1 Kanzi the bonobo has learned hundreds of arbitrary symbols that represent objects, words, and people he knows. Courtesy of AF Archive/Alamy Stock Photo

chimps can respond to various vocal instructions, they never ask questions—a crucial cognitive skill that even young human infants display regularly.

Within their troops in the wild, chimpanzees think, reason, and use gestures and vocal signals to communicate a wide range of feelings and desires. Chimpanzees and humans have the same facial muscles. Chimps smile and laugh. They giggle when tickled. The fact that chimpanzees display a laughing facial expression not only when they laugh but in situations where they are silent reveals a level of communication flexibility they have in common with humans.[32]

Chimpanzees naturally use more than 60 gestures to say things like "come here," "go away," "let's play," "give me that," and "hug me" to their conspecifics. When contesting for the dominant position within their troops, male chimpanzees form coalitions of supporters by hugging, touching, kissing, and grooming each other. Bonobos peep and babble in ways that sound like human babies.[33]

No ape has been trained to speak a human language or spontaneously use gestures to represent words. But just because their communication ability does not closely match complex human language skill doesn't mean apes have not evolved very far. They don't form words, but they do send clear messages. Within the practical realities of their lived worlds, apes have developed the communication skills they need to survive, reproduce, and express themselves. The fact that apes have many communication behaviors that Sapiens recognize suggests that our common ancestry planted these behaviors in our shared DNA more than six million years ago. However, the fact that advanced animal species share many genes with humans and behave like us in some respects does not mean that the forms of animal communication we observe today represent intermediate steps in our own evolution as communicators. Because we became separate species millions of years ago, humans and the other contemporary apes have had sufficient time to develop very different communication modes and competencies.

What Is Language?

We often refer to language in a generic sense. We try to read someone's "body language," for instance, or decipher the "language of love." We might even talk about "animal language." But what happens when we define language in more precise terms? Do non-human animals have language?

The *Oxford Dictionary* defines language two ways:

1. A method of human communication, either spoken or written, consisting of the use of words in a structured and conventional way.
2. Any nonverbal method of expression or communication.

The first definition excludes non-human animals because we're the only species that makes words and positions them in complex, meaningful structures. Some animal calls and songs are **combinatorial**—the elements of the sounds fit together according to a rule or pattern. Those sequences are meaningful and can refer to something external to the animals themselves. But the individual elements cannot be understood separately and cannot be used together in various ways to create an overall meaning.[34]

What apes and other animals have are multimodal communication systems that conform more closely to the second definition of language given above. Many species interact effectively using **paralanguage** (the acoustic properties of their vocalizations—volume, pitch, rhythm, tone, duration), **nonverbal cues** (especially body positioning, facial expression, and gestures), and the **contexts** in which they make sounds (which guide the message receivers' interpretations).

The capacity to intentionally express an infinite range of meanings and communicate complicated lines of thought by using a small number distinct sounds, arranged creatively and precisely to represent original, complex, abstract, and even invisible ideas—**spoken language**—is peculiar to our species.[35] The creation of spoken language represents the key transition between evolutionary processes that take place in the natural world and what our more recent ancestors were able to produce in the worlds they devised.[36]

The ways animals send and receive messages overlap in some ways with human communication. We will describe more of these similarities in this section of the chapter. But non-human communication is not the same as human communication. And it certainly isn't language. Human language is generative; animal communication is derivative.[37] Animals respond to their primary worlds; humans construct a variety of worlds of perception and communication.[38] Other than as the basic instinct to communicate that inheres in all living organisms, animal communication should *not* be considered preparation for the emergence of language.

Language also did not burst forth at one critical moment in Sapiens' evolutionary history.[39] Likewise, language did not appear as a brilliant adaptation. It is not encoded in the human genome. Languages didn't form inevitably because of Sapiens' big and complex brains. Instead, language grows out of a platform of abilities, some which are very ancient and shared with other animals, and others that are more modern and intimately tied to other cultural developments.

Pre-Language

The first attempts made by our ancestors to communicate vocally took the form of sounds we can refer to as **pre-language.** It's impossible to know exactly when, where, or how many pre-linguistic vocalizations evolved because speech, like gesture, leaves no fossil trace. Pre-language emerged among our hominin ancestors at least two million years ago, but some researchers push the date back millions of years before that.[40] Pre-languages set the stage for development of more complex forms of speech.

The first requirement for acquiring spoken language ability is having the right physical equipment. All mammals have a larynx and are capable of making sounds. Human oral cavities became bigger and more resonant, allowing our six basic speech organs to evolve (**Chapter 2**). But to be able to survive and reproduce, all advanced species also needed the ability to hear. The transitional

fish-to-amphibian species *Titkaalik roseae* likely already had that ability when it emerged from water onto land more than 360 million years ago.[41] The biological origin of hearing dates back to long before our hominin ancestors evolved.

To be functionally effective, any signaling system, no matter how crude, must have a **referential** quality**.** Some of the gestures and sounds that made up pre-language had to have had referred to something external to the individual sending the message. Our hominin ancestors first pointed to locations and imitated other species to organize hunting, foraging, and child-raising (**Chapter 2**).

Making particular sounds is also associated with physical and emotional states that range from the pain and joy of childbirth to the deep sadness and grief of losing a loved one. Emotional expression lies at the heart of human life. Babies cry and coo without prompting. Laughter provoked by humorous situations dates far back into our evolutionary past.[42] A successful hunt may have led our early ancestors to cry out happily in celebration.

We don't know precisely what pre-linguistic vocalizations sounded like or exactly how they emerged. One major theory is that spoken language developed gradually from natural grunts, groans, cries, shrieks, wails, and similar sounds. An alternative perspective holds that language developed relatively rapidly when the expressive (emotional) and lexical (practical) components of vocal communication that were already present in our developing brains merged together to produce speech.[43]

Summarizing what we know, a combination of factors led to the development of spoken language:[44]

- Manual gestures served as a precursor to spoken language.
- We developed the necessary physical characteristics to make differentiated sounds.
- Mimicking animals and spontaneous emotional outbursts explain some aspects of language development.
- Comforting babies and raising children stimulated purposeful vocalization.
- Coordinating physical efforts to accomplish group tasks like hunting or defending tribal territory provoked vocal interaction.
- Genetic mutations prepared our species for language learning.

Speech and Song

The physical body and vocal apparatus are the biologically interconnected organs with which our ancestors invented speech. The body and voice also facilitated creation of two related natural communications media—song and dance. Access to these primordial communications media is inclusive. Every able-bodied person is born with the physical capacity to speak, sing, and dance.

The emergence of pre-language may have begun with the soothing sound mothers make—humming to calm their infants.[45] The purpose of the mothers' wordless singing would have been to maintain the attention of their young children, put them to sleep, and make them feel emotionally secure. The evolved physical flexibility of Sapiens' large and resonant oral cavity allowed for a unique range of pitch, tone, and speed of sound production. These vocal characteristics gave us the physical ability to hum or sing. Humming and singing required other physical adaptations that must have evolved by that time too—measured control of breathing and fine motor control.

Humming reveals the musical character of spoken language. The pleasing sounds made by our ancestral mothers developed into what we call lullabies today. *If this intriguing theory of the origin of spoken language is true, then the first form of speech was also the first form of music.* Neanderthals were likely singing these simple melodies to their children before Sapiens did.

Many animals sing solos to attract mates. Some birds sing together to scare off predators. Wolves howl in chorus to rally the pack together. Singing is natural communicative behavior. Charles Darwin noted the musical qualities of spoken language when he expanded his theory of evolution to include humans.[46] The deep structures of vocalized music production are common to the human psyche.[47] All cultural groups sing. The main function of music for individuals in human societies is clear and compelling: Participating in the making of music increases an individual's capacity to succeed as a social being by bonding with others.

Music excites us physically, emotionally, and chemically. Dopamine shoots through various parts of the brain when people make music *and when they simply imagine or expect it.*[48] Think about how good it feels just to anticipate an upcoming concert that features one of your favorite singers or groups. Mere anticipation of the pleasure becomes a meaningful event itself. We enjoy music that is sung in languages we may not know (for example, the Brazilian bossa nova, Mexican mariachis, Cuban and Puerto Rican salsa, French love songs).

To our brain, some musical instruments, including the piano, guitar, cello, and saxophone, sound like voices telling sentimental stories.[49] Many musical textures—for instance, the sound produced by a pedal steel guitar, bagpipe, or Chinese violin—represents the expression of culturally based feelings that can be accessed emotionally by outsiders.

The ways music functions as an agent for forming social relationships have been documented by brain researchers and mapped neurobiologically.[50] Music allows us to express our affective states and induce strong feelings in other people.[51] Group music-making creates shared emotional experiences and can provoke synchronized bodily movement that leads to social "boundary loss"—downplaying individual differences and melting into a group identity.[52] Music has been crucial in binding human communities together as cooperative cultures and serves as a channel for passing along cultural information. Music establishes and reinforces cultural identity and keeps immigrating populations connected to their original cultures. Nation states and religious institutions use music to gain and maintain loyalty from their members (**Chapter 8**).

Music serves more individualized purposes too. It allows people to call attention to themselves, reach out to others, and deceive others.[53] Music-making can advertise an individual's availability for mating and helps facilitate the cognitive and emotional development of children.[54] Recorded music helps people set moods in various situations, lessen the drudgery of work and the boredom of travel, relax, reminisce, exercise, provide topics for conversation, and develop friendships based on shared taste, among many other personal and social uses.[55]

Music became an important part of how we express ourselves because it functions to our benefit in many ways. But music as a communications medium cannot be reduced to practical uses alone. Music also appeals because of the intrinsic expressive joy it produces for musicians and everyone who hears and appreciates it.

We cannot analytically separate the evolution of spoken language from music. As our ancestors developed their social connections and built communities over long expanses of time, speech, music, and dance fused together as essential forms of human communication in ways that are common to us alone.

Dance

The ability to move rhythmically and in unison with others evolved from our bipedalism and the original form of human communication—gesture. Dance evolved from these factors and from our ability to run. Indeed, the "running man" dance became a popular American street dance in the 1980s. In any case, dance evolved as an adaptive trait that confers a powerful evolutionary advantage because it works with music to strengthen human bonds.

Chimpanzees sometimes dance around individually or parade in pairs conga style, but only humans dance with partners.[56] Dance creates a special form of what the French sociologist Emile Durkheim called "collective effervescence"—the buoyant feeling of being part of something together.[57] Today, dance binds people together in contexts that range from raves to ballroom dancing, indigenous cultural rituals to choreographed dance teams, European folk dances to hot hula classes. Singing, swaying, dancing, and praying together in Christian religious services also attest to the enduring power of music and bodily movement to create shared emotions and inspire social bonding.

Unsurprisingly, sexual selection also comes into play with dance. Males of many species compete in music-making and dance to get the attention of females. In some cases, this behavior unfolds at the group level. Frogs, crabs, fireflies, and Sapiens are among the species in which groups of males vocalize and move together to attract females—"cooperative calling."[58] In most of the animal kingdom, once the dancing group has attracted the female's attention, she chooses the individual with whom she will mate. For Sapiens, the process is considerably more complicated.

The way we learn to move our bodies to music demonstrates how the brain regulates communication processes. In dance, we sense and predict the timing of external beats and then match those beats with movements of our bodies. This coupling of auditory information with rhythmic physical movement requires coordination among widely dispersed parts of the brain.[59] The process is called **entrainment**—in this case, coordinating physical behavior with external sounds. The synchronization of musical beat with bodily movement, even with tempo changes, became instinctual over time and now emerges in children from three to five years of age.[60]

The Brain

Non-human animals lack the single crucial physical property that is necessary for language to emerge: a large and highly differentiated brain capable of producing and understanding complex thoughts. Most animal vocalizations reflect hormonal and emotional states—like the cries chimpanzees make when they get food or the mating call of howler monkeys. Animal vocal signaling is contained within a limited range of sounds and meanings, while human language is virtually unlimited.[61]

As our brains grew larger and our cognition became more complex, the demands of increasingly intricate social organization required the ability to express more complicated thoughts. Complex spoken language was the solution. Vocalizations that function linguistically as subjects, objects, and verbs together with the smaller parts of language that hook these major components together (pronouns, adjectives, adverbs, prepositions, conjunctions) evolved from necessity. The pressure to communicate more and more precisely over time compelled speakers to instinctively merge the big and small parts into cohesive utterances.

The size of the human brain increased relatively rapidly from 800,000 to 200,000 years ago—a period of dramatic climate change. Sapiens had to interact with each other and with the environment in more elaborate ways in order to survive the climatic challenges. Those challenges spurred the remarkable growth in brain size. Among the social adjustments brought about by a bigger brain was language development. In turn, acquiring language stimulated additional growth in brain size and complexity, leading to progressively greater language ability.

Social complexity made the brains of all primates comparatively large. But Sapiens are unique. The typical adult brain today weighs about three pounds and is six inches long. That's about three times the size of the brain of our chimpanzee relatives.

Speech and Language Gene

At least one-third of the 30,000 genes that make up the human genome are located in the brain.[62] No single gene is directly responsible for the development of speech and language. But the gene that is commonly referred to as the speech and language gene—**Foxp2**—plays a key role. Foxp2 evolved around the same time anatomically modern humans appeared and began to interact in more complex ways, about 300,000 years ago.

The Foxp2 gene is not unique to humans. Other mammals—ranging from mice, bats, and hedgehogs to orangutans, gorillas, and chimpanzees—have the gene. Birds have a variety of the gene. But the human version of Foxp2 has a distinctive mutation that permits much greater vocal control, which makes speaking a language possible.

The Foxp2 gene's main function is to orchestrate how a large network of other genes interacts with the parts of the brain that are involved in speech and language.[63] In general, parts of the brain's left hemisphere carry out the production and comprehension elements of speech and language for humans and apes (**Figure 5.2**). These areas of the brain were named after the nineteenth-century French and German physicians Paul Broca and Carl Wernicke, whose research associated particular parts of the brain with the primary characteristics of language.

Language Areas

Located in the frontal lobe above and slightly forward of your left ear, **Broca's area** is a concentrated mass of brain cells that enables the expression and articulation of language. We know this because when these cells are damaged in an accident, the injured individual's ability to speak is degraded and sometimes lost completely.

The other main component of language ability—comprehending and understanding audio signals—is facilitated by **Wernicke's area**. This part of the brain is located in the temporal lobe, located behind your left ear. When this area is damaged, individuals have difficulty understanding spoken language.

We naturally speak with a range of melodic and tonal qualities. This behavior is an effect mainly of right brain activity. When we stress a word, like un-be-*lieve*-able, we are using right brain ability.

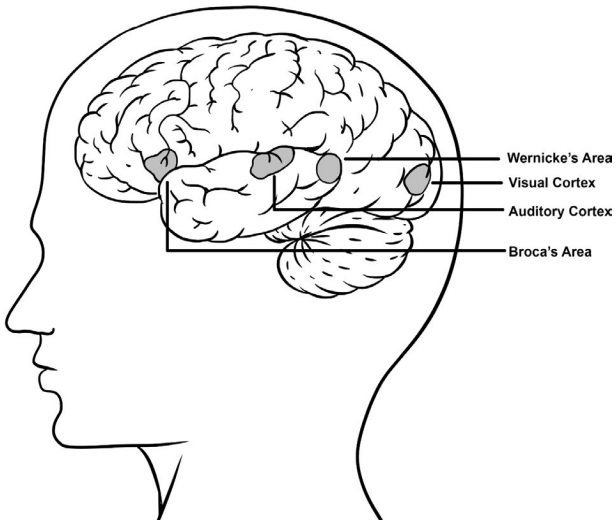

FIGURE 5.2 Language areas of the brain

Patterns of vocal inflection, rhythm, and poetic, alliterative speech, including song—**prosody**—are all processed in various parts of the right hemisphere.

The mellifluous quality of spoken language intensifies when people sing, rap, or otherwise vocalize musically. The vocal elements of music—form, tone, rhythm, melody, texture, harmony—require complex neurological structures to process the multiple streams of information involved. As we learned earlier in this chapter, making, imagining, and expecting to hear music activates the same regions of the brain.[64] Individual differences among us stand out. Musicians' brains differ from non-musicians in the way they process information.[65]

The brain is not a neatly compartmentalized organism composed of independently functioning parts. Simple generalizations that were made in the past about hemispheric activity (the left brain is more "analytical," and the right brain is more "creative") have broken down as new research has been reported.[66] However, in the case of language, we know that the left brain contains the primary regions involved in speech and language and in mathematical calculation, which is a type of language function.[67] Left brain functionality helps us make sense of the incoming flow of information. It is the information rich side of the brain. Complementarily, the right side adds melody and tone to vocal expression, including song. It also helps us recognize faces, focus attention, and control visual-motor tasks.[68] Ultimately, the two sides of the brain operate conjunctively to merge the intellectual, logical, and comprehensive qualities of language production with the rhythmic sounds of vocalized speech.

Of course, communication is not limited to spoken language. Sighted people instinctually navigate the world by perceiving and responding to the visual fields they constantly encounter, which is not an easy task. Think of how good we must be at processing visual information just to drive a car, play a video game, or read this book. We also sensitively decode visual cues that are given off by our interlocutors' facial expressions and body language. To process visual information, additional parts of the brain also had to evolve. The **visual cortex**, located in the occipital lobe of both right and left hemispheres at the back of your head, is the part of the brain that receives and processes sensory information from the eyes.

Processing Experience

The Foxp2 gene also connects the acquisition and use of language with the way we learn from commonplace visual and auditory experience. The gene instructs the brain to transform particular events in human experience—for instance, hearing the word "glass" when we are shown a glass of water into a nearly automatic association with things we encounter in the world that look and function like water glasses.[69] This special kind of learning appears to have played a determining role in the evolution of our ability to speak.

Sapiens is the only species that makes these kinds of complex connections. Our human cousins—Neanderthal and Denisovan—did not acquire the Foxp2 gene. They also had smaller forebrains that would have limited their ability to innovate and improvise. These conditions may have curtailed their chances to survive and compete with Sapiens, who arrived later.[70] Our capacity to learn language set the stage for development of even higher cognitive functioning that would be required for acquiring more advanced language ability.

By drawing on the totality of prior experiences a person has had, the brain unites all sensory perceptions of the world "out there" and sorts them into preexisting cognitive patterns. Those constantly evolving patterns give the brain a dynamic operational framework from which to interpret new experiences. Because every person's life experience is different, every brain produces a different narrative. This internally driven process explains how our brain creates provisional perceptions of "reality" that differ from person to person.[71]

The brain attempts to decipher, interpret, and integrate all incoming sounds in terms of speech and language. The left and right **auditory cortex** processes sounds that come from the ears. For infants, that process begins even before the child is born. Babies react to the melodic qualities of their mother's voice while they are still in the womb.[72] After birth, babies respond positively to **motherease**—the repetition of simple words over and over in a slow, high-pitched manner often accompanied by exaggerated facial expressions. Babies enjoy this experience and adults, feeling reinforced, comply by repeating the behavior. This universal baby-adult communication is one of the very first experiences an infant has.[73]

Babies quickly develop ideas and concepts from their routine visual and auditory sensory experience. Even newborns pay attention when something novel appears in their environment. They delight in many of these surprises, like hearing nuanced motherease or being given a new toy. Babies are also particularly alert to danger signals. For instance, the voice of an angry person or deep-voiced male can scare them. A sudden noise or change in the way they are being held can frighten them. Fear is embedded deeply in our DNA. Babies' differing responses to external stimuli reveal their inherently reactive and adaptive nature. Positive experiences are rewarded with smiles and coos. Terrifying experiences elicit frowns and tears.

We've already explained how the brain matches the sound of music with body movement instructions to create rhythmic dance. By the same process of entrainment, the sound waves produced by spoken language are recognized by the brain of the person who hears the waves. The speaker's and listener's brains become coupled by the sound of a common language. This is how we learn to speak. The brain of the individual who hears spoken language aligns the motor control of the listener's speech organs to imitate what was heard. This matching of external information with personal behavior is central to vocal learning. Many other animals also learn how to vocalize this way.

Human brains can function together at a higher level to create a neural dialogue about the *content* of spoken language too.[74] When the speaker and listener share a code, like language, the potential exists for their neural circuits to synchronize on ideas. The burden rests primarily on the speaker to use language clearly enough that the listener's brain can lock neurologically onto the ideas being expressed.

The Nervous System

Some specialized areas of the hominin brain evolved in ways that made producing and processing pre-linguistic vocal communication possible. Those areas later became the brain's neurological encoders and decoders of more complex linguistic information.

Neurons, sometimes called "nerve cells," are the communications media of the body's nervous system. The prevailing scientific view is that the nervous system is a complex communication network, made up of neurons that constantly send, receive, and integrate signals throughout the body in a delicately interactive manner. The **central nervous system** is the part of the nervous system to which the brain and spinal cord belong. Neurons inside the brain respond to incoming internal (physiological) and external (environmental) stimuli. Whenever we perceive, think, or act, we automatically and unconsciously activate sets of neurons that converse with each other.

Language began as a special kind of computational cognitive system that is implemented by neuronal interaction.[75] Electrochemical impulses transmit information back and forth within a unified neuronal network composed of more than 100 billion neurons with at least 100 trillion connecting points, or synapses. The neural pathways of the brain form the **connectome**. The transmission of information by nerve cells is **conduction** (**Figure 5.2**). Normal social interaction requires highly integrated communication among disparate, distant parts of the brain.[76] Individual neurons link

up with some of the other neurons in the brain, but not all. When the brain's ability to send and receive the correct signals breaks down, mental illness—usually schizophrenia—ensues.

Most neurons have two appendages that are used to communicate. *Axons* send signals. *Dendrites* receive signals. Neurons respond to genes' instructions by pumping an electrochemical charge down the long axon to the receptor dendrite of another neuron. The points where the neurons intersect are *synapses*. A *myelin sheath* insulates the axons, enabling more efficient signal transmission.

Neuronal connections are task-specific. For instance, Broca's area and Wernicke's area send information back and forth down a specific network of axons—the **arcuate fasciculus**—to allow individuals to produce and understand speech comprehensively. Similarly, information travels down axons from the visual cortex to Wernicke's area so people can make sense of visual information. Even written words are processed by the brain as visual objects. When learning how to read, a particular network of nerve cells forms to recognize the physical shape of every word that makes up the ever-expanding visual dictionary stored in your brain.[77]

Not all our conversations are with other people. We also engage in **inner speech**—the stream of thoughts, images, scenarios, and sensations that go through our heads privately. Inner speech can be monologic—giving a "speech" to ourselves—or dialogic, where we imaginatively create conversations with other people. We verbally but silently work out problems that face us, regulate our behavior, make jokes, and practice interactions we expect to have with others, among other thoughts. As we engage in inner speech, our neuronal activity mimics what happens in actual conversation.[78]

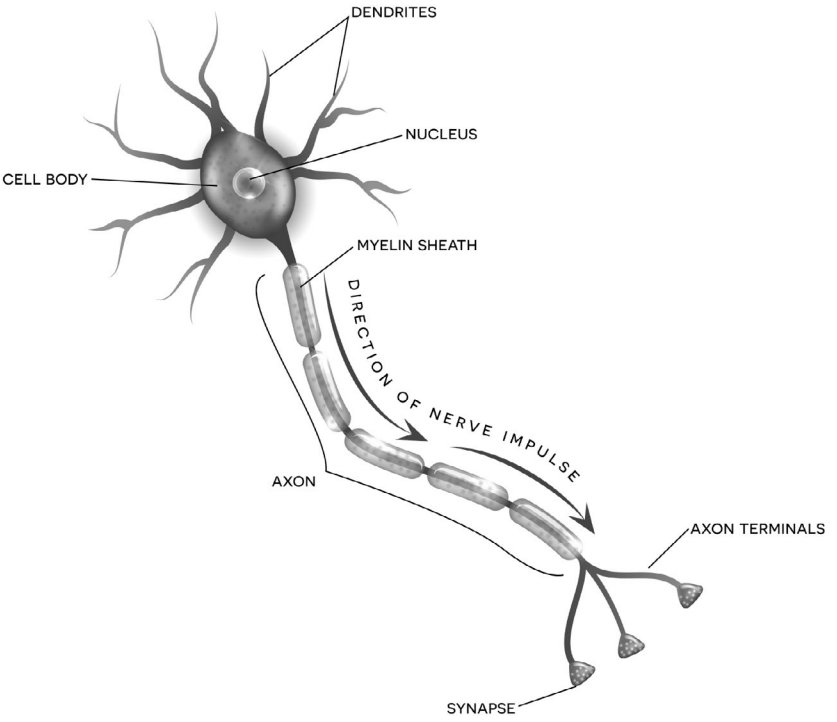

FIGURE 5.3 Neuronal communication. Courtesy of Tefi/shutterstock.com

Complex cognition and language ability separate humans from other animals even though the brain regions of all primates are essentially the same. Researchers have attributed the big differences in cognition and behavior between species to comparative brain size, neuronal density, and the human brain's superior self-organizing capacity.[79]

Protolanguage

After pre-language, the next stage of language evolution is **protolanguage**, the precursor to modern developed languages (**Table 5.1**). Protolanguages represent efforts by our ancestors to develop more elaborate and reliable ways of communicating vocally within their own communities and with outsiders. Improved ways of speaking and understanding developed in tandem with cognitive growth, especially more complex imagining, considering, reasoning, and remembering.

The main parts of the brain that facilitate language production had evolved by the time our Habilis ancestors evolved in Africa more than two million years ago.[80] Protolanguage, brain size and complexity, and the creation and use of simple tools evolved together. Habilis got their name because they have been widely considered to be the first humans to invent simple stone tools, though some recent research suggests tool use may have developed earlier (**Chapter 7**). The skills being considered here—language ability and tool use—required complex neuronal functioning that appears to be closely related.[81] We don't know exactly when or where in Africa our ancestors first began to speak or what the first protolanguage or languages sounded like. A diversity of protolanguages likely flowered after the species that most scientists believe was our immediate direct ancestor—Erectus—migrated out of the African continent to southern Europe, China, and Indonesia.[82] Because they had to organize sailing expeditions of at least 20 individuals to get to islands in the South Pacific, Erectus must have had a crude form of language.[83]

During this period—from roughly 1.9 million years ago to only about 70,000 years ago—language ability continued to evolve together with other key biological and cultural traits. The voice box had fallen into place. The brain got bigger, prompting significant growth in general and social intelligence. Our Erectus ancestors controlled fire, cooked food, and made sophisticated tools.[84]

The same evolutionary demands that prompted language to emerge in the first place caused our immediate ancestors to find better ways to communicate vocally. Greater levels of abstraction in language were gradually being introduced. In order to invent new words and create more complex

TABLE 5.1 Stages of Language Development

Language Stage	*Key Features*	*Main Consequences*
Pre-language	Vocal tract emerges	Diverse vocalization made possible
	Brain size and complexity increase	Cognitive growth
	Speech/language gene appears	Embeds speech ability in DNA
	Emotional expression	Increased survival/reproductive potential
	Musical expression	May be origin of spoken language
Protolanguage	Greater brain size and complexity	Great cognitive growth and tool use
	Phonetic/semantic growth and diversity	Greater levels of abstraction; increased social organization and range of practical uses of language (hunting, foraging, child care, and cultural transmission)
Developed language	Diversity of spoken languages	Key to cultural development
	Elements of language	Facilitates complex communication
	Large vocabulary	Widens range of expression, information explosion
	Specialty languages	Vocational, professional specialization

utterances, speakers had to have expanded their vocabularies and merged various sounds together. The new expressions could then be combined in novel and more extensive ways. Most important, protolanguages had to give the speaker the ability to refer to concrete and specific things or ideas in the perceptual world, not just physical states or emotions. Yet the rules that governed their vocalized interactions cannot be described as grammar.

PIDGIN, CREOLE, AND SPANGLISH

As protolanguages became more complex, they functioned much like early versions of today's **pidgin languages**—simplified forms of speech communication that develop between ethnically diverse groups that need or want to interact but don't share a common tongue. Pidgin languages have a simple vocabulary and barebones grammar. Like protolanguages, pidgin languages are oral, not written. They tend to be dominated by vowels so they sound soft.

Throughout history, pidgin languages emerged spontaneously so that diverse peoples could accomplish things together. The nature of their cooperation has been anything but democratic, however. Colonial powers England, Spain, France, Holland, and Portugal had to be able to communicate with the indigenous populations they conquered in Africa, the Americas, and Asia. Through day-to-day experimentation, they co-created pidgin languages. Later, the slave trade generated a variety of pidgin languages because African slaves from different parts of the continent had to interact with each other and with plantation owners in the New World. In forming the vocabulary and implicit rules of pidgin languages, the part of the hybrid language that derives from the more powerful group dominates.

A well-known contemporary pidgin language was created in the 1700s, when the indigenous Hawaiian population encountered immigrants from the United States, Japan, Portugal, the Philippines, and China. People from these countries worked and did business together in Hawaii and needed a way to talk to one another. Because of the economic power wielded by Britain at the time, English became prominent in the emergent hybrid. Today, Hawaiian pidgin has morphed into more general use with phrases like these:

> "*Ho, look at Waltuh boy on dat beeg wave. Eh,* ***geev um, brah*** *!"* (Go for it, brother!)
> "*Ho, brah, Pua wen spoke me in da cah wid Charlene an geev me* ***stink eye*** *!"* (dirty look)
> "*Ho,* ***lolo dat buggah*** *, Junior"* (That guy is stupid.)[85]

Most pidgin languages disappear when they are no longer needed. But when pidgin becomes especially useful for a large population, it may be spoken by subsequent generations even as a first language. For some residents of Hawaii, pidgin remains not only a viable way to communicate but a source of ethnic pride.

Technically, linguists classify a pidgin language as **creole** when the hybrid form lives on for many generations as it has in Hawaii. The term "creole" can also refer to people of mixed descent (usually European with African) or more broadly to hybrid cultures (including language, food, and religion), especially in the Caribbean or Louisiana delta areas.

Today another kind of language fusion takes place where immigrants impact mainstream culture. In parts of the United States, many Latin American immigrants speak Spanish and English fluently. Young Latinos are especially likely to move deftly back and forth between

the two languages in their daily conversations, often in the same sentence. **Spanglish** allows speakers to take the best aspects of both languages and meld them together functionally for their own purposes. Standard English tends to be a more efficient way to communicate something specific, while Spanish provides a more poetic, romantic mode of conversation. Some radio deejays in the American Southwest speak Spanglish on the air because the combination is not only functional—it sounds cool. This fluid moving back and forth between one language and another is **code switching**.

Social Organization

Our ancestors became more cognitively complex and cooperative as they evolved as social beings. Having already established a shared sense of joint intentionality, Erectus individuals could enact and negotiate many kinds of social behavior with their peers. They were developing language skills that allowed them to plan, not just react. They could better coordinate hunting and foraging activities, avoid danger, give instructions for tasks like building fire and making tools, negotiate sexual and living relationships, raise offspring, and establish and maintain the productive social bonds and alliances they formed in their tribal communities.

As tribal communities grew larger, coordinating tasks and forming alliances in the political factions that were emerging within tribes became more demanding. Individuals needed language skills that would allow them to describe to others the complicated ideas and situations they were now able to picture in their minds. Consequently, their vocabularies grew larger, and their ability to synthesize words improved.

The Limits of Protolanguage

But there were profound limits. Describing complex or abstract ideas, such as complicated human behavior or the qualities of things, would require a more comprehensive way of talking. Verbs, nouns, adjectives, and adverbs would be needed. These elements of language had not been present in protolanguages in part because the brainpower needed for developing more advanced language and other forms of complex behavior was not yet in place.[86]

Protolanguages began to exhibit aspects of the underlying structure and vocabulary that developed languages would require. But they did not have a way to integrate the various elements of an utterance that would allow speakers to express nonrepresentational ideas or contingencies. Complex grammar—the key feature of developed language—would be necessary.[87]

Developed Language

The development of complex languages that are organized by grammatical structures evolved for good reason—it made social communication more efficient and useful. Vocabulary words and grammatical elements were added over time. This is a natural process because language is behavior that is acquired from day-to-day experience. The motive that pushed cultural groups to continually make language more and more elaborate is clear: Effective social interaction increases the cooperative potential of the group.

The main stages of language development—pre-language, protolanguage, and developed language—do not divide neatly into categories. We identify these stages here in order to describe the key features and consequences of the main transitions in the history of spoken language (**Table 5.1**). Like all evolutionary processes, languages grew slowly and unevenly. They diffused widely. The

root of most languages spoken today developed around the world after Sapiens tribes headed north from Africa between 70,000 and 60,000 years ago (**Chapter 2**). Since then the original languages changed and often converged into hybrid forms. Linguists estimate that at least 6,500 different languages are spoken in the world today.[88]

Before science, a religious explanation described how the world's various languages came into being. A placard at the Creation Museum in the state of Kentucky tells the story: "When Noah's descendants disobeyed God's command to disperse around the world, God gave them different languages, forcing them to spread out all over the Earth. The wide scattering of people led to formation of the many language groups that exist today. Rejection of God's Word had led to confusion:'. . . the LORD [*sic*] confused the language of the whole world' (Genesis 11:9)." This is the language origin myth known as the Tower of Babel.

In science, the debate is between (1) monogenesis—the original language with roots in Africa—and, (2) polygenesis—the idea that languages began in diverse parts of the world. Clearly, Sapiens were using some form of language before the migrating groups left Africa. What happened after that is where we turn next.

Proto-Indo-European Language

The languages that descended over the millennia have been transformed many times, making it impossible to trace their roots all the way back to Africa. But by analyzing remains from the first forms of written language, and by working backward through time by examining the characteristics of contemporary spoken languages, scholars have at least been able to reconstruct what they believe was the mother tongue of the languages that eventually spread throughout the Middle East, India, and Europe. Many of those languages remain with us in modified form today. That ancestral language has been termed **Proto-Indo-European,** or **PIE**.

Linguists believe PIE was spoken widely between 5,000 and 3,000 years ago.[89] The linguistic roots of PIE can be seen in the original Latin, Greek, and Indian languages. Researchers have been able to estimate when PIE was spoken by comparing the origins of contemporary languages associated with PIE with the elements of material culture that were known to exist at various periods in the past. For example, the roots for some words that are associated with animals and agriculture (for instance, milk, wood, weave) and words that reflect the presence of early wheeled vehicles (like yoke, wheel, axle) can be traced to PIE. These kinds of linguistic roots are not found, however, in words that came after PIE (such as gun, iron, or chariot). Tracing the origin of language this way tells us much about cultural history. For instance, if a word like "plow" can be traced to PIE, which it can, then we learn something important about agriculture at the time the language was spoken.[90]

We're not done tinkering with language and never will be. New words are added to the vocabularies of world languages every year, while other words fall into disuse. Conditions in the modern world have accelerated language change. Globalization and immigration constantly expand the reach of some languages. Mass media and popular culture influence how we talk. Social media have altered the way we use language.

DISAPPEARING LANGUAGES

Many languages are vanishing rapidly from the face of the earth. Scholars estimate that more than 15,000 languages were spoken in the 1500s. But by early this century that number had

dropped to less than half that number.[91] Even worse, more than 90 percent of the remaining world languages will likely become extinct by the end of this century.[92]

Plants and animals vanish when their habitats change in ways that make it no longer possible for them to reproduce. Languages disappear much the same way. When the basic living conditions of cultural groups are transformed, the languages they speak are threatened and often extinguished. Historically, language extinction has been inflicted on unwilling populations. Military conquests followed by forced assimilation and re-education in an imposed tongue represent prime examples of how this happens. English together with French, Spanish, Portuguese, and Dutch became global languages as a consequence of conquest and colonization. More recent political history shows the same result. For example, after the former Soviet Union invaded the Baltic States—Estonia, Latvia, and Lithuania—local teachers in the Baltic nations were required to learn Russian and give their classes in Russian. All government business was conducted in the imposed language.

Marginalized cultural groups often lose their native languages over time. Consider what has happened to Native American tribal languages. Native American languages developed originally from a small number of tribal bands that crossed over the Bering land bridge that connected Asia to North America (**Chapter** 2).[93] Before the Europeans subjugated the native populations, indigenous peoples in North, Central, and South America spoke more than a thousand languages. More than 250 languages were spoken in the territory that would become the United States alone.[94] Today most Native American languages have gone nearly extinct. Only eight Native American languages currently have more than 10,000 speakers among them.[95]

FIGURE 5.4 Indigenous language learners. Indigenous North Americans in Canada were forced to learn the language and culture of their European conquerors. Courtesy of The General Synod Archives, Anglican Church of Canada

Somewhere between 150 and 200 species of plants, insects, birds, and mammals disappear from the face of the Earth every day, an accelerated rate of extinction that is fueled dramatically by human activity.[96] This loss of biodiversity is considered by many scientists to represent a crisis. The same can be said for languages. Languages are worth keeping. Languages represent cultural and intellectual diversity in a globalized world. They serve as anchors of ethnic identity and pride, often for disenfranchised or marginalized peoples. For these compelling reasons, tribal leaders, activists, and scholars work together to help preserve and revitalize endangered languages, especially on Indian reservations across North America.

Elements of Language

Language makes the efficient and accurate transfer of information from one individual to another possible. Developed languages are comprised of interacting elements. Each element evolved because it makes the whole of the language more effective, enhancing the communication potential of its users.

TABLE 5.2 Elements of Language

Element	*Unit of Analysis*	*Primary Function*
Phonetics	Phoneme	Physical production and perception of speech sounds
Semantics	Morpheme	Gives meaning to language
Syntax	Rules	Organizes language into comprehensible structures
Pragmatics	Context	Provides extra-linguistic cues for interpretation

The **elements of language** include four main components: phonetics, semantics, syntax, and pragmatics (**Table 5.2**).

The first three elements are internal; they refer to aspects of the message itself—the sound, meaning, and the way language is expressed in order to be understood. A system of rules—**grammar**—governs relationships among the internal elements to make language work efficiently. The fourth element, pragmatics, is external; it refers to conditions outside the message that influence how it is interpreted.

Phonetics

Phonetics refers to the physical production and perception of speech sounds. The ability to generate the differentiated individual sounds that make up a language—**phonemes**—did not come easily to our ancestors.

Pre-languages and protolanguages came into being when our ancestors began to vocalize simple but distinctive sounds—in essence, the first phonemes—in efforts to communicate with each other. Phonemes represent the smallest unit of sound in language. Phonemes are not to be confused with individual words, syllables, or letters. For instance, the same basic sound in English can be made with the letter "f" (face), "ff" (stuff), or the combination of "p" and "h" (phone). Phonemes function collectively as the auditory platform upon which the entire grammatical structures of languages are constructed.

By repeatedly vocalizing basic sounds over the millennia, our ancestors developed the physical characteristics necessary to create and ultimately standardize the variety of consonants and vowels—the phonetic building blocks of spoken language. Complicated bodily adaptations had to occur, centered mainly on the flow of air and the contraction of muscles. For example, pay attention to what's involved physically just to say the one syllable word "Hey!" out loud. Try it. Your diaphragm tenses up and moves forward to propel the air, and the sound of reverberations that are activated by your vocal chords goes up and out of your throat and mouth. You automatically push up air from your lungs. Your voice box rises to get the right pitch. You shape your mouth and lips to let the sound escape with the proper enunciation. After you say the word, your body returns to a restful position.

Now add a bit more complexity to the vocal interjection and notice what happens. Say out loud, "Hey! What do you want?" See how much additional work your lips and tongue have to do to form the various sounds that make up this exclamatory question and how quickly you get it done.

The human vocal tract evolved over time to allow a broad array of possible sounds to be produced. Yet when we speak, we use only a small percentage of the many distinctive sounds we could have made. That's because evolution tries not to waste energy. The number of phonemes that make up a given language is all that is needed to create patterns of sound that can express highly complex forms of meaning. The sounds we make originate in the brain and flow out from the body in

complicated combinations at lightning speed and with sufficient volume. As adults, we don't have to think about what we're doing to make this happen.

Phonetic Diversity

Speaking is universal, genetically driven ability. But the particular set of phonemes we can pronounce easily and correctly depends on the language(s) we hear and imitate as we grow up. The phonemes that evolved in different language groups around the world required varying kinds and degrees of physical adaptations. They became part of our DNA.

We notice the differences in our native ways of speaking when people from other language groups try to speak "our language," no matter what language that is. For instance, for many non-native English speakers, the sound of the letter "r" causes problems. Putting the sounds of "r" and "l" (both phonemes) together in an English word like "world" or "squirrel" can be very difficult for native Mandarin, Japanese, Hindi, and Portuguese speakers, among others. Mixing "r's" and "l's" together in a word like "rural" is also difficult. And the "th" phoneme when used inside or at the end of a word like "isthmus" or "sixth" doesn't come naturally for most non-native English speakers.

Most native English speakers struggle mightily to pronounce words correctly when trying to speak other languages. English is spoken so widely that native speakers can usually get by almost anywhere without bothering to learn even a few words in the local language. The challenge for native English speakers is greatest when trying to say words in languages whose roots lay outside familiar European tongues. Some native tongues, like the southern African "click" languages, require the production of radically different vocalizations compared to other language groups.

Linguists agree that modern English contains about 44 phonemes.[97] Mandarin Chinese has 29 but also has many different tones and inflections. Arabic has 31 phonemes, but only 3 of them are vowels. The language of Thailand has 39 phonemes, including 18 vowels. That's why Arabic sounds relatively hard and Thai sounds soft to speakers of other languages. You can hear what each of the 44 individual English phonemes sounds like by visiting Sally Cole's blog on language.[98]

The phonetic qualities of the language to which we are first exposed are retained subconsciously even if we hear it for just the first few months of life and never speak it.[99] Learning how to speak that language later in life will be less difficult than it is for individuals who were not exposed to it earlier. But when learning a completely new language, we often have to re-train our speech organs to perform some tricky maneuvers. But regardless of the language spoken, shaping combinations of phonemes by the mouth, lips, and tongue—**articulation**—requires a type of musculature and flexibility that only our species has developed.

Other Species' Phonemes

Humans are not the only mammals physically capable of producing a wide range of basic sounds that could be shaped into words. For instance, macaque monkeys have vocal tracts that produce hundreds of individual sounds.[100] But a fully functioning vocal tract is just one of the preconditions needed for an organism to speak a language. Our human ancestors also evolved special brain circuits that allowed them to learn and repeat new sounds, even as babies. Within our large brain, we developed a unique set of nerve cells that permit unequalled fine motor control of our vocal tract.[101]

Semantics

Language becomes useful when the sounds that are uttered by individuals can be interpreted by others in ways that make sense and are thought to advance the interests of the interlocutors.

Distinctive vocalizations have to be associated reliably with discernible referents. To achieve this in the evolution of language, the expansion of vocal expression into a functional vocabulary was required.

The meaning of an utterance, word, phrase, sentence, or text refers to the **semantics** of language. The smallest unit of meaning in language is the **morpheme**. To produce meaning, two factors must be present: (1) The language that is used must be able to express meaning symbolically; and (2) senders and receivers of messages in the language must understand the code that is being used.

We are the only species capable of creating and transmitting complex information. Notice how each word contributes something vital to the meaning of the total utterance in the following sentences:

"An enemy tribe is coming over the next hill!"
"Your child is safe."
"That person is angry."

Polysemy, Multisemy

From the slow and unsteady utterances made by the first speakers of pre-languages and protolanguages to the rapid-fire remarks produced by eloquent speakers today, the meaning of a message can never be completely self-evident. Even when words or phrases are spoken with grammatical correctness and clarity, not everyone comes away with the same understanding of what the speaker meant.

Ultimately, language is personal. Meaning is made subjectively by individuals who receive a message. Message receivers' competencies, motivations, and experiences vary widely. Those differences affect how they interpret what they hear. For instance, "boat ride" sounds like fun to most people, but for individuals who are prone to motion sickness, have suffered a boating accident, or were forced to migrate by sea, those two words used together would likely generate different meanings.

Language and all other symbolic forms are inherently **polysemic**—they can have different meanings for different people. Symbolic forms are also **multisemic**—they can have different meanings for the same person in different contexts or moments in the individual's life. For example, for the person who suffered a boating accident, the term "boat ride" or a photo of a boat excursion would likely mean something quite different before and after the accident.

Semantics and Information

Providing valuable information to others requires focused cooperation between the speaker and the hearer. Sharing information within our community makes the community stronger; individuals in the community are more secure when the community is strong. Sapiens' propensity for sharing information has been encoded in our DNA. Children are taught to share with others, but they also share information instinctively. That's one way children learn new concepts and vocabulary words.

Beyond the practical advantages, exchanging useful information helped members of our distant ancestral groups cultivate trusting social relationships, just as it does today. Sharing information nurtures a strong sense of common interest, encourages and reinforces cooperative reasoning, teaches expected behavior, helps individuals gain social acceptance, and identifies outsiders.[102] Our evolutionary antennae constantly scan the environment and alert us to potential threats to our safety. Language provides warning signs. Even a slight accent or the misuse of vocabulary words can identify someone as "not one of us."[103]

FIGURE 5.5 Sharing information. This comes naturally for young children. Courtesy of Picture Partners/Alamy Stock Photo

Syntax

Words are sorted into categories that represent parts of speech—nouns, verbs, articles, adjectives, adverbs, and so on. In order to make spoken language meaningful, the parts of speech must function in a structure. Signs come alive with meaning in the structured way they are used. **Syntax** is the way the phonetic and semantic aspects of an utterance are structured into phrases according to rules that make utterances understandable. Syntax makes language **compositional**—capable of facilitating complex original phrases. Humans are the only animal species that has syntactic structures in their communication systems.

Grammar refers to how those rules function as a system. As children, we learn how to speak in ways that make sense by listening, repeating, and self-correcting through trial and error. We are usually introduced to the formal rules that govern language when we study grammar in primary school.

The dynamic interaction of morphemes—the smallest units of meaning—helps to create the overall meaning of an utterance. To understand how morphemes work together semantically, consider this sentence:

"The bird-like man hardly touched his food at dinner."[104]

The sentence contains 11 morphemes. Each morpheme contributes a distinct aspect of meaning to that part of the sentence:

The (article)
bird-(noun)
like (suffix, determines meaning of "bird")
man (noun)
hard (adjective)
ly (changes "hard" from adjective to adverb)
touched (verb, past tense)

his (possessive pronoun)
food (noun)
at (preposition, suggests time, event, or location to follow)
dinner (noun)

How do we know how to faithfully interpret this sentence? We need the rules of syntax to help solve the problem.

The sentence about the "bird-like man" contains nouns, verbs, adverbs, pronouns, and prepositions. The sentence makes sense because all the individual units of meaning—the morphemes—fit together in such a way they could be comprehended by a competent English speaker. If you were to throw the same words instead into a random order, the resulting word chain would be rendered difficult if not impossible to interpret, or at least not representative of the meaning the speaker intended.

Each morpheme contributes a distinct bit of meaning to a sentence. But the intended meaning can only be understood properly when we consider the utterance a whole. In this way, semantics and syntax work together. Semantics associates various morphemes with particular feelings, things, or conditions. Syntax organizes the elements of a phrase or sentence into rule-governed sequences that make a phrase or sentence comprehensible.

To summarize the process thus far, language production transforms sounds (phonemes) into units of meaning (morphemes) that make sense according to rules (syntax). Languages must be able to reflect and express the complexity of cognition. No other species has communication behavior that in any way resembles the complexity and precision of human language.

Pragmatics

Grammatical rules make the internal elements of language conform to each other in ways that insinuate meaning. But the words and the order in which they are expressed often don't give us enough clues to grasp the real meaning of an utterance as it was intended by the speaker. We need more information about the situation to know how to interpret messages. **Pragmatics** refers to how the physical and social and contexts of language production contribute to how the meaning of an utterance can best be interpreted.

The more we know about the context in which an utterance is made, the better chances we have to interpret the message correctly. It helps first of all to know who the sender of the message is and what that person's motives were for making the statement. But we also need to know about the circumstances in which the exclamation, phrase, or sentence was made.

Returning to our previous example, simply hearing or reading the sentence, "The bird-like man hardly touched his food at dinner" gives us no idea about who made the remark or what that individual's intentions were. We don't know who the man is. We don't know who heard those words. We have no idea where the comment was made, when it was made, or where and when the "dinner" was served.

In other words, we know nothing about the context of the utterance. You might imagine dozens of scenarios where the same sentence could elicit very different meanings. For example, was the man a prisoner? Was he ill? Homeless? Was he at home, institutionalized, or on the street? We have indications in the sentence that point to a sad scenario of some kind. But we don't have enough details to comprehend the situation more fully or know why he "hardly touched his food."

Apart from the syntactical rules that govern language, the way a remark is likely to be interpreted depends on who says it, who hears it, what the remark refers to, and under what conditions the message was sent and received. Until we know the circumstances that surround the production of an utterance, we cannot confidently interpret what it means.

Context and Environment

The **context** of communication refers to the immediate circumstances within which a particular interaction takes place. Context includes objective factors that center on the *where*, *who*, and *why* of the communications event. This includes the physical location or setting, the individuals who are present, and the occasion for the interaction. For example, imagine that you are helping a friend bake bread in the kitchen. When your friend asks you to pass the flour, you reach for the bag of white flour on the countertop and not the long stem rose sitting in a vase next to it. Context determined your response because it clarified the meaning of the ambiguous spoken word "flour."

Knowing the details of the immediate context helps the people involved better understand the meaning of a communications experience. This is true whether we are witnessing it from outside as an observer or living the experience from inside as a participant.

The **environment** represents a broader range of considerations that influence how messages are understood. We already have a general sense of what the term "environment" means in ordinary language. When we hear of "environmental conditions," we typically think of the various natural and material conditions that make up our surroundings, even on a global scale.

In communicative interactions, the environment consists of those factors that extend beyond the immediate situation (the context) that helps to frame and influence what happens. This includes but is not limited to the political, economic, and cultural circumstances that are in place when any particular communications event takes place. For example, significant changes in the political and cultural landscape in the United States took place in recent years. Those changes represented a reshaping of the communications environment.

Pragmatics helps us interpret communications events where we are not a participant, like comprehending the "bird-like man" example. But we routinely use pragmatics to manage the events that make up our everyday lives successfully. We automatically consider the context and environment to make the right interpretation of any comment.

Acquiring Language

For many years, debate has raged among language specialists about how people all over the world developed the common ability to create and use complex language. The primary questions that have driven the debate are straightforward: Is language skill somehow innately hardwired into the human brain? Or did language ability evolve the way other biological traits and behaviors came into being—primarily by means of natural selection?

Universal Grammar

The linguist and critical theorist Norm Chomsky wrote more than 50 years ago that every human being is born with an intrinsic sense of the implicit rules for language—what he called "universal grammar."[105]

Chomsky noted that while the observable surfaces of various languages differ, he believed that all languages have essentially the same underlying structure. They contain the same internal elements (for instance, phonemes and morphemes, verbs and nouns) and a means to blend them together in ways that make sense (syntax). According to Chomsky, a language template in the human brain initiates and guides communicative expression. The ability to speak a language arises inevitably as we mature biologically. That's when the universal language template becomes activated in each individual.

In Chomsky's view, the particular linguistic characteristics and vocabulary of various contemporary languages function only on the surface. He argues that the deep structure of all languages—a universal syntax—is built into our common biology as a specialized module in the brain. But if such a specialized language module exists in our brain, what is it and how did it get there?

Natural Selection

Evolutionary psychologist Stephen Pinker offers a more direct evolutionary perspective based on the principles of natural selection. Evidence from field studies shows that the birth, growth, and segmentation of language into interacting elements developed gradually over thousands of years through processes of natural selection.[106]

Pinker points out that many other seeming universals also exist in nature, including the body types of many advanced animals. For instance, amphibians, reptiles, birds, and mammals all have common body architecture: a segmented backbone, four jointed limbs, a tail, and a skull.[107] These structural similarities in body type all evolved by means of natural selection that took place before the various classes of animal descended from their common ancestor. Our species' language instinct had to have arisen over vast expanses of time, the same way the rest of our biology and behavior evolved.[108]

Complex biological systems emerge through the gradual accumulation of random genetic mutations that take place over thousands of generations. The mutations are acted on in ways that increase the organism's chances for survival and reproduction. For humans, a diverse set of complementary biological adaptations, including bipedalism, a large and complex brain, and the larynx and other associated speech organs, had to be in place before language could emerge. Our ancestors were using some form of language before they left Africa. The subsequent growth and spread of language depended on conditions in the social and cultural environments where the ancestral tribes relocated.

Evolution of Complex Forms

Complex language evolved through the same kind of natural processes that created the eye, which is itself an extremely complex organism.[109] The eyes of various species evolved in ways that respond to their particular needs. For instance, some species have forward-facing, stereoscopic, or binocular vision that allows them to clearly see objects in front of them. Besides humans, other species including the other apes, monkeys, and dogs, as well as predators like wolves, lions, and hawks have front-facing eyes that allow them to focus on their prey. Other species like rabbits, deer, most fish and small birds have eyes that function independently on both sides of the body to allow for greater peripheral vision. This arrangement gives them better chances to see and escape predators. Some species have but one eye. Others have four, six, eight, or more—always for reasons directly related to survival and reproduction.

Like all other species, human eyes evolved to their highly functional state by means of a buildup of tiny random improvements that accumulated over hundreds of thousands of years in the life forms that came before us. The predecessor to the eye was a less differentiated organ that was sensitive to light. Letting in more light was a gradual process influenced by natural selection. Throughout the stages of our history, the ancestral individuals lucky enough to survive were the ones who could see slightly better than their less-sighted rivals, giving them a clear reproductive advantage.

Languages evolved into complex communications systems the same way. Each element of language added a clear communicative advantage or it wouldn't have evolved. The adaptations that enabled the emergence of language have been in place for so long that the ability to speak a

language became hardwired into our DNA. No antecedent language template needed to be activated. Instead, we have a language instinct that has been forged over long expanses of our evolutionary history.[110] The cumulative effect of the natural selection over more than two million years created the extraordinary instinct for language we have today.[111]

Usage-Based Language Learning

Natural selection created the potential for learning to speak and understand language, but how did we actualize that enormous potential?

Language ability is made possible in part because of the mental abilities that evolved within our species. Our ancestors inherited multiple general-use cognitive tools, including the ability to categorize things in their environments; understand analogous relationships among those things; read the communication intentions of people; and absorb the sound, meaning, and rules of the developing language(s) they heard. Learning a language well became the practical application of these interacting abilities. The theory and research that underpins the acquisition of language is **usage-based language learning**.[112]

We gain insight into how language ability evolved in our species by observing how children acquire language today. Children are energetically predisposed and capable of learning language on their own. From the moment of birth, babies express their physical states and emotions by making sounds, facial expressions, and nonverbal gestures, like pointing. The infant's brain instinctively wants the organism to communicate. It doesn't care if the tongue, face, or hand does the signaling.

Babies cry and babble at two months old, begin to repeat soft vowel-like sounds (ooooh, aaaah) and add consonants around ten months, then single words, two-word phrases, and finally proper sentences by four years of age. During that time children grow cognitively by leaps and bounds. By six years old the average child has a vocabulary of about 13,000 words.[113] Young children learn language by first hearing and imitating grammatical patterns; later they figure out the rules that govern language through creative trial-and-error experiential learning. Like other cultural traits, children learn the norms for using language from everyday experience. Driven by the powerful need to understand and be understood, they unconsciously conform to linguistic and cultural norms.[114]

Conversation

Technology offers us many ways to communicate. But unmediated spoken language remains the most widespread and useful form of communication for most people. Spoken language quickly and efficiently moves ideas and information from one person to another. We can say about 150 words per minute. The average typist on a full-size keyboard manages 50–70 words per minute. Texting on mobile devices reduces that average to 35 words per minute.

Spoken language gives people a readily accessible vehicle through which they can coordinate their activities with others in order to accomplish specific tasks efficiently. But many of the reasons we have for talking don't have obvious practical purposes. We also causally converse, and that is equally important. Engaging in **conversation** is a social skill that advances the evolutionary interests of the participants.

Many public places have been created to provide space for people to gather for conversation. Some of those places have played important roles in history, particularly in Western cultures, before electronic and digital media arrived on the scene. In London in the 1600s and 1700s urban coffeehouses were meeting places where educated men could carry on wide-ranging discussions about politics, business, and philosophy.[115] Taverns played the same role in the early history of the

United States. Much early American political history was shaped by men conversing in "drinking houses."[116]

Conversations that were held in European coffeehouses and in American colonial taverns gave birth to the concept of the **public sphere**—a discursive space where open, rational discussions about the pressing issues of the day could be conducted. That idea was vital in shaping young democracies centuries ago. The philosophy it promoted still has relevance.[117]

Except for the occasional town hall meeting, discussions that enliven the public sphere today have shifted from physical locations toward mass and social media. Much of the dialogic nature of the public sphere is lost with the change from live to mediated venues. Mass media, including Fareed Zakaria's *GPS: The Global Public Square* on CNN, limit participation to experts. Social media "conversations" often descend into diatribes and personal attacks.

Unmediated, informal conversation remains central to the conduct of everyday life. Although cultural groups differ in how their members converse, when people get together anywhere, they almost always feel *a need to talk*.

Conversing provides clear evolutionary benefits. First, talking informally creates a unique feeling of social belonging, helping to fulfill an essential human need.[118] Second, debating issues that emerge in conversation often advances the interests of those persons who are most persuasive and the communities to which they belong. And third, chatting conversationally provides an opportunity for people to identify individuals they believe threaten the stability of the community in some way.

We now explore how conversation takes form in social grooming, mediated discussions, gossip, and argument.

Grooming

Addressing someone vocally is not completely unlike touching the other person; that's one reason why some conservative societies forbid young people of different genders or social classes from talking to each other or sharing common space without supervision. But because social interaction is so natural and necessary, most people in modern societies easily engage in friendly conversation in lots of situations, at times even with strangers. With our friends, we make it a point to "stay in touch" with in-person get-togethers, social media posts, text messages, and phone calls.

Our unique communication skills give humans various ways to establish and maintain social relationships that other animals don't have. Yet the need for repeated intimate contact drives other animals' behavior too. One primary way non-human social animals develop and nurture relationships is by grooming each other physically. Apes, monkeys, horses, big cats, and birds all engage in frequent reciprocal grooming.

Being willfully touched releases pleasurable endorphins in the brain. Stroking, rubbing, scratching, massaging, tickling, and petting all produce a chemically induced drug-like effect within and across species. The individual who provides the service also feels pleasure. Think of the joy dog owners and their pets experience through petting and grooming.

The beneficial effects animals get from grooming are not just physical or chemical. Ridding each other of fleas, ticks, mites, parasites, and dirt also enhances the condition of an animal's skin, fur, or feathers, thereby improving health, survival rates, and mating opportunities. But apes and monkeys regularly groom each other to develop and maintain friendships, affirm family bonds, reconcile differences, settle conflicts, and reduce boredom.[119] Grooming became common behavior in many species because it provides clear evolutionary benefits centered on social bonding.

For humans, informal conversation among friends serves as social bonding that produces pleasurable effects similar to physical grooming. Intimate couples make time for each other to talk and

FIGURE 5.6 Macaques. Japanese macaques make unique vocalizations to communicate when they want to groom or be groomed. Courtesy of Pratchaya.Lee/shutterstock.com

FIGURE 5.7 Human grooming. We groom each other through touch and talk. Courtesy of Wavebreakmedia/iStock.com

touch. Casual friends come up with a good excuse to get together and catch up. Conversations provide opportunities to reinforce positive human connections. We consult our friends in times of need, but to varying degrees, we also value a "good talk" no matter what the subject. Vocal grooming gives people a chance to simply spend time together, sometimes in pairs, other times in small groups. Our ability with language combines with our eagerness to converse and maintain

friendships in ways that allow us to groom each other conversationally as a form of cooperative communication behavior.

Media Conversations

Casual conversation is so essential to our well-being that it has been appropriated widely by the mass media as a popular genre—the talk show. The success of social media depends on conversation.

Mass Media

Commercial electronic media are particularly good at identifying human wants and needs and finding ways to gratify them. Television talk shows like *The Tonight Show*, *The Late Show*, *Ellen*, and *The View* give viewers opportunities to vicariously drop in on conversations involving people we know. The radio talk show became one of the most successful contemporary radio formats. Emotion and conflict are emphasized because lively conversations on television and radio achieve high ratings.

Conversation has also become a political trope that inevitably appears when polarizing topics arise in public discourse. Politicians and cultural commentators in the media often talk about the need to "have a conversation" about race relations or gun violence, for instance. One way the electronic media wield tremendous political and cultural power is by determining which of countless possible conversations will actually take place. A topic rises to the level of conversation only when television news producers and radio hosts deem the subject matter important or provocative enough to attract a wide audience.

The electronic media not only determine what topics get attention and who gets to speak about them, they also determine how those conversations unfold. Part of learning how to speak a language conversationally is to know when to talk and when to keep quiet. Parents teach their children when they are allowed to enter a conversation without interrupting it. As adults, we follow implicit general rules of **turn-taking** in conversation—I don't talk when you do, and you don't talk when I do.[120] Part of the art of conversation is allowing other interactants to finish their contribution to the flow of talk and then choosing the right moments to say something yourself. These patterns have been worked out in conversation throughout our history as a species, perhaps dating back to the era of protolanguage. Just as children learn not to interrupt, some primates learn to wait their turn when making calls, suggesting that conversational turn-taking long predates the evolution of language.[121]

The rules of conversational turn-taking differ from culture to culture.[122] Social power differences between interactants (especially male-female, boss-employee, parent-child) influence the flow of conversations as well. Gender greatly affects conversational turn-taking in mixed groups, with men interrupting women much more frequently than the other way around.[123]

Controlling the flow of conversational turn-taking represents another type of power exercised by media talk-show hosts and interviewers. They determine who gets to talk and for how long. The hosts freely interrupt or hang up on guests or interviewees according to their own agendas and schedules in ways that ultimately reflect the political, economic, and cultural biases of those who own the media outlets.

Social Media

Social media platforms make it convenient, fun, or otherwise satisfying to start a conversation or reply to others' posts and comments. The platforms encourage users to form friendship networks. They then exploit the natural tendency for friends to communicate with each other regularly. For

example, every time someone logs on to Facebook, they're immediately asked, "What's on your mind?" That gets many conversations going. But social media platforms also make it easy to join a conversation that is already underway. Responses to others' posts or comments include "like," "share," "vote," and "comment." An explicit emotional dimension can be added from the ever-expanding inventory of emojis.

The success of social media also depends on our psychological need to groom each other with conversation. Because social media friends tend to think alike, many of the conversations are supportive. Just as some people prefer to use their phones to text rather than talk, social media also provides a channel for initiating or entering a conversation.[124] But some online discussions quickly turn toxic, especially in today's polarized political environment.

Gossip

Chatting informally in person with family, friends, neighbors, and coworkers gives people an opportunity to talk about others—and not always favorably. That kind of conversation is popularly known as **gossip**.

We typically think of gossip as malicious behavior that serves no positive purpose and reflects poorly on those who do it. That can be true. But from an evolutionary perspective, policing the community through gossip and rumor serves as one way to enforce the group's social and cultural norms. Maintaining a stable community makes individuals feel safe and secure. Gossip protects those communities by identifying outliers—individuals who act in ways the group does not approve. Violators of community norms that are identified by gossip can then be ostracized by the group and kept from harming its members.[125] Bad actors can also be encouraged to reform in order to become more cooperative community members.[126]

Social surveillance like this formed originally when we lived in small communities. Our communities have become much larger in the modern world. Furthermore, we simultaneously live in more than one community. We may have a strong sense of community about the neighborhood where we live, the place where we work, or, for religious people, the setting for worship. Online communities abound. We get to know lots of people in all these locations and develop opinions about their trustworthiness. Individuals don't always have the same standing in the various communities to which they belong.[127]

Media Scandals

For decades, Americans have relied on responsible investigative journalism to provide reliable clues about who to trust in society. But in today's political and cultural environment, the media have hit new lows in the ways they are regarded by the public.

Mainstream media's low rating for trustworthiness doesn't mean people don't want to know about the scandalous behavior of public figures and celebrities. Media outlets like cable television channel TMZ, the *National Enquirer*, *Hollywood Star*, and *People Magazine* purposefully try to uncover and even create scandals as their primary content.[128] Internet sites including The Drudge Report, The Smoking Gun, and TMZ.com do the same. These media attract large audiences who take advantage of the natural interest we have in gossip and scandal, particularly when they are related to sex and money.

Social media extend all these tendencies by encouraging users to share provocative content within their online friendship networks, though this practice has come under sharp criticism recently. Still, the widespread attraction of mass media and social media is rooted in our evolutionary disposition toward getting useful information and maintaining stable communities.

Argument and Persuasion

Most people will readily express a point of view about topics being discussed in friendly conversations. They're expected to do so. When participants hold back, they are often encouraged by others to state their opinion as in, "What do you think about this, Erin?"

Making an **argument**—advocating a position on an issue and supporting it with evidence—is one powerful way people use language to influence other people in everyday interactions. Conversations provide constant opportunities for people to sharpen their ability to argue and persuade. **Persuasion** relies on the expert deployment of language and other symbolic forms to shape people's values, attitudes, beliefs, or actions.[129]

The history of argument and persuasion can be traced back to factors that stimulated social communication in the first place. Motivated individuals who believed they had valuable information urged others to act on that information (**Chapter 3**). When those others benefit from shared information, the behavior of the source is often reciprocated. That's one way tribal communities formed; chose their leaders; and developed into cultures with rules, norms, and laws.

Language and culture evolved together, each nourishing the other. As our ancestors developed more complex cultures, their attempts to persuade became increasingly elaborate.

Making things happen in our economic and political systems today hinges on the rhetorical power of persuasion—probably too much so. But the outcome of any attempt to persuade ultimately depends on how those who receive the message react.

Language is an integrated symbolic code that makes it possible to use evidence and reason to fashion a persuasive argument even in casual conversation. The ability to uncover and present information, judge its validity, and draw conclusions based on logical reasoning confers a strong evolutionary advantage on those who can manage to do it. Logical reasoning—a key to human evolutionary success and enlightenment—became a crucial cognitive skill that emerged over time. It springs directly from our deeply held instinct to share information and argue. Logic-based argumentation appears in conversations taking place in every cultural group on earth.[130] Throughout evolutionary history, those individuals who proved to be most persuasive with language became the winners in the game of natural politics or clever enough to align themselves with those who win.[131]

Chapter Summary

When our early ancestors began to explore their potential to communicate vocally, they were developing the most powerful resource known to humankind—language.

Biological evolution provided the anatomical and auditory resources necessary for the ability to speak. Then culture took over. Although other animal species have developed communication systems, our most useful ability—complex language—is unique to our species. Even without training, every able-bodied person learns to speak.

Spoken language evolved in three stages—pre-language, protolanguage, and developed language. Each stage represents a long period of time and the stages are not easily distinguished from each other. The pre-linguistic stage was marked primarily by physical adaptations. The vocal tract emerged. Brain size and complexity increased to include an extensive nervous system. A speech and language gene developed. Crude vocalizations could now be uttered in tandem with gestures to communicate messages that enhanced survival and reproductive opportunities. The ability to share basic information inspired greater social cooperation.

Throughout evolutionary history, the production of rhythmic sound and the socially coordinated body movement that goes with it have played profound roles in creating and sustaining

human communities. With their roots in biology and culture, music and dance shaped human evolution in uniquely functional ways.

During the protolinguistic stage, all the tendencies of pre-language were intensified. More abstract ideas could now be communicated because the phonetic and semantic diversity of language was increasing. Protolanguages helped to forge and cement social relationships that were becoming increasingly interdependent.

Developed language—the third stage in the evolution of spoken language—became much more comprehensive. The sounds we uttered (phonemes) became differentiated in ways that allowed more meaningful linguistic elements associated with semantics (morphemes) to emerge. The increasingly complex meaning units became governed by rules (syntax). Pragmatics provided extra-linguistic clues for how to interpret a speech event by considering the context and environment.

Developed languages were being shaped by tribal populations in the various geographical places and sociocultural situations where the migrants settled. This adaptive process gave rise to a diversity of languages around the world. Proto-Indian-European language served as the root of most languages spoken in the Western world today.

Language allows us to interact socially and share information in progressively powerful ways. Human brains were preprogrammed by natural cognitive growth to acquire language skill. Usage-based language learning displaced the theory of universal grammar as the best explanation for how language evolved and is acquired by children today.

The pressing need to engage in conversation gives people constant opportunities to use their most accessible and powerful symbolic resource. Conversation functions like physical grooming to develop and maintain social alliances. Modern communications technology has expanded the reach and impact of conversation. When people chat, they sometimes gossip about other individuals, serving as an informal system of social surveillance that protects the interests of the community. And conversations give individuals frequent chances to hone their skills of argument and persuasion, which creates evolutionary advantages for those who become most effective.

Language developed slowly as a productive response to the challenges faced by our ancestral communities at various stages in history. The proliferation of complex social and technological development accompanied development of our unique ability with spoken language. Spoken language became the platform for every subsequent advance in human communication, including writing, the subject of the next chapter.

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6

WRITTEN LANGUAGE

It's impossible to know when our ancestors first began to speak, but we have a very good idea about when they began to write. We also know why our ancestors invented writing. Writing solved practical problems that the limitations of oral communication could not overcome. The ability to write and the written documents that were created soon became recognized as highly valuable resources that the cultural and political authorities of the day were determined to control.

In this chapter you will learn how, when, and where written language, including mathematics, originated. You'll see how written language evolved through many stages until it could represent the full spectrum of spoken language and beyond. Finally, you'll learn why written communication was crucial to the development of human civilization and how everyday life with computers and social media has changed the ways we use language to communicate.

Origins of Writing

Writing emerged initially in Sumer, one of the world's first urban settlements. Sumer is located in the southernmost part of ancient Mesopotamia—the Middle Eastern land mass that lies between the Tigris and Euphrates rivers. This area makes up large parts of present-day Iraq and Syria. Sumer and Mesopotamia are situated within the broader Fertile Crescent, the part of the world where the Agricultural Revolution began 12,000 years ago. The terrain, water supply, and climate in Mesopotamia at the time were ideal for edible plants to grow profusely, which proved to be key for transforming Sapiens' way of life.

The Agricultural Revolution

Our tribal ancestors survived as hunters and gatherers for tens of thousands of years before the Agricultural Revolution. Tribes followed the migration of wild animals as their main source of food. But by thinking innovatively, people living in Mesopotamia discovered they could better survive by systematically growing native plants, domesticating animals, and settling down in one location. Wild wheat, barley, flax, chick peas, and other grains and legumes could be planted methodically and harvested annually as dependable sources of food for people and livestock. Goats, sheep, and pigs were domesticated during this period, and later cows, oxen, and horses were tamed for food and labor.

What does all this have to do with the invention of writing?

By planting crops and domesticating and herding animals, the relationship between human beings and their food sources radically transformed the way humans live, not completely for the better. As people settled down, they became less physically active and began to depend on carbohydrate-rich grain as a major food source.[1] Mesopotamia and the Fertile Crescent have been called the "cradle of civilization" for good reason. Agriculture became a way of life that spurred the rise of complex urban societies. Village communities sprung up. Small settlements turned into cities. Individual members of the growing populations had to learn how to live close to each other.

With the change from nomadic life to settlements, the daily search for sufficient caloric intake needed to stay alive had been alleviated. Time took on a very different meaning. Individuals were learning that communal life requires that people depend on each other in many ways. Instead of having to fend for themselves every day in every way, people could now concentrate on specialized tasks. Social class inequalities began to widen way beyond what they had been in hunter-gatherer groups. Political and religious leaders emerged.

The increased density of human populations and the division of labor within agriculture-based communities sparked the invention of new tools, including wheeled carts. An elaborate system of barter was created, trade within and between communities flourished, and a growing regional economy was born. Tremendous innovations in technology, art, and architecture would later emerge. The massive cultural changes that occurred during the Agricultural Revolution prepared the ground for the way we live today.

Demand for Writing

As trade within and between communities expanded, a need was created for individuals who were capable of keeping track of financial transactions and other persons who could adjudicate disputes.

Before writing, the only way to store information and keep track of things was to memorize using spoken language. But memorization was no longer tenable for these purposes because simple cultures were maturing into complex civilizations. The constraints on human cognition also played a role; our brains have limited capacity to remember things and are prone to error. Moreover, evolutionary pressure had shaped the human brain to focus on the things that mattered most: sources of food, contours of territory, shapes and sounds of useful and dangerous things, and histories of social relationships.

Writing—a remarkable technological advance—emerged out of practical necessity in a budding civilization. With the huge amounts of information being generated, a more efficient "data processing system" was needed. A reliable system could keep track of all kinds of relationships between and among people, especially debts and social commitments, all of which were becoming increasingly complicated in a growing population.[2] The system that was created to respond to these demands was written language. Writing emerged between 5,500 and 5,000 years ago during a period known as the Bronze Age because the first metal alloys were being fabricated at that time as well.[3]

Written records became the first form of embedded knowledge. At first, writing served to document ownership of property and to record transactions having to do mainly with agricultural products and merchandise. Among the oldest written artifacts to have been uncovered are lists of goods, invoices, shipping and receiving records, salaries, and borrowing and lending documents.[4] But commerce would eventually also require written forms, calendars, tables, accounts, catalogs, and a host of other kinds of documents that could be used to count and categorize the stuff of everyday life. Creating written documents accelerated the pace at which business could be conducted.

Written records also provided valuable evidence and insight into who could or could not be trusted within the area's rapidly expanding human populations. To assure accountability, individuals

involved in commerce needed a written symbol that would serve as their identifying mark. The idea of **signature**—a distinctive way of writing one's name for identification purposes—was born. The linguistic root of the word signature is "sign." The first recorded name in history does not belong to a prophet, poet, or conqueror but to an accountant.[5]

Later, written signs that refer to more abstract concepts and actions appeared. Not only the name of a person but the individual's title, the names of temples and gods, and pleas for life after death were among the first words inscribed on the tombs and statues of Mesopotamia.

First Stages of Writing

Evolution unfolds as chains of endless adaptations made by life forms in ways that enhance their potential to survive, reproduce, and express themselves. Think of how Darwin's birds and tortoises adapted to local conditions on the various Galapagos Islands, for instance. But Sapiens is the only species that can self-consciously change its living conditions for the better. Writing allowed us to substantially transform our social and physical environment.

The original innovation in Sumer that led to the invention of writing was the sculpting of symbolic **commodity tokens** out of wet clay (**Figure 6.2**). Each clay token represented an item that was owned or traded by an individual. The tokens were referential; they stood for something else. For instance, a small cone stood for a small bin of grain. A larger sphere represented a large bin of grain. An egg-shaped token designated a jar of oil that was used for caulking structures and fueling lamps. Taken together, tokens like these formed the first scripted communications code and represent the first stage in the development of written language (**Table 6.1**).

The tokens had specific meanings that were commonly understood. But the significance of any particular assortment of tokens did not depend on how the pieces of clay were arranged. The first written code lacked a means for understanding relationships among the elements involved—syntax.

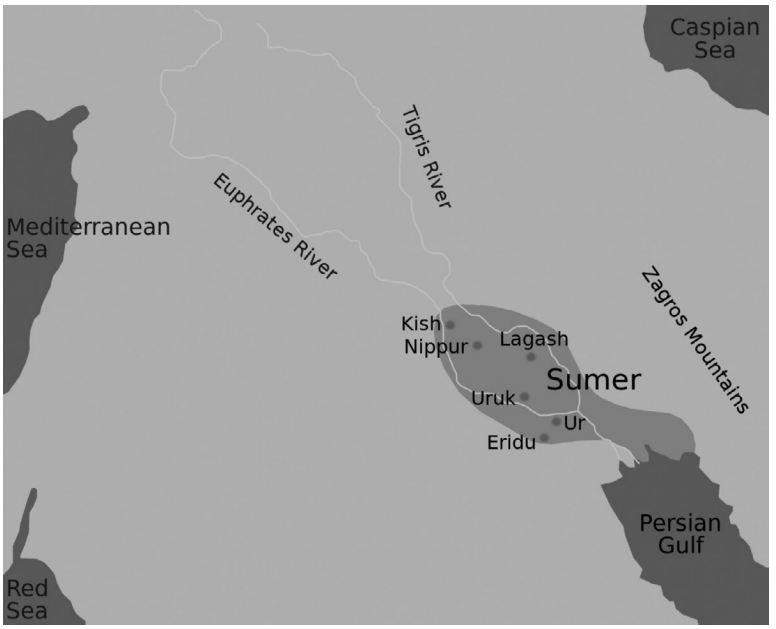

FIGURE 6.1 Mesopotamia and surrounding regions. Courtesy of Wikimedia Commons

TABLE 6.1 Stages in Development of Writing

Commodity tokens made of clay
Impressions of tokens on exterior of clay bulla
Impressions on soft clay tablets
Pictographs representing physical objects and actions
Cuneiform writing system using pictographs
Mathematics
Phonetic signs
Alphabet

FIGURE 6.2 The bulla and commodity tokens. Tokens like these were stored inside the bulla but also pressed into its soft exterior, inspiring the next step in the invention of writing. Courtesy of Denise Schmandt-Besserat/Musee du Louvre, Paris

Tokens owned by an individual or a family were kept inside a large, hollowed-out clay ball called a **bulla**. The bulla functioned as a safe. To prevent tampering, the opening to the bulla was sealed with a veneer of clay applied by a government official who represented the growing city-states. Only state officials were authorized to open or close the bullas.

It was not possible to see inside a bulla without opening it. This limitation prompted a second step in the history of written language. To solve this problem, government accountants pressed the side of the tokens into the bulla's soft clay exterior before placing the tokens inside. The impressions that were left on the outside of the bulla indicated what was stored on the inside.[6] Those faint impressions represent the second stage in the evolution of written language.

The markings that were pressed into the side of the clay bullas gave rise to a much better idea for documenting the contents. Rather than refer to barely legible marks imprinted on the exterior of the curved bullas, why not make more distinct engravings onto flat clay tablets? The tablets could then be used to represent the bulla's contents. Relocating the impressions from the side of the clay balls onto clay tablets represents the third stage in the development of writing (**Table 6.1**).

Writing Technology

Wooden sticks shaped into styluses with sharp, pointed edges were used to carve impressions into the clay tablets. Simple slash marks indicated quantities of property, like the number of bins of grain or heads of cattle. But the system of commodity tokens pressed into clay proved to be way too limited to properly represent the range of things and concepts that needed to be identified, counted, and recorded in the expanding Sumerian culture.

In order to represent a broader range of categories with writing, a creative system of **pictographs** engraved in clay was devised. Pictographs are analogical images that represent objects and actions; they look like what they stand for. For example, an image of a cow's head stood for a cow. The outline of a fish represented a fish. Other pictographs were more imaginative, like three semicircles arranged in a triangle to represent "mountain" or parallel squiggly lines to mean "water" or "river." Later, simple actions, not just things, could be communicated by combining pictographs. For instance, an etching of a hand together with the etching of a mouth positioned next to the symbol for bread meant "to eat."[7]

Sumerian writing developed over more than a thousand years by refining the technology and symbolic nature of the pictographic system. The first writing system that used elaborate pictographic technology and symbolism is called **cuneiform**, after the Latin word for wedge, referring to the shape of the writing utensils. With cuneiform, the Sumerians had created the first written language.

The idea of **literacy**—the ability to read and write—was born along with the development of writing technology. Eventually, complicated government decrees, letters, and oracles—godly advice given by religious priests and priestesses—could be expressed in cuneiform and delivered to their designated recipients.

Because they are eye-catching, efficient, and easy to decode, modern versions of pictographs are still used today to send messages, especially when safety or message clarity are the primary

FIGURE 6.3 Clay tablet. Pressing the edge of a stylus into a soft clay tablet made clear and lasting impressions as the clay hardened. Written language developed from cuneiform script like this. Courtesy of Adam John Figel/shutterstock.com

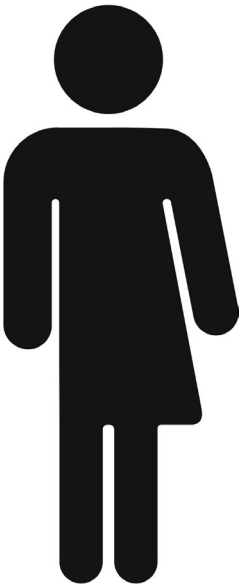

FIGURE 6.4 Pictograph representing an all gender safe restroom created by combining existing pictographic images representing "man" and "woman." Courtesy of Gardashov Javidan/shutterstock.com

considerations. Many icons like those found on your computer and the emojis you might use for texting or messaging are contemporary pictographs. Many of the logos that represent products and institutions today also draw from the communicative power of pictographs. Think of Apple, Shell Oil, or Target stores, for example.

The Language of Mathematics

The use of clay tablets improved the Sumerian writing system, but the impressions that were made remained fundamentally identical to the earlier system; the symbolic marks that were chiseled in clay had the same meaning as the tokens. However, one extraordinary improvement was made at this stage in the development of written language: Sumerian writing began to contain symbols that represented different linguistic categories. Some written marks represented objects, while other symbols stood for quantities.

This functional distinction in basic types of symbolic forms made written language more efficient. For instance, rather than use 33 icons representing grain to indicate 33 bins of grain, three different symbols could be used in combination to represent the same thing. One symbol stood for a type of grain, another sign stood for ten units, and a third sign represented one unit. Thus, in place of 33 indentations on clay tablets, only seven were necessary: grain, ten, ten, ten, one, one, one.[8]

Mathematical notation—itself a special kind of written language—was born in the form of written script.

The development of mathematics—the universally understood and most commonly used language in the world—was an unforeseen but logical outcome of the evolutionary pressure to document everyday things. The first applications of simple mathematics were for solving practical problems. To do so, a new kind of information—bits of data—had to be managed, made permanent, and stored. Possessions, transactions, taxes, debts, and discounts needed to be calculated and

registered.[9] More complex calculations, including plans for digging irrigation plots and architectural designs for constructing temples, palaces, and other large buildings, had to be made.[10]

All the breakthroughs made in mathematics since the time of the Sumerians can be attributed to the birth of the brilliant idea to simply write things down. Making slash marks on clay tablets was the first way to document quantities. But more complex forms of mathematical expression were needed. For instance, a system of fractions was required to divide the ownership of property shares fairly. Sumerian fractions were calculated from a base number of 60.[11] That base number remains with us today: One minute is 60 seconds, an hour is 60 minutes. A circle is comprised of a multiple of 60–360 degrees.

Higher-level mathematics would be necessary to accomplish what the Sumerians and other populations in Mesopotamia needed to do over the long term. To accomplish their goals, the mathematical system of written notation would eventually require a complement of complex written symbols—signs, equations, tables, diagrams, graphs, formulae, and the like.

The original forms of mathematical notation were invented by adapting the existing ideographic and pictograph symbols of written language and using the new forms for very different purposes. As the system grew in sophistication, mathematical notation allowed people to visualize certain abstract relationships in ways that spoken language could not inspire.[12]

Speaking, Writing, Doing Math

Every stage in the evolution of human communication stimulates new ways of thinking. For example, the development of spoken language made it possible for our ancestors to become more efficient communicators of simple messages. But speaking also empowered them to think in new ways, use their imaginations, and "say" much more than gestures alone would allow.

Writing later became a means not only to document physical materials and track social relationships but to engage in powerful new levels of abstract thinking, reflection, analysis, and criticism. Thinking and writing are inextricably intertwined.[13] The advent of written language signals a major milestone in human cognitive development. Expressing one's thoughts through writing puts pressure on the author of a message, no matter what the content or technology involved, to communicate information or ideas clearly and persuasively.

When functioning at its best, human communication is interactive. Written texts become avenues for presenting information and expressing fresh thoughts that can be read by others, provoking innovative thinking and writing on their part too. The perspective provided in this book, for instance, draws factual information and inspiration from many kinds of texts and images presented in multiple media that were written by hundreds of authorities. Hopefully, some of what is written in this book will inspire you to think in new and productive ways too.

Like spoken and written words, the notational symbols and numbers that make up mathematical systems function as communication resources. Mathematics became a special type of written language that is made comprehensible to all its users because of the symbol system it employs and the patterns of meaning it creates through use.

Beyond the applied computational advantages, mathematics can also be considered a vast and unique man-made imagination machine.[14] Mathematics inspires thinking that greatly transcends its original functions—counting and documenting quantities. The language of mathematics is a *method of reasoning* that makes technological development possible. The mathematical notations first created by Mesopotamian cultures to accomplish spectacular engineering feats more than 4,000 years ago set the stage for all kinds of advanced thinking.[15]

Centuries after the first mathematical notations were etched onto clay tablets, the field of mathematics became the launching pad for science, technology, and engineering. Mathematics and

science intersect to help people make predictions. Math-based languages are used to write programs and algorithms for computers, law, and medicine. Computational skills associated with math make it possible to calculate, check results, verify, compare, and decide on a course of action.[16] Expressions like "do the math" or "check the math" suggest that some irrefutable evidence can be summoned to validate an argument or point of view being expressed about almost anything. In persuasive public speaking, deductive reasoning, like we find in mathematical proofs, is one powerful way to link the presentation of evidence in an argument to a claim in order to draw a logical conclusion.[17]

MATH IN POPULAR CULTURE

People who are good at math and really love it have traditionally been negatively labeled "geeks" or "nerds." But with the technological breakthroughs of the early twenty-first century, especially the dominance of personal computers and other digital devices, people who enjoy math have gained a much more favorable social status. Geekdom is celebrated today. Nerds are getting their revenge.

Math fans have lots of places to share the love. Hundreds of twitter feeds like @mathtourist, @humancalculator, and @Mathocist provide opportunities for math enthusiasts to interact. Math-centric websites in many languages and countries attract countless followers. Facebook pages such as mathmemes and welovemaths invite participants to solve puzzles and play mathematics-based games. Even the old math club at high school projects a more proud image now.

Beginning in the1800s, technological advances made possible by the application of advanced mathematics to modes of human communication would produce the full spectrum of mass media, Internet, popular culture industries, and content providers that are around today. Two popular media forms—music and movies—provide particularly striking examples of math's influence.

Math drives the technology that creates popular music. The floodgates opened wide when technical engineers amplified the sound of the acoustic guitar with electricity. That's when rock and roll was born—in the 1950s. Youth culture suddenly had its own cultural space.[18] Later, wah wah and fuzz pedals expanded the range of tones guitars could produce, giving musicians new avenues of expression. Superstars like Jimi Hendrix and Pete Townsend of The Who used distortion, feedback, and destruction of their instruments to produce extreme effects.

Sound engineers became *de facto* band members beginning with the first electronic groups like The Human League, New Order, and Depeche Mode late last century. Audio synthesizers generated sound waves whose intensity, duration, frequency, and timbre could be modified to create audio textures. Machine-generated dance beats brought us disco, new wave, house, and techno. Those developments opened up massive musical and cultural space for the current generation of electronic dance music and alternative genres, like symphonic metal. The synthesizer became the "folk instrument" of late last century. The computer is the folk instrument of the early part of this century.

Mathematics has gone to the movies, too. Like music, much of the math that propels the film industry exists behind the scenes. Math-savvy technical directors and their crews produce thrilling visual effects. Directors shoot digital footage on their phones. Producers and

their accountants determine how millions of dollars will be invested in talent and equipment. Movie theater operators expand their technical capacity to accommodate laser-based 3-D and IMAX.

Some of the best films in recent years feature mathematicians in front of the cameras as central dramatic characters. For instance, *The Man Who Knew Infinity* tells the story of twenty-five-year-old Indian math genius Srinivasa Ramanujan. The life of the eminent English theoretical physicist Stephen Hawking was the subject of *The Theory of Everything*. The film *A Beautiful Mind* was based on the life of Nobel laureate in Economics, John Nash. The mathematician who decrypted German intelligence codes for the British government during World War II, Alan Turing, was the main character in *Imitation Game*. The plot of *The Martian* revolves around Matt Damon's calculations of what it would take to survive indefinitely after being left behind by his crew on the red planet.

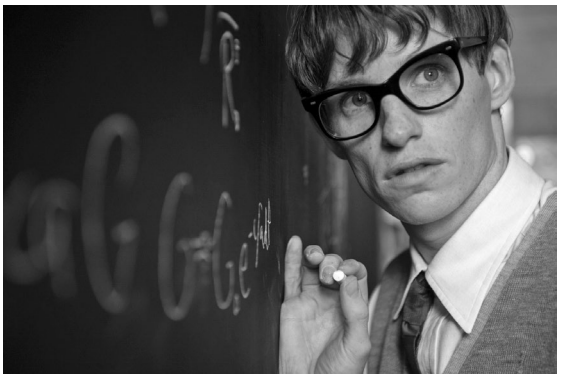

FIGURE 6.5 Eddie Redmayne. He won an Oscar playing Stephen Hawking in *The Theory of Everything*. Courtesy of Photo 12/Alamy Stock Photo

Other people who are good in math—like Bill Gates, Neil deGrasse Tyson, Bill Nye the Science Guy, and Tricia Berry—have become some of the top thinkers and stars of contemporary popular science. They merge math, science, academics, and popular culture into one piece that appeals to wide audiences while at the same time advancing science and promoting technological development.

Using Three Kinds of Language

Spoken language, written language, and mathematics function as tools that represent three intersecting systems of human communication.

The three languages differ in their essential qualities. Spoken language has a constricted range of phonemes. Writing draws from a limited alphabet and vocabulary. By contrast, mathematics' "alphabet," which is numerals, has no upper limit. Numbers express quantities in precise terms while spoken and written languages can be extremely vague, even by intention of the source. Mathematics is not bound by context or circumstance; two plus two is four all the time. This unwavering precision led great ancient philosophers like Plato and Pythagoras to see mathematics as a path to divine knowledge.[19] Messages transmitted by spoken and written languages, on the other hand, acquire their meaning from the way their grammatical elements are interpreted. The pragmatics of context and environment also play a determining role in what is communicated (**Chapter 5**).

All three types of language have built in limitations, but each one empowers more than it constrains. Spoken, written, and mathematical languages can be used separately or in combination to convey an unlimited range of ideas.

Other Early Writing Systems

By the time the Agricultural Revolution was underway in the Middle East, other ancestral tribes had spread throughout much of the rest of the world, including Asia and the Americas. Three other independent writing systems evolved: Egypt (4,500 years ago), China (3,500 years ago), and the Mayan culture of the Americas (3,000 years ago). The great success of the Sumerian, Chinese, Egyptian, and Mayan empires was directly attributable to their ability to archive, catalog, and retrieve written records.[20] All major writing systems today descend from these four written languages.[21]

Egypt

Like Sumerian writing, a system of pictographs formed the basis of written communication in Egypt. The Egyptians made thick, durable writing surfaces out of papyrus. They hollowed out reeds as writing utensils, which they dipped into a soluble mixture of carbon black pigment that functioned as ink. The images they made could be quite complex and beautiful. Unlike early Sumerian writing, Egyptian writing represented a fuller script. Early Egyptian written language is known as **hieroglyphics**. "Hiero" means that many of the inscriptions had religious meaning—sacred, holy, or priestly. "Glyph" means pictograph.

China

Original Chinese characters typify the pictographic nature of written language that emerged in East Asia. At first, Chinese pictographic figures were carved into animal bones or dried tortoise shells. The main purpose of the early Chinese inscriptions was to connect people to the gods and predict the future. The characters are of mixed types. The character that references "sun," for example, looks like a sun. Mountain, rain, fish, and most physical objects are also quite faithfully

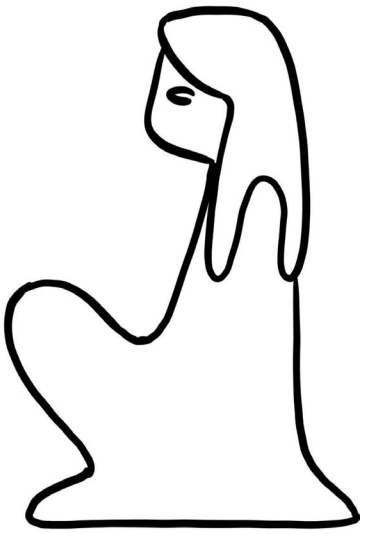

FIGURE 6.6 Egyptian hieroglyphics. This symbol means "woman"

represented by pictographs. But most Chinese characters are not literally pictographic; they do not look like what they refer to. Many complex characters have been devised to represent a particular word, concept, or idea. Graphical signs that refer to objects or ideas but don't resemble those object or ideas are called **logograms**.

The Americas

In North and Central America, the Mayans first experimented with written language by making simple marks on light-colored bark and animal hides. They cut and shaped plants into writing tools and made brushes from animal hair to create more elaborate images. Later, the Mayans carved complex inscriptions in stone and wood and painted images on walls and pottery. Interpreting Mayan writing has proven to be extremely difficult because various types of symbols were integrated into one block and could have many meanings. Mayan writing referred mainly to religious beliefs, astronomy, and prophecy. Other combinations of symbols documented births, marriages, military campaigns, rulers, and dynastic histories.[22]

Natural materials, like clay, bone, bark, animal hide, stone, and papyrus, were used as writing surfaces for thousands of years. Natural writing utensils persisted well into modern history, including in the United States. Quill pens made from the molted feather of birds like geese, eagles, hawks, and owls were used to write medieval manuscripts but also modern documents like the Magna Carta and Declaration of Independence.

Advanced Writing

The early stages of written language were **denotative**: the faint impressions, engravings, and pictographic symbols stood for things or concepts that could be faithfully represented by iconic images. Hundreds of pictographs were created. But daily life everywhere was becoming more and more complex. Iconic images could no longer represent the range of ideas that needed to be communicated in writing. A more efficient and expansive written language system was needed by every cultural group.

Phonetic Signs

Rather than develop written language based solely on signs that represent *things*, a better writing system reproduces the *sounds of speech* using **phonetic signs**. Abstract ideas and the natural flow of thought can only be expressed by written signs that stand for distinct vocalizations—phonemes. The next major transition in written language was the creation of symbols that stood for the phonetic elements of spoken language, not just for literal images of things (**Table 6.1**).

Like all transitions in evolution, the past is partially preserved but also transformed in the present. For example, the pictographic basis of written Sumerian language did not disappear when phonetic-based written language evolved. It was imaginably adapted for more wide-ranging purposes. The simple nature of written language at the time made the transition from purely pictographic to phonetic signs possible.

Most of the objects represented by pictographs in Sumer had one-syllable names that were commonly spoken in everyday conversation. An enormous advance in written communication occurred when people experimented by using those basic sounds to expand the range of meanings

the pictographic symbols could have. *The sound of a spoken word originally associated with a pictograph could now be used to refer to something completely different.*

This creative use of symbolic forms follows what is known in linguistics as the **rebus principle**. Concepts, ideas, or just proper names that are difficult to portray in a denotative writing system can be represented by pictures (or, in the case of early writing, by pictographs) of objects that are pronounced the same way as those concepts, ideas, or names. A simple example in English shows how this works: Everyone today can easily recognize a car when it appears in a picture. We say the one syllable word "car" to refer to an automobile. But we also use the sound of the word "car" to create parts of other words, like "carpenter," "cardinal," "bicarbonate," or "cartoon," for example, that have nothing to do with the meaning of the word "car."

In isolation, a picture or pictograph that represents "car" would refer to a category of transportation. But the same image, when used with other images, could evoke the sound of the word "car," but not to refer to an actual car. The meaning of the phonetic element "car," therefore, changes depending on how the syllable is used.

At first, a phonetic sign like "car" was used to begin other multisyllabic words—like carpenter. Eventually, the syllable could appear anywhere in the word. For instance, in English the one-syllable word "man" can be used in combination with other syllables to form hundreds of additional words: "woman," "manipulate," "emancipate," "statesman," "romantic," among many others. **Syllabograms** are written symbols that represent single spoken syllables. Those symbols are used to compose written words that may have nothing to do with the original meaning of the syllable.

Personal names, things, or concepts with more than one syllable can be combined creatively using syllabograms. So, for example, a common Sumerian individual's name, "An Gives Life," combined a pictographic star that stood for "An, the God of Heaven" and a pictographic arrow, because the sound associated with that sign stood not only for arrow but also for "life."[23] The reader made sense of the combination of written signs by inferring "gives" in much the same way that Chinese characters are understood today; when used together, the characters suggest a meaning that transcends the literal meaning of each character in isolation. The meaning of a phrase is derived from the arrangement and relationship of characters—or, in the case of the Sumerian language, the arrangement and relationship of cuneiform signs.

Linguistic Hybridity

Written language was becoming hybridized by the very nature of phonetic signs. For centuries, pictographs, logograms, and syllabograms were all used, often in combination, in written language. Hundreds of signs were invented to reflect a wide range of meanings. The fact that the first written languages were composed of extensive vocabularies, and allowed for the combined use of pictographs, logograms, and syllabograms to produce intricate meanings, makes it clear that complex spoken communication must have already been present in human evolution for quite some time before writing was invented.[24]

Through daily usage, the Sumerians continued exploring ways to make written language reflect the sounds of spoken language as closely as possible. Combining signs to formulate written language moved written communication closer to syntax, which is necessary for the expression of complex thoughts. Within this multistage transformation, we also see clear evidence of written language's empowering flexibility. The basic sounds of language—its phonemes—can be used in progressively complicated ways to express unlimited meanings in spoken and written communication.

Spread of Written Language

Because Sumerian written language developed into a system based largely on phonetic signs, neighboring cultures could quite easily appropriate the technique for local purposes in their own languages. The various versions of hieroglyphics that were developed in Egypt represent such a system. Hieroglyphics have a pictographic appearance but are based in phonemes that afford flexibility in expression and interpretation.

The transition from literal pictographs to more abstract phonetic signs demonstrates how constant adaptation drives written language development and, as we show throughout this book, reflects evolutionary processes generally. Form follows function. For language to be more useful to people in a given location, its form—the way language was written—had to be augmented to fit the functional role it could play in that particular culture.

Thousands of words came into use in many written languages over the next centuries. This proliferation of written vocabulary further validates the scientific claim that spoken language must have matured among diverse cultures to levels of considerable sophistication long before writing appeared.

Universal language development reflects the powerful motivation people have to improve their ability to communicate. Like all evolutionary processes, language evolves through constant tinkering. The stages in language development are not planned; they emerge spontaneously from everyday social interaction to make language more efficient where it is being used. The next stage in language development—the creation of written language based on alphabets—takes this evolutionary principle a big step farther.

Alphabet

Written language evolved in ways that attempt to make writing as true to spoken communication as possible. Efforts to represent and categorize the distinct sounds of language more precisely led to the creation of the first alphabet, the next major phase in the evolution of writing (**Table 6.1**).

Phoenician Alphabet

After many gradual transformations of the phonetic-based symbolic forms that made up early written languages, the first true alphabet was created about 3,200 years ago. Inscriptions on tombs along the Mediterranean coast in places that became present-day Lebanon, Syria, Israel, and Cyprus bear evidence of the first alphabet known as the **Phoenician alphabet**.

The Phoenicians were an ambitious maritime trading culture, whose merchants needed precise written language to carry out their commercial exploits successfully. Moving from syllables to letters greatly increased the precision of written language while simplifying its use. Cuneiform writing and hieroglyphics required the use of hundreds of signs. By contrast, the Phoenician alphabet was comprised of only 22 letters (**Figure 6.7**). The limited number of letters in Phoenician script made it easy for traders and merchants to conduct business. An alphabet-based writing system was easier to learn and put into practice than elaborate image-based writing, which required great skill of memorization and artistic writing by hand. In that sense, the alphabet proved to be a democratizing influence. It increased the number of functionally literate language users among uneducated populations.

As always, something of the past was preserved in the present. The shapes of the letters of the Phoenician alphabet were derived from pictographic symbols that had been passed down from earlier languages in the region, especially Egyptian hieroglyphics. The way the letters of the alphabet were pronounced also descended from the way earlier forms of spoken and written language

intertwine. *The sound of the letters that made up the Phoenician alphabet was the initial sound of a vocabulary word*. For example, the spoken word for "snake" in the Phoenician language begins with an "n" sound so an adaptation of the symbol for snake became the letter *n*. The written word for "house" in Phoenician begins with a "b" sound so the adapted symbol for house became the letter *b*.[25]

There was one profound limitation. All the sounds represented by letters in the Phoenician alphabet were consonants. The softer parts of the language, the vowels, were filled in by the native speakers in everyday conversation. Readers pronounced the words of written script by taking cues from the consonants and supplying the vowels orally. An alphabet whose letters derive from and represent particular sounds is called **acrophonic**.

Because the Phoenicians were a seafaring culture, their practical alphabet was adapted for use by many of their trading partners in the eastern Mediterranean area through repeated routine contact. Over time, variations of the Phoenician alphabet became the root for Aramaic, Persian, Hebrew, and Arabic alphabets. The word "alphabet" itself derives from the first two letters of the Phoenician alphabet—*alef* and *beth*.

FIGURE 6.7 The 22-letter Phoenician Alphabet and corresponding sounds in English. Courtesy of Bildagentur Zoonar GmbH/shutterstock.com

Greek and Roman adaptations

Between 2800 and 2500 years ago an adaptation of the Phoenician alphabet had also spread to Greece. The Greeks added new letters to account for vowels and other sounds they had in their spoken language, expanding the size of the alphabet to 27 letters. These changes made Greek the first fully functional alphabet because it covered the entire range of vocalizations spoken by a language group. Greater clarity was achieved because words written in the Greek alphabet could quite easily be distinguished from each other. For instance, adding written vowels to the consonants *b* and *d* in order to construct English words like "bed," "bad," "bud," and "bid" makes their diverse meanings more clear, even though they represent phonetically similar sounds.[26]

The Greek alphabet then spread to Etruria—now the Tuscany region of Italy—which was a powerful independent nation and civilization at the time. The shapes of the Greek letters were further modified by the Etruscans to more accurately reflect the local spoken language.

Armies of the expansionist Roman Empire conquered Etruria about 2100 years ago. The Romans imposed Latin—the language of Latium, the region where Rome is located—on Etruria. But the Romans soon recognized the considerable advantages afforded by the Etruscan alphabet and adapted Latin accordingly. This decision by the ruling Romans represents another principle of human evolution—*a less efficient or productive aspect of culture tends to be replaced by a better alternative when that option becomes known*. The foundation of the writing system that was developed in Italy 2,000 years ago became the Latin alphabet that remains in use today. In the West, we still sometimes employ "Roman numerals" (I,V,X,L,C,D,M), which the Romans used for counting.

As the powerful Roman armies marched north over the next several centuries, they took their written language with them. Consequently, populations within the nations they conquered—the Gauls, Angles, Saxons, Franks, and Germans (cultures that lived in present-day England, France, and Germany)—were forced to become literate in Latin. Even after the fall of the Roman Empire, Latin survived as the written and spoken language for religious and intellectual life throughout much of Europe. Europe's contemporary Romance languages—Italian, Spanish, French, and Portuguese—and, to a lesser degree, other major languages that are spoken and written throughout the West, all descended from the original Latin.

Writing Culture

Together with our ability to walk upright, the growth of our large and complex brain, and the capacity to invent and use tools, writing paved the way for modern civilizations to come into being and evolve. Africa was the birthplace of humanity. The Middle East is where Sapiens became civilized.

The cultural history of writing reflects a series of advances that were initiated by the realities of life in Mesopotamia more than 5,000 years ago. Written language evolved originally for record keeping related to property ownership and agricultural commerce. But from the start, writing was changing culture in bigger ways too. Establishing written schedules for planting and harvesting crops, recording the rise and fall of rivers, and tracking the movement of stars, all promoted agricultural development. Living spaces that were occupied by disparate tribal groups in Mesopotamia grew into sprawling and diverse city-states that needed to be organized and regulated. Extensive administrative bureaucracies depended on writing to carry out their work.

Beyond the function of writing to document and clarify transactions and relationships, the ability to write also encourages new kinds of creativity, even pure playfulness, with language. The combination of clear and creative thinking leads to innovation. Innovation enhances cultural development.

What was happening in Mesopotamia marks the beginning of writing culture—an epoch-making stage in human evolution. But of the more than 6,500 languages currently spoken around the world, only about 100 have been written down. While many spoken languages have gone extinct and still more are threatened, all the languages that have been developed in written form live on today. Writing endures so tenaciously because it helps keep cultural groups stable and creates boundless opportunities to make those groups more productive.

Cultural Transmission and Power

Before writing, basic information and cultural histories were passed along unreliably by word of mouth from person to person and from generation to generation. After writing was invented, information of all kinds could be recorded, stored, and consulted. In the process, writing certified some "facts" as having the weight of authority. Systems of thought based on those facts, whether valid or not, accumulated over time, were passed down generationally, and shaped future cultural growth.

Cultural development always unfolds within the structuring influence of the social hierarchy that is in place at the time. Writing was used by the religious, political, and economic elites to help maintain control over populations of the Sumerian city-states and later in Egypt and throughout the region.

Writing Education

The powerful and potentially dangerous influence of written language motivated the ruling forces in Mesopotamia to formally institutionalize education in order to control it. The world's first official schools emerged in Sumer at the same time cuneiform script was invented.[27] The schools—**tablet houses**—were named after the clay tablets onto which the symbols of cuneiform script were etched.[28]

Mesopotamian civilizations had developed sufficiently by that time so that human labor could be utilized in ways that corresponded with the varying talents and interests held by individual persons. Specialists emerged, including those who were authorized to be writers. The tablet houses were mainly concerned with teaching individuals to become **scribes**—persons who could take dictation from governing officials to produce a document or copy documents from one tablet to another.

Written language originated as a bottom-up phenomenon. Industrious individuals tinkered with writing utensils and symbols to find ways to communicate better. But from the start, literacy was considered to be a cherished ability that was *not* to be widely shared. The directors of the tablet schools were not the least bit concerned with educating ordinary citizens. To the contrary, the ability to write became a resource that would be controlled tightly by the state. Individuals who were selected to become scribes—the first literate persons—came from affluent families. The skills needed to create, copy, and read script were highly valued and protected. A small literate class supported by the elite sector of society emerged.

Access to information is power. Scribes had access to documents that were directly associated with the control and management of religious, political, and economic power in Mesopotamia. There was much work for the Sumerian scribes to do. The administration of daily life by temple priests and the government bureaucrats under their supervision required greater precision than before. Government laws were encoded. Religious mythology, rules, and rituals were formalized in writing. Military conscription for the world's first armies was enacted and documented.

LITERACY: A HUMAN RIGHT

Not being able to read or write severely limits opportunities for those unfortunate individuals and the societies in which they live. One cannot become properly educated in the modern world without being literate, and education is key to almost every other kind of success. The ability to read and write commonly used languages is **alphabetical literacy**.

Literacy is the gateway to education and cannot be separated from it. That's why the United Nations recognizes literacy as a human right.[29] Literate people make better-informed decisions, participate more fully in local and global discourses, and gain a strong sense of personal empowerment.[30]

The first literate persons, the scribes of Mesopotamia, lived more than 5,000 years ago. Sadly, today the gap between literate and illiterate individuals remains wide at the global level. The United Nations estimates that nearly one-fifth of the global population, two-thirds of whom are women, still cannot read or write.

FIGURE 6.8 Women in Afghanistan and Niger suffer the highest level of illiteracy in the world. Courtesy of Majority World/shutterstock.com

Religious fundamentalism, poverty, and political oppression—which are often interrelated—limit opportunities for many women to become literate and educated.[31] Low levels of literacy and education among women in a population greatly hinder economic progress and cultural development for the nation state too.[32] The poorest nation states are the most repressive; the richest nation states are least repressive.

The quest for social justice and the need for economic development drove national literacy campaigns in the communist revolutions that took place in the last century in China and Cuba. Literacy in China before the 1949 revolution was 20 percent.[33] Today it is more than 95 percent.[34] Part of the success in improving the literacy in China is attributed to a simplification of Chinese logograms and reduction of characters from more than 2,000 to about 500.[35] In Cuba, the literacy rate before the 1959 revolution was about 60 percent. "Literacy brigades" were dispatched throughout the country and brought virtual 100 percent literacy in the island nation today.[36]

Teaching methods and the extreme amount of time children spend with phones, computers, and television screens today negatively impact literacy in more developed countries too.[37]

From Speaking to Writing

With the advent of writing, complex information could be authored privately, exist independent of the person who created it, and be passed along to others. Just the idea that facts and thoughts could be documented, made durable, and made accessible was a major breakthrough in the history of communication and culture. People could also now be held accountable for what they had written or other written sources to which they refer—a clear break from far less traceable speech.

Any major technological change brings about significant psychological, social, and cultural disruptions and opportunities. The introduction of writing changed the world by creating new channels for human communication. Reflecting on the stages of media development, the famous media theorist Marshal McLuhan tried to sort out the differences between "oral" and "print" as primary communications modalities.[38]

The Medium Is the Message

McLuhan had a remarkable insight. He believed that the *way* a message is communicated—the communications channel or medium—can be more important than the content. Think about it: If you want to wish your mother "Happy Birthday," would it matter if you phoned, texted, wrote an email, handwrote a letter, or said that to her in person? Of course it would, although individuals and families differ in their preferences. These are the kinds of distinctions about communications media that McLuhan was trying to disentangle.

McLuhan first contrasted life in the oral stage of human communication, which is characterized by spoken language, with that of the print media stage, made possible by written language. But *writing* as a stage in the evolution of human communication is not the same as the print media stage McLuhan wrote about. Writing has been around a lot longer than print media. Writing was invented about 5,000 years ago. Mass produced books, newspapers, and magazines did not appear until after the printing press was invented 600 years ago. Further, print media in the McLuhanesque sense implies that a meaningful level of literacy exists within a population. But as we've seen, early writing and the first forms of print media were the sole provinces of the privileged few for thousands of years.

Moving from spoken to written language is to go from audio to visual communication. The two modes are processed differently by the brain (**Chapter 5**). The principle qualities that differentiate speaking from writing as communication behavior are presented in **Table 6.2**.

McLuhan drew a contrast between what he called the inherently "tribal" nature of oral communication and the "de-tribalizing" tendencies of print media. Oral communication (or speaking) takes place within local environments that were originally composed of people who share common ancestry, culture, and language. Although at first writing was the domain of the elite, eventually writing and print media released human cultures from their tight-knit tribal origins.

TABLE 6.2 Transition from Speaking to Writing

Speaking	*Writing*
Tribal	De-tribalizing
Communal	Private
Local	Spreading
Nonlinear	Linear
Immediate	Delayed
Fleeting	Durable
Interactive	One-way
No literacy	Literacy
Spontaneous	Organized and edited
Democratic	Becomes more democratic
Conversation, oral history	Documentation, planning
Numerically limited	Mathematically unlimited

Speaking is essentially nonlinear, interactive communications activity. Spoken words normally are uttered spontaneously. Their impact is immediate and local. In contrast, writing is slower, more organized, sequential, and durable. The flow of written communication is one way. Written language can be read over long periods of time and travels well.

Speaking is inherently social, and everyone has the natural ability to participate, including deaf people, using sign language. By contrast, writing is private behavior that requires training to encode (write) or decode (read) a message. Speaking is fundamentally more democratic than writing and reading, which require specialized education.

For thousands of years, spoken language was the means by which information and knowledge were passed from person to person and from generation to generation. Writing made it possible to document various aspects of culture and make elaborate, specific plans.

Oral cultures had limited ways to count and do simple mathematics. Writing evolved into a mathematical methodology as well as a linguistic system, empowering individuals to count and calculate.

The Mobile Resource

Language was first expressed and perceived as an audio code that is learned initially by hearing and repeating specific sounds and vocal inflections. For literate people today, language also functions as a visual code that is put into practice by writing and reading. The essential qualities of written language—the ability to inscribe, store, and share ideas and information—add immeasurable levels of complexity and depth to spoken language, while it serves as a platform for development of more highly evolved forms of human communication.

The act of writing gives information quasi-permanent status at the same time it physically separates the message from the source. Unlike spoken language—where something that is said can often be easily denied—written language can make the source of information more accountable for what they say. By its very nature, writing increases the potential for being able to trace a message to its source, serving as a form of legal proof.

Written language inspired the radical idea that a message authored by someone at one location could be understood by others at other locations and at other times, even by perfect strangers at great distances. This revolutionary capability became enormously helpful for the political and economic purposes of the creators and first adopters of written language—the rulers, merchants, and conquerors that lived after the Agricultural Revolution.

The long-term consequences of writing have proven to be numerous, diverse, and broadly democratic. Modern nation states have made literacy education a priority that is less influenced by religious or political ideology than before. As communications technology has advanced, written documents have become increasingly mobile and accessible, further widening and deepening their sphere of influence.

Standardization and Innovation

When people learn how to read and write, they enter into a communication system that relies on standardization of a code to be effective. Through tens of thousands of years of practical use, spoken languages have evolved consistencies and boundaries in their semantic components and syntactic relationships. Except for the more superficial aspects of language, like vocabulary and punctuation, the structural features that define developed languages remain in place. For example, the 26 letters of the English alphabet haven't been altered for more than two centuries. For hundreds of years before that, changes in the alphabet were also minimal. Spelling and the rules of grammar likewise persist over long expanses of time.

We might expect that the chronically fixed features of written language would limit how language could be used. But instead of inhibiting linguistic innovation, certain immutable qualities of language—like the limited number of letters in the alphabet—enable creativity and intensify its impact.

Here's how the flexible standardization of language works: We have no choice but to communicate within essential parameters that have long been established by language—the sound of individual phonemes, for example, or the way those sounds merge to form meaning, that is, the interaction of semantics and syntax (**Chapter 5**). Those shared understandings provide a platform that enables intelligible communication. But fewer and fewer constraints are imposed by linguistic conventions when people combine the basic elements of language into statements or comments. At that moment, each separate linguistic element becomes a symbolic resource that can be creatively put to use by the message source. The compulsory rules of language fade even farther into the background when a speaker or writer integrates individual sentences into lengthy utterances or compositions that reflect increasingly complex ideas.[39]

This combination of language standardization and human innovation has been immensely productive. For instance, not counting e-volumes, more than 16 million books representing a profound diversity of literature have been published in English so far using just the 26 standard letters of the modern alphabet.[40] Imagine how many handwritten or typed notes, text messages, letters, term papers, blog and social media posts, business contracts, and government documents have been written by creatively combining the small number of letters that make up the English language during just the past year alone.

Adaptive Value

Dominant languages spread in part because they were imposed by conquering armies and colonizing governments. But the uniformity of written language and the way it combines with creative authorship have also allowed important ideas to spread way beyond their places of origin. Written languages serve as reliable and comprehensive vehicles for spreading valuable information and ideas to large and remote populations. That's one primary reason why Latin, French, English, Chinese, Arabic, and Spanish have each become dominant at different stages in world history.

When people are exposed to good, new ideas—including the spread of written language—they typically try to find ways to fit those potentially useful notions into their local contexts. Accommodating unfamiliar ideas into an established culture functions like a biological adaptation. Favorable biological and cultural adaptations improve living conditions for individual organisms and groups. In cultural terms, local problems often can be solved faster and more efficiently by borrowing innovations that arrive from afar. Written language is one of those productive innovations that spread rapidly around the world, but so are the countless fresh ideas that written languages convey. Copying good ideas is far more efficient than reinventing the wheel.

Writing made it possible for information to travel in precise, complex, lengthy, reliable, and durable forms across wide expanses of space and time. Because of this, writing has greatly accelerated the speed of learning. In turn, the civilizing process of humankind has quickened.[41] Language allowed our ancient and recent ancestors to take greater and greater control over the direction and pace of their development. In effect, writing created the modern world. The main trajectory of human evolution began to shift away from genetic inheritance to learning facilitated by communication technology that responded to the necessities and ambitions of cultural groups.[42]

Computer Language

Written language allows us to communicate with machines—in most cases with computers. But the idea that humans can instruct machines to perform tasks—**machine programming**—has a history that dates back more than 1,000 years. The first programmed machine was a musical instrument—a water-powered organ in Baghdad in present-day Iraq in the 800s. The organ was designed to play by itself. The machine contained a large revolving cylinder with teeth. As the cylinder rotated, the teeth were positioned in a way that opened and closed the various pipes of the organ in sequences designed to produce familiar melodies.[43] The machine functioned by "reading" a code—the arrangement of the teeth—as they passed by the organ valves. The self-playing organ was conceptually similar to the player piano of recent vintage.

Using basically the same technology, programmable music later spread to Europe. For example, a life-sized model of a shepherd playing a flute was a tourist attraction in Paris in the 1700s. The shepherd's fingers were programmed to cover and uncover the holes of the flute to play a variety of songs. The ingenious idea of applying programming concepts to material instruments produced nothing more than music for nearly 1,000 years. Although this may seem to be a frivolous use of coding ability for creating human-machine interaction, it highlights the critical importance of musical entertainment and popular culture in the realm of human experience.[44]

The cylinder-and-teeth programming system for making music subsequently gave way to perforated punch cards that initially were used to program a loom for making intricate textiles. This new application of programming code was inspired by the spirit of entrepreneurship that drove the Industrial Revolution in Europe in the early 1800s. That same spirit also brought us the next major developments in the evolution of written language technology.

Hardware

The focus turned to hardware, which was being designed to improve the speed and efficiency of written language. Simple keyboards and "writing machines," the first typewriters, were developed to produce alphanumeric text. Different kinds of keyboards—like the arrangement of air holes on a flute or the black and white keys of a piano—had been in use for many years. But the idea that a person could strike keys in order to put letters on paper did not materialize until the late 1800s, with the invention of the typewriter and the standard QWERTY keyboard.

Important economic and cultural shifts were stimulated by invention of the typewriter, which quickly became a hot consumer item. But biological and social transformations prompted by introduction of the new writing machines were underway too. The production of written text could now be done much more quickly and legibly than handwriting would allow, speeding up many forms of human interaction. Typewriter keys were activated by the force of the pads of the typist's fingers. Each finger was assigned a set of keys and corresponding letters, making the new hardware apparatus an extension of the physical human body—a spectacular development that we take for granted as we type away on our digital devices today.

Evolution had prepared us for the physical challenge. Like most primates (including all the great apes) and some other species, we have developed opposable thumbs that give our fingers great flexibility and range of motion. The human version of the hand dates back at least to the time of Habilis—the tool maker. Several species with opposable thumbs, including orangutans, chimpanzees, and bonobos, also use their hands to shape and use simple tools—like sticks for poking and stones for pounding. For this reason, researchers believe the origin of human hands dates back to a period of shared ancestry even before our hominin ancestors traversed the African plains and woodlands.[45]

Typewriters remained the primary technology of written communication until computers burst onto the scene in the middle of last century. The first giant mainframe computers gradually got smaller and migrated away from the offices of scientists and mathematicians in government agencies, universities, and private institutions. Computer technology, which would be available to the American middle class by the end of last century, was invented in the 1960s.[46] Peripherals changed too. The typewriter keyboard that had been modified originally to interface with large-scale computers was adapted to function with personal computers. A mouse that used a rolling ball technology to interact with the keyboard was developed in the 1970s. The first optical mouse—a forerunner to the type of mouse we use now—arrived a decade later.[47] Keyboards and mice of various shapes and sizes have since been integrated to function with all kinds of personal computers and phones.

Smaller and smaller keyboards require a great degree of manual dexterity on the part of their users. People have always had to make physical adaptations to keep up with technological change. As future technologies come to occupy every corner of our everyday lives, Sapiens' physical transformations will continue to evolve in new directions.[48]

Programming Language

The original programming languages were instructional codes designed to make a musical instrument produce patterns of music or a textile loom produce patterns of fabric. The communication was one-way. Feedback to the producers could only be measured by sales the music or textiles generated.

Programming language gradually shifted away from physical products that could be marketed to a consuming public toward more diverse forms of human connectivity. Programming languages today instruct computers to perform tasks, but most of those tasks are designed to facilitate social involvement or interaction—from website development and computer games to artificial intelligence and database creation.

Like any language, computer programming languages function as communication codes that become refined over time. They have vocabularies and grammatical rules that produce meaning and govern the interactions among components of the language. The term "**programming language**" refers to widely used, high-level computer languages, such as BASIC, C#, C++, COBOL, FORTRAN, SQL, and Java, for software development. But lots of other less complex computer languages—for instance, markup language, which is used for annotating documents, and command language, which communicates with a computer's operating system—also transmit specific kinds of instructions to a machine.

Mastering a programming language for computer programming requires literacy that is not unlike other written language literacies. Specific languages and language groups are used to write particular kinds of software. For instance, Java, C+, and C# can be used for game development. Engineers use HDML, HTML, and JavaScript to develop web pages.[49]

User communities based on various programming languages have sprung up, often within companies or online networks, where particular languages are needed to accomplish specialized work. Programming languages allow individuals from different ethnic and language groups to work together for a common purpose. Ethnic diversity fuels creativity among professionals, which is enabled by the shared codes of English and programming languages.[50]

Social Media Language

Clay tablets in Mesopotamia served as the first media for written language. The physical nature of that simple technology and the traditions of culture where writing was invented presented opportunities for new ways to communicate. But those same conditions also created significant

boundaries that limited development: Only a small amount of information could be documented on clay, and the fragile tablets didn't travel well. Moreover, clay tablets and the subsequent forms of written communication that emerged in the region were tightly controlled by religious and political authority.

The invention of any communications technology inevitably changes the ways language is expressed and perceived (**Chapter 7**). Modern mass media exemplify how this works. Print, audio, and visual media mold and emphasize language in ways that reflect the nature of the technology and the interests of their owners and sponsors.

Within the system of mass communication, media and the mainstream popular culture industries, like the music or film industries, work in top-down fashion. They function as primary sources of information, entertainment, and advertising. Media and popular culture professionals, including screen writers, news anchors, actors, and talk-show hosts, have unique opportunities to exert strong influence over how language is used. The rest of us play the largely passive roles of audience members and consumers.

With the arrival of the Internet and the booming popularity of social media, traditional sources of influence over language are being challenged. New forms of language constantly emerge in ways that surface from the bottom-up nature of change.

Internet Influence

Think of any Internet user as a living organism that constantly searches for faster, more convenient, and more meaningful ways to communicate. The main motivations people have for going online are to gather useful information and interact socially.

As our distant ancestors went about their daily lives, they looked for ways to reduce the time and effort needed to get food. They had to ingest and save sufficient calories every day or face starvation. Today, most people who live in the more developed parts of the world don't worry much about burning up too many calories—in fact, obesity has become a major health problem in many advanced societies. But the instinctual drive to save time and energy—rooted in the evolutionary history of our basic physiological needs—still motivates human behavior. *Effective communication improves the prospects for survival by saving time.*

Today's personal communications technology extends and diversifies the evolutionary benefits of spoken and written language. The creation and constant expansion of the Internet enhances human communication by making it more interactive, global, and fast. In a short period of time, the Internet has become both the world's greatest information resource and the most powerful channel of social connectivity ever invented. Key to the growth of the Internet are websites and applications that allow users to share content and network socially.

Nothing has changed the way people use language as quickly as the Internet. At first Internet service providers tried to impose strict rules for how language could be used online. For example, the original mainstream service provider in the United States and forerunner to today's social media sites, America Online, wouldn't allow chat rooms to be conducted in any language other than English "in order to insure that there is a comfortable community for all members."[51]

That kind of linguistic and cultural parochialism did not last long in the fast-moving, open, democratically inclined era of digital communication. All major written languages quickly found their way onto the Internet. Although social media still impose rules for participation on their sites, supervision no longer has to do with which language is being used. Now social media administrators attempt to regulate violent posts, hate speech, fake news, and inappropriate sexual content—a daunting task given the number of posts made each day (**Chapter 10**).

Net Speak and Text Language

The way people use language to interact online and send text messages has changed as personal communications technology and social media sites have evolved. Users responded to the new communications environment by discovering creative ways to tap into the flexibility of modern language. The most noticeable change is that thoughts and ideas are expressed in greatly shortened form.

Condensing written language can be accomplished by using slang and emojis. But the main way people make communication more efficient is by creatively using new forms of written language—**net speak** and **text language**—which depend mainly on abbreviations and acronyms.[52]

An **abbreviation** is a shortened version of a word or phrase that represents the complete form. People used abbreviations to economize written communication long before today's communications technology arrived, and they still do. Usually, abbreviations contain the beginning fragment of a word followed by a full stop. For example, "lib." stands for library, "ref." for reference, and "approx." for approximately.

Alphanumeric conversions make up another kind of abbreviation that characterizes much of today's short message style of written communication. Most common among the simple conversions in English are 2 (too, to), 4 (for), b (be), c (see), I (eye), o (owe), r (are), u (you), and y (why).

By using the vocalized sound of the number or letter to substitute for a word, the writer takes advantage of the same adaptive technique that shaped early written language. In Mesopotamia, the sound of a spoken word associated with a pictograph was used by the Sumerians to refer to something completely different. Context also helps social media users interpret text language correctly. For instance, the receiver of a text understands that the number 2 should be read as "to" or "too" because of the situation being described. This efficient linguistic conversion represents a syllabogram—where *written* symbols represent single *spoken* syllables—discussed earlier in this chapter.

An **acronym** is an expression that is usually formed from the initial letter of each word in a familiar name, title, or phrase. Often all the letters are capitalized. Like abbreviations, many acronyms also predate modern communications technology. For instance, TGIF, DIY, AKA, or NYC have been used for decades. Especially in the case of technical or scientific concepts, modified acronyms sometimes become commonly used words, such as "scuba" (self-contained underwater breathing apparatus) or "laser" (light amplification by light stimulated emission of radiation).

These kinds of familiar acronyms are commonly used in handwritten or typed communication. They appear in Internet speak and text language too. But hundreds of new acronyms have been created and merged together creatively to allow people to communicate on social media and text messaging.

A **short message acronym** is a particular kind of linguistic shorthand that is especially useful in text language. Like abbreviations, acronyms speed up the pace of written communication. But acronyms used in messaging serve other purposes too. Acronyms such as BFF, XOXOXO, ILU, IMU, BM&Y, WYWH, and KFY connect people intimately, creating and reinforcing social relationships. Other acronyms—including PIR, P911, CTN, POS, and KPC—alert the message receiver to privacy problems, especially when teens want to signal the intrusive presence of parents. Some acronyms—SLAP, WYCM, CYT, BRT, JTLYK—help texters coordinate plans. Many other short message acronyms simply supply information, clarify something, comment on a subject the texters are discussing, or indicate a physical condition or mood. Acronyms like TMI, SEP, B3, OIC, C-P, NM, and CWOT are forms of text language shorthand.

Hybrid Codes

By using short message forms of writing, social media users and texters have found ways to tap into the inherent flexibility of language. Through routine practice, a **hybrid linguistic code** has evolved, which is shared widely among users.[53]

For example, the common short message language expression "c u l8r" requires only five symbols to get the intended meaning across. The formal version, "see you later" requires 11 separate symbols. The short version thus saves 55 percent of the effort needed to express exactly the same idea in standard English.

In some cases, the structure imposed by social media inspires truncated communication. The clearest example is Twitter, with its 280-character limit. But because many mobile phone users have become less inclined to communicate by voice, the tendency to write in abbreviated form also appears routinely in the preferred channel—text messages.

A second type of hybrid code fuses written language with photographic images and video. Written language is processed by the brain as visual communication (**Chapter 5**). But the image-sharing capability of the Internet and social media has made written communication online significantly more visual and appealing. Trillions of photographic and video images are posted every year on social media sites, with more than 90 percent of the images taken by smartphone cameras.[54]

Many user-friendly image-sharing sites have appeared in recent years, and the quality of smartphone cameras has improved greatly, encouraging the trends. Posting photos and videos helps reap rewards. Social media posts that include images get more likes, comments, re-tweets, and click-throughs than text-only posts.[55] When people post images on photo-sharing sites, their brains' reward circuitry reacts in ways that resemble the response they have when waiting to see a loved one or winning money.[56] It is *anticipation* of the reward, not the reward itself ("likes" on social media, seeing the loved one, or winning the money), that stimulates the strongest chemical reaction in the brain.[57]

Body language, physical gestures, and facial expressions—the paralinguistic and nonverbal aspects of face-to-face interaction—are difficult to express or interpret with written language alone. That's why emoticons and emojis were created and became so widely used.[58] Emojis originated in Japan to help Internet users to overcome limits on the number of characters they could use in an email on the Japanese provider Docomo.[59] The first emojis represented external concepts like weather, food, and drink but also a wide range of emotions. Taking advantage of the trend, emoji-like designs have been developed by businesses like McDonalds and celebrities, including Kim Kardashian, to brand and market their products. Social media users today select from hundreds of emojis, often without adding text. Brief descriptions and stories are told by stringing emojis together without words.

The ways Sapiens have developed language over the past six or seven million years—from gestures, grunts, and groans to the ways we communicate with computers and social media—make us unique among all species (**Table 6.3**).

TABLE 6.3 Development of Language Forms

Language Form	*Origin*
Gestures	At least 6–7 mya
Prelinguistic vocalizations	More than 2 mya
Paralanguage	2 mya
Developed spoken language	At least 100–150,000 ya
Written language	About 5,500 ya
Computer language	75–80 ya
Social media language	20–25 ya

Chapter Summary

Throughout human history, our Sapiens ancestors were constantly on the move and living on a diet of wild plants and animals. But beginning about 12,000 years ago, the nomadic tribes began to settle down and form stable cultural groups. Key to the change in behavior was the creation of reliable food sources—agriculture.

Agriculture brought about enormous social and cultural change. As settlements like those in Mesopotamia grew in size, the nature of work was transformed. No longer was everyone needed to produce food. The need to create and keep accurate records of financial transactions and social contracts arose. Written communication emerged under the pressure of these changing conditions of life.

The first attempt to create written language was crude visual imagery inscribed onto clay balls and later onto clay tablets. In the next stage, pictographic images wedged into clay depicted physical objects and actions. Pictographs then grew into the first writing system—cuneiform script. Mathematical notation grew from this system and gave us new ways to think and communicate. Other early writing systems developed in Egypt, China, and the Americas.

Written language became more complex when phonetic signs that represent the sounds of spoken language were adapted from pictographs. Hybrid written languages that emerged reveal that cultural groups in the region already possessed a large spoken vocabulary. Creation of the Phoenician alphabet made language more flexible and accessible, eventually leading to the spread of writing throughout the Middle East and southern Europe.

Writing is civilizing. Mesopotamian culture expanded beyond agriculture as city-states grew. Writing was key to administrating the expanding communities. But at the start, education—mainly learning how to read and write—was tightly controlled by the groups that held religious and political power. Scribes chosen from powerful families were the first literate individuals and carried out the official work of the government.

Eventually, writing became more widespread and profoundly changed the lives of individuals and groups in the modernizing world. Compared to spoken language, writing is more private, linear, durable, organized, and better for documenting and planning. But writing also tends to be unidirectional, less immediate, and less universally democratic because it requires literacy.

Standardized linguistic codes make written language comprehensible to large populations, accelerate the speed of learning, and inspire innovative thinking. Writing was essential in the development of high technology. Written codes were first created to program machines—from ancient music boxes and player pianos to typewriters, computers, and mobile phones.

Our evolutionary roots prod us to communicate faster and faster. Mass media and the Internet give populations and individuals speedy access to information and create novel forms of written communication. Internet speak and text language feature abbreviations and acronyms to produce compact messages on websites, social media, and mobile phones. Constant tinkering with language has produced revolutionary changes in the way we communicate and promises more surprises in the future.

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7

TECHNOLOGY

Technological evolution is existential. The rapidly accelerating growth of communications technology responds to our basic needs while continuously transforming the way we live. In this chapter we explore the correspondence between processes of biological and technological evolution and explain why communications technology evolved the way it did. The pace of technological and cultural change has accelerated to previously unimaginable proportions. It's been a long journey getting there, which began with the creation of the first stone tools.

Tools and Technology

The meaning of the word "**technology**" originates from the role language played in the creation of civil dialogue in the world's first political democracy—Greece nearly 3,000 years ago. The philosopher Aristotle used the Greek word *techne* to refer to the "craft" or "skill" of debating public policy. To be considered valid, the claims and arguments that were made in political debates had to be based on evidence, reason, and logic. Thus *techne* (communication skill) and *logos* (logic) made up the first "technology." Today's communications technology evolved from and extends the power of language as a social and cultural force that has been instrumental in the establishment of democratic discourse.[1]

The term "technology" means two things today. First, technology can refer to a *machine-based technique* that can be used to solve a problem or achieve a goal. These techniques function at the systems level. For example, "Wi-Fi technology" helps us connect wirelessly to the Internet. Or, "distance education technology" enables instructors and students to interact in virtual classrooms over long distances.

Second, technology can refer to a particular *technical device*. For instance, a Bluetooth-enabled speaker is a form of communications technology. Inside each speaker are *component technologies* (including a circuit board, battery, and audio amplifier) that combine to receive digital signals and turn the signals into recognizable sound. Gradations of even smaller components exist inside each component technology. True to evolutionary principles, *each piece of technology at every level is under constant revision and modification*. Tiny upgrades in every component continually improve the performance of the overall device.

FIGURE 7.1 Steve Jobs. Courtesy of Anton Ivanov/shutterstock.com

Inventing Tools

Tools typically develop incrementally as bottom-up, user-centered innovations. When Steve Jobs and Steve Wozniak tinkered with technology in their California garage, they were laying the groundwork for what would become Apple computers and a new stage in the evolution of communications technology.

In a world of fully accessorized smartphones, global positioning satellite tracking devices, and curved high-definition television screens, we might not think of knives, hammers, and scrapers as forms of technology. But ancient versions of these common household tools were among the earliest technological forms and proved to be crucial to our ancestors' survival. All the modern communication technologies that surround us today reflect the spirit of innovation and accomplishments of all the tool makers who came before.

Together with our capacity to control fire and communicate with language, our ability to make and use tools was long considered to be a defining difference between humans and other animals. Even today the idea of tool is understood in terms of practical human use. For instance, the *Oxford Dictionary* defines tool as a "device or implement, especially one held in the hand, used to carry out a particular function, such as 'gardening tools.'"

Animal Tool Use

The natural world is full of materials that can be turned into simple but practical tools—and not just for humans. Many animals purposefully and creatively use leaves, sticks, stones, and other natural resources as tools to achieve specific goals, especially getting food and defending themselves.

The great apes became particularly good tool users. Chimpanzees use tools to probe; pound; extract items; inspect their environments; clean themselves; defend and attack within their own species and with other species, including leopards, snakes, and humans.[2] Their habitual tool making and tool

use reveal significant cognitive complexity. For instance, they select and use particular rocks to crack open nuts—one rock serving as a hammer, the other as an anvil.[3] They use leaves to soak up water. Some chimpanzees sharpen long sticks with their teeth to spear small nocturnal primates called bush babies, the first known case where non-human animals use tools to hunt other vertebrates.[4]

Chimps, bonobos, and orangutans use twigs to extract termites from logs and mounds. Some bonobos and gorillas use sticks to measure water depth before crossing a river. Orangutans employ a different kind of stick to remove seeds from fruit. Some orangutans chew a particular plant that is not part of their diet into a foamy lather and rub it into their fur to reduce inflammation and pain. People in the area use the same plant for the same reason.[5]

Other animals also search for and select the right tool for the job. For instance, some monkeys choose stones with surfaces that make it easier to puncture shellfish or pulverize seeds.[6] Elephants make backscratchers and tick removers from long sticks. They throw rocks at fences and other barriers that block their movement.[7] Dolphins slap the back part of their body on the water surface to create a "bubble net" that prevents a food source, small fish, from getting away.[8] Female dolphins carry oceanic sponges in their snouts to help them forage in murky water.[9] Sea otters float on their backs and use their chests as tables where they slam crabs and clams against a rock they have placed there in order to get at the meat.

Birds drop shellfish to the ground, crack them open, and then use twigs to extract the edible parts. Some fish employ rocks to crack open clams for food.[10] Animals adapt to the encroaching presence of human activity by using urban resources as tools too. For instance, carrion crows in Japan use passing traffic to crack open nuts.[11]

Animals' culturally specific tool-using behavior remains entrenched over time, but they can adapt to new circumstances when necessary. For example, when chimpanzee females enter a new troop, they abandon their previous way of using tools and conform to the techniques employed by the host culture.[12]

Material Culture

Our human ancestors also looked for the right stones that could help them do things like smash open nuts or bring down wild animals. But unlike other animals, our ancestors gradually transformed a variety of natural materials—stone, wood, animal antlers, and bone—into complex useful forms and became skilled users of the tools they created and accumulated. Then they used those tools to make other tools, another trait specific to Sapiens.

Tools represent the first artifacts of material culture. Clearly, the skilled and learned integration of material objects like simple tools into daily life is not just human activity. Creating material culture at this level does not require language, human-style teaching, cooperation, or a large brain.[13] But in the end, humans invent and mass-produce infinitely more complex and diverse artifacts than other animals.

Making Tools

The first human-made implements that can be traced archaeologically are stone tools. Making and using stone tools are surprisingly complicated tasks. Our ancestors first had to have the cognitive ability to imagine particular ways that stones could help them survive. Then they had to act productively on those thoughts. A level of physical dexterity we take for granted today was required just to break open a food source with a stone, for instance, or to throw a stone accurately in order to bring down game. Developing those skills represents a crucial stage in the evolution of **precise movement**.[14]

Rounded stones that could be pulled out of river beds served as especially good raw materials with which to make the first tools. Human tool makers struck the rounded stones several times with harder stones. Repeating this action created sharp edges on the target stone—hence the expression, "cutting-edge" technology. The result was **pebble tools**—the first **made tool** crafted by our ancestors. Pebble tools could be used as crude multipurpose knives. The stones used to strike the blows to create pebble tools functioned as the first hammers.

For many years, researchers believed the first stone tools date back to somewhere between 2.5 and 1.75 million years ago in what is now the east African country of Tanzania. Remains of one of our Habilis ancestors had been discovered with stone tools of that era in that location. Researchers made a logical connection between the human fossils they found and the tools. Accordingly, they named the human species that was found at the site Habilis—the "tool maker" or "handyman" (**Chapter 2**).

Researchers now believe that Habilis probably wasn't the first species in our evolutionary line to make tools. Recent evidence pushes back the likely origin of stone tools to 3.3 million years ago in Kenya.[15] This means that the first tool makers may have lived before the genus *Homo* evolved. The only *Hominin* species known to be alive when these ancient tools were made was Australopithecus.

Tool making thus does not begin with Sapiens and is not exclusively a human trait. Even the technique of banging rocks together to forge sharp edges for getting at food sources is not unique to us. Capuchin monkeys in Brazil do that. The monkeys also adjust and readjust the angle and force of the strikes they make with a stone to open nuts according to how well the task is proceeding—a clear case of precise movement.[16] Similarly, those chimpanzees that use spears to hunt small vertebrates maintain a powerful grip on the tool and execute a forceful downward stabbing motion that requires precision.

One of the main roots of our humanity—imagining, selecting, making, and using tools with precision—clearly extends back to our pre-human state. The means by which tool-making ability is passed on from one individual to another, however, marks a crucial difference among tool-using species.

The difference lies in communication ability. Humans possess **high fidelity skills** of information transmission, an ability that leads to the development of cumulative cultural knowledge. Sapiens' cultural foundation increases in complexity and diversity over time. By contrast, apes and monkeys rely on passive forms of observational learning compared to the active forms of intentional and coordinated teaching and learning that eventually evolved among our ancestors and developed into complex cultures.[17] Our ancestors also must have uttered simple vocalizations and made gestures that indicate "yes," "no," "here," or "there," to refer to specific actions necessary for tool making.[18]

Knapping

Stone tool technology developed slowly over more than three million years. Incremental changes began to take place as our ancestors imagined additional purposes to which tools could be applied, learned which stones could be altered most effectively, and advanced in their ability to teach others how to make tools.

The special skill that would be required for the next advance in stone tool development represents a major breakthrough in the history of technical craftsmanship. Instead of simply making one side of a target stone sharp, our ancestors discovered how to fracture the outer layers of certain kinds of stones into flakes. **Flakes** are extremely sharp double-edged sheaths of stone that break off from the core of the target stone when struck. Creating flakes by striking one stone against another stone held in the palm of the hand represents the deft artisanal craft of **knapping**.

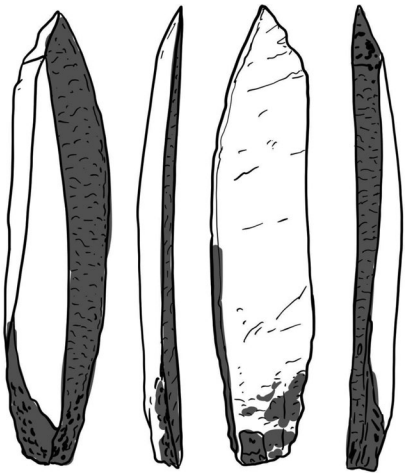

FIGURE 7.2 Flake tools

Flakes could be used to cut up animal carcasses for meat, extract marrow from bones, and chop whole plants into edible pieces.[19] Flake tools represent the second major step in the evolution of stone tool technology. Although knapping began in Africa, Neanderthal and Sapiens groups also created flake tools after migrating to Europe and other parts of the world.

Weaponizing Tools

No other significant improvements were made in stone tools until our ancestors began to grind hard stones against softer "target" stones to make specialized spearheads, arrows, axes, and knives. Making advanced tools, weaponizing some of them, and developing superior communication ability ultimately helped Sapiens tribes outlast Neanderthals in Europe.

Tools and weapons have been so important to human survival and to the conquest of other peoples that entire archaeological periods have been named for the materials used to make them. The Stone Age commenced more than three million years ago and lasted until the Bronze Age, which began nearly 4,000 years ago. The Iron Age dates to about 2,500 years ago. Advances in tool making in the latter two periods led to significant civilizational changes in the production of entire sets of emerging technologies—agricultural, industrial, military, and domestic.

The primary purpose of the early tools was mechanical; tools extended the physical capabilities of humans. Cognition was evolving too. A strong spirit of invention and entrepreneurship was emerging in human cultures. Individuals who could successfully craft tools and weapons became the world's first artisans. The potential for musical expression was there too. The first musical instruments may have been portable sound tools—simple stones that resonate at varying tonality when struck.[20]

Tools and Communication

The pace of tool development accelerated rapidly during and after the Agricultural Revolution. People tinkered with tools to improve them. Sapiens' language skill eventually allowed tool-making techniques to be passed from person to person and on to subsequent generations.

Tools themselves became meaningful signs. Just the state of being useful sends a powerful message. Successful tool makers enjoy evolutionary benefits. They become valued members of communities that depend on their creative talents and artisanal skills. Well-designed and crafted primitive tools also made their inventors outstanding candidates for sexual selection.[21]

The primary meaning of a tool resides not only in its functionality but in its association with other tools. For instance, a particular kind of knife—whether made of stone, bronze, or steel—functions as an instrument with a defined purpose. But as individual tools like knives mutated into various forms, they became embedded in broader contexts of meaning. For example, any knife belongs to a category of tools, like hunting knives. But as possible applications are imagined, dozens of subcategories evolve—for example, carving knives, bread knives, even medical scalpels. Within categories, knives become part of a tool kit that may contain several types of knives and other implements associated with specific tasks, like hunting, food preparation, or medical procedures.

Tools fall into higher-order classifications too. Similar to the way biological organisms are sorted into taxonomies (species, genus, family, order, and so on), tools can be categorized in ways that indicate the sphere of their use (for instance, farming, food preparation, or medical) or functional characteristics (like cutting, fastening, or digging). The meaning of any tool thus depends not only on its particular function but on its relation to other tools that are grouped into classes of utilization. Today's elaborate tools function within even broader spheres of technological application—for instance, educational technology, construction technology, sports technology, or personal communications technology.

Technology Transfer

As time passed, tools and tool-making techniques began to demarcate cultural differences from one group to another. But it didn't take long for our ancestors to understand it makes no sense to re-invent the wheel or any other useful technology. Good ideas have been borrowed, stolen, and copied throughout history. Useful technologies often spring up as independent inventions in various parts of the world. But as our ancestral groups grew larger, more productive, and more mobile, inventions that originated in one place were noticed and desired by populations elsewhere.

The invention of stone tools sometimes led to cooperative interactions between tribes. Stone Age tools have been found as far as 50 kilometers away from their place of origin. These discoveries suggest that inter-tribal trading networks emerged as far back as 200,000 years, long before many of our Sapiens ancestors left Africa.[22] The traders, at first strangers to one another, began to treat each other as kin or community members.[23] In order to conduct trade and form social alliances, the groups had to find ways to communicate peacefully and productively with each other. In the process, tools, language, and culture evolved together.

GETTING TECHNICAL IDEAS FROM NATURE

Some of the best ideas innovators get for creating new technologies come from imitating what happens in nature—**biomimicry**. For instance, a design for the manufacture of tiny light reflectors was inspired by a pattern found in the luminous skin of ribbonfish. The quality of glue used to fasten wood pieces together was improved by researching how mussels use tiny thread-like tentacles to attach themselves to underwater objects. Techniques for delivering painless hypodermic needle injections were developed by observing how mosquitoes work

their proboscis into the skin. Sonar systems for small boats were invented by approximating the way porpoises' foreheads control beams of sound precisely.

Sapiens learned the physical principles of flight by studying the morphology and behavior of birds.[24] Birds and humans face the same problem getting off the ground and staying aloft: Defeat gravity with thrust, balance weight to assure stability, create an airfoil that suspends the body in the air, and decelerate to land safely.

Inventors of the first aircraft had to meet these challenges. Since then, the aerospace industry has continued to incorporate the dynamic principles of bird flight into the construction of modern aircraft. For example, when designing jet airliners, engineers constructed a "winglet" like what many birds have on the tip of their wings.[25] Winglets direct the passage of air over the wings of birds and airplanes in a way that increases control over flight.

Prototypical airplane winglets were constructed out of metal but proved to be too heavy. So engineers kept searching for the right material—not too heavy but still able to withstand the pressure of air flowing over the wings at great speeds thousands of feet in the air. After many failed attempts, they found the solution in a composite plastic part. That seemingly small adaptation of an idea observed in nature made the difference between success and failure in achieving stable flight for many aircraft.

The search for the right design and the right material to create functional flight technology resembles the way random mutations work in biological evolution; many mutations will be discarded by nature, but some will work. Winglets on birds evolved as slight improvements brought about by random mutations that occurred over long periods of time. Winglets on airplanes were invented because engineers were able to copy an idea and then test materials until they found a way to approximate nature's success.

After winglets on aircraft proved to be effective for stabilizing flight, market forces took over in the competition between aircraft manufacturers. Like the owls, swallows, swifts, falcons, cormorants, and pelicans which glide effortlessly with winglets overhead, many aircraft were fitted with nature's solution for directing the flow of air in order to fly safely and efficiently. Survival in the marketplace of aircraft production depended on incorporating the right adaptation into the design.

How Technology Evolves

Scientific research reveals how biological organisms evolve. History makes clear that technology constantly changes too, but can we say that technology develops in ways that resemble organic evolution? Does technology live? Does it evolve in the scientific sense? Some top technology experts—Kevin Kelly and W. Brian Arthur most prominently—believe technology evolves with a significant degree of organic-like autonomy, even self-determination.

Just as we have a strong love of nature, biophilia, we also have a powerful natural attraction to technological things—**technophilia**. But our connection to nature and technology differs in the most basic respect. Plants and animals are "born." Technology is "made." These two worlds—one natural, the other manufactured—seem at first to be quite different. But distinguishing between them becomes less clear when we examine how technology actually gets put together. In this section we describe the natural correspondence between biological and technological evolution. Then we focus on the primary characteristics of technological development—inevitability, complexity and diversity, self-organization, combinatorial evolution, and accelerated growth.

Biology into Technology

The term "evolution" has two primary meanings. The first meaning derives from biological science and refers specifically to the modification and transformation of *living organisms*. The second definition of evolution is much more general. It refers to the gradual development of *something*, usually moving from the simple to the more complex. That something can include living organisms but also anything that develops over time—like a soccer team or local business, an artist's work or downtown neighborhood, a spoken language or the latest communications technology.

New biological species emerge from processes that govern the trajectories of organic evolution. They mutate from a common origin. Selection then acts on the mutations in ways that reflect conditions present in the inhabited environments (**Chapter 2**). Favorable environments heighten chances that successful variations will emerge. Plants need sunlight, water, air (carbon dioxide), and nutrients to live. Animals need food, water, shelter, and room to grow.

Nature has no conscious intention to improve, follows no predetermined course for development, and does not always produce superior or even viable solutions. Biological organisms cannot organize themselves into the best possible version of a grizzly bear, palm tree, or sunfish. Things change when humans intervene, however. People can willfully influence the course of nature's production by managing the biological or cultural environment where the production takes place.

The domestication of plants and animals initiated a key stage in human evolution. Cultural groups in Mesopotamia discovered they could modify certain strains of wheat in ways that would produce enough quality grain to feed their populations. They domesticated animals—especially sheep and goats—by confining them and controlling their mating patterns and food intake. The Fertile Crescent proved to be the perfect environment for dramatic cultural change. By altering nature to their advantage, foraging cultures developed into geographically stable farming societies and became the first civilizations (**Chapters 5, 9**).

Technological evolution requires far greater human intervention. Unlike nature's inefficient production of random organic mutations, technology inventors take much of the arbitrariness out of the evolution of made things. Boundless creativity and persistence are the key factors in moving a project along. Inventors first have to imagine and sketch ideas in order to bring concepts to life.

Like organic evolution, technological developments need favorable conditions to materialize—creative people with a scientific perspective, specialized knowledge, and the good fortune to work in environments that support innovative thinking.[26] Errors in development are common, even necessary.[27] Many technology companies encourage their futurists to seriously explore what might seem at first to be really bad or impossible ideas so that absolutely nothing is ignored.

New biological species emerge in changing environments. Stagnating species recede or disappear. Similarly, technological innovation creates superior material forms, while it destroys outmoded industries and products.[28] The changes can happen fast. Adaptations that have been made in communications technology illustrate one kind of evolutionary trajectory: Typewritten letters replaced handwritten correspondence. Email replaced standard delivery mail. Messaging replaced email. Digital images, including emojis and photos, can be substituted for written words.

Technology developers try to make their innovations useful and attractive, but they cannot guarantee that any tool or device will succeed in the marketplace, even when they believe they have a winner. Like the flowering of biological mutations in nature, more technology is invented than is needed or wanted. Spray-on hair, videophones, Google Glass, and countless other technological "miracles" failed. Other new technologies—MapQuest, My Space, Beta Max, Blackberry, Napster, and Palm Pilot, for example—burst onto the scene but were soon replaced by mutations—Google

Maps, Facebook, VHS, iPhone, Spotify, and tablets, for instance. Those technological mutations will evolve from their present form too. Ultimately, the economic market decides which new technologies will be added to the stock of made things and at what pace. The market visibility created by financial backers and the functional value judged by customers determine the future of new technologies.[29]

New technologies that catch on quickly become imitated and mass produced. Some technology brands—Apple, Rolex, Harley Davidson, or Tesla, for instance—take on a cultural life too because they prove to be not only functional but fashionable. They make lifestyle statements for their users and serve as identity markers for the clubs and communities that form around the brands.

Inevitability

Every American elementary school student learns that Thomas Edison invented the light bulb. But would the light bulb have been invented had Edison never lived? Without question, the answer is "yes." In fact, more than 20 other inventors had developed comparable technology around the same time. Edison was the first to be granted a patent.[30]

Not only have significant technological advances been made by more than one person in more than once place, most major advances developed in roughly the same order everywhere, even going all the way back to the time when stone tools emerged independently in different parts of the world. Some of the most important technologies that ushered in the modern world—the steamboat, airplane, photography, telegraph, telephone, and telescope among them—were invented independently by multiple individuals, often in different countries, at about the same time.[31] The capture of electricity and origination of the lightning rod were discovered separately a few years apart. Money-dispensing ATMs were invented more than once just a year apart. The silicon microchip was created twice in the same year.

A bold claim that was made early last century seems doubly appropriate today: The evolution of some technological forms is inevitable.[32] Could the smartphone *not* have been invented?

Failure is inevitable too. The vast majority of organic mutations don't survive. Only a small number of technological innovations gain much interest. But the visions and central ideas that drive the best innovations can be so good that the resulting technology seems destined to be invented. Human inventors simply respond to the innate force of the idea. *Inevitability is the demand that technology places on human ingenuity and labor.*

Complexity and Diversity

Life on earth began to evolve when a tiny bacterial cell split in half nearly four billion years ago (**Chapter 2**). Since then, an astounding number of complex and diverse organisms have arisen from random mutations shaped by natural selection. Today our planet is home to nearly nine billion plant and animal species, a number that continues to grow. Billions more species have gone extinct.

Just as robust organic species give life to an unlimited number of new biological forms, cumulative advances in technology lead to the creation of more complex and diverse technological forms. Plant and animal species become more complex and diverse as they compete for space and resources in constantly changing environments. The emergent cells of successful mutations provide some evolutionary advantage for the organism. Technology drives the evolution of its own complexity and diversity in environments where innovation is encouraged.[33] The economic market reacts favorably when technology gets better and cheaper in the unending spiral of novelty and demand.

Technological evolution was set into motion when our ancestors created the first tools. Since then, a combination of the contagious spirit of innovation and the power of economic incentive has encouraged inventors and industrialists to keep developing new technologies.

Computer processing ability doubles every 18 months as expressed in a formula known as **Moore's Law**. Because most modern communications technologies are versions of computers, their functionality expands exponentially. Technological complexity invariably leads to information abundance. The ensuing juggernaut of attractive technologies and ideas penetrates deeper and deeper into our physical environments and our individual and collective consciousness. Applications are limited only by the imagination. Communication technologies made telemedicine possible. Robotics transform the nature of work. Twitter alters political discourse.

As technology evolves, it opens up greater and greater opportunities to actualize our need to communicate. Being able to connect with others instantly across the globe is a tremendous capability. But the same tools that allow us to do that also provide powerful channels for bad actors to act. We therefore have to distinguish between the evolving technical capacity to communicate in complex and diverse ways, which is ongoing and progressive, and the human uses to which advanced communications technologies are put, which are undetermined and potentially dangerous.

Self-organization

Although genetic mutations lead to great diversity over long expanses of time, nature's clear tendency is to reproduce solutions that have worked billions of times before. Predictable outcomes result, especially reproduction of the physical attributes most likely to enhance a species' survival prospects. For instance, evolution favors and reproduces physical symmetry. Our own bodies, the tiny appendages of a centipede, and the branches of trees all grow symmetrically. Symmetrical morphologies evolved among different species in various parts of the world because they provide advantages over less proportional organisms. Beneficial organic redundancies like these are driven by the internal logic of nature's self-organized complexity.[34]

Technology also grows according to an organizational logic. But that logic must be recognized and nurtured by human agents in order to maximize technology's potential. New layers of technological sophistication are constructed on top of existing forms. Sapiens invented wheels before carts and wagons. Bicycles before cars, trucks, and busses. Gas-powered vehicles before diesels and hybrids. Driver-controlled vehicles before autonomous cars. Autonomous cars before whatever comes next.

Biological organisms retain certain basic physical elements as new species evolve even after millions of years and many gradual changes. This is the principle of **reversion**. The basic organizational structure of technological forms remains in place as those forms evolve too. The first metal hand tools looked and functioned like their stone tool predecessors.[35] The original wooden plow pulled by men evolved into a similar Roman iron plow pulled by draft animals, which later became a mechanized plow pulled by a tractor. Monocrystaline, polycrystalline, and film solar panels evolved sequentially, but all rely on the same internal organization. New computer software codes build upon previous iterations of the same code structure.

Even though the central idea that energizes development of any successful technology may be inevitable, the particular forms that new technologies take are not the same. For instance, Apple and Samsung smartphones operate similarly but differ in their beautifully crafted appearance. Teslas don't much resemble Chevy Volts.

How technologies are used also differs in response to the internal logic of the user. For instance, the ways people use their phones or cars are influenced not only by the nature of the devices and vehicles but by the users' gender, cultures they belong to, and individual personalities.

Combinatorial Evolution

New technologies are made from materials that already exist in the physical world and from component technologies that were previously assembled. For example, the inventors of AM radio combined various mechanical components that would make up the physical radio with electromagnetic waves that can be shaped to transmit audio signals through the air. This dynamic process—combinatorial evolution—underlies and propels technological growth.[36]

The components of any technology evolve from their previous architectures. Take your smartphone, for example. Smartphones get better each year because the processor, computer chips, image sensors, batteries, and the rest of the component hardware all constantly improve. In addition, the phone's operating systems (like Android and iPhone OS), user interfaces (the graphical material you see on the screen), and application suites (how you access your menus, calendars, and messages) are updated regularly and adapted to each other. The aesthetic look and feel of the device are constantly modernized too.

With the hardware and operating system in place, your phone then interacts with your service provider's latest protocols and with a multilayered, ever-expanding assortment of applications and features. All the elements of combinatorial evolution merge in ways that make smartphones so continuously appealing.

The dynamics of technological development draw from multiple sources to create a high level of multifunctionality. For instance, smartphones function as still cameras, video cameras, music sources, search engines, messaging media, GPS devices, and hundreds of other applications that respond to the needs and interests of users. In the process, smartphones made watches unnecessary. Technological innovators then created wearable computers to fit our bodies where the watches used to go.

The coordinated interplay between components of communications technology produces dynamic **hybrid energy** in much the same way that biological evolution is shaped by humanly induced hybrid vigor genetics—the crossbreeding of plant or animal species to create offspring that are superior to their parents.

Accelerated Growth

The pace of human genetic change has accelerated rapidly in recent history. The changes have affected our biological constitution as well as our social and cultural behavior. In just the past 10,000 years, the human genome has evolved more than 100 times faster than it did in the previous six million years.[37] Culture changes even faster. An especially astounding rate of cultural change has taken place over just the past 60 or 70 years—a miniscule increment of time—stimulated in large measure by the global revolution in communications technology.

The force that compels development of communications technology above all else is **speed**—the pressure to move information around fast. From implicit codes that regulate spoken language to the algorithms of encrypted software, and from scratches made on parchment by quill pens to global interactions facilitated by communications satellites, Sapiens are driven to connect as quickly and efficiently as possible.

Spoken language probably emerged somewhere between 300,000 and 100,000 years ago. Written language was created just 5,000 years ago. The printing press was invented slightly more than 500 years ago. Print mass media first appeared about 200 years ago. Electronic media were invented less than 100 years ago. The Internet arrived 25 years ago. The first smartphones were marketed less than 15 years ago.

Not only do the gaps in development of communications technology become increasingly shorter over time but the saturation of technology likewise accelerates. For instance, it took 81 years

for the original telephone to achieve 75 percent market penetration in the United States, 28 years to reach that mark for cellular phones, and only 13 years for smartphones.[38] North America, Europe, Australia, and South Korea remain way ahead in rates of technology adoption worldwide, but Internet usage and cell phone ownership are also increasing noticeably in developing countries.[39]

Technological development affirms and extends the human potential. It gives material form to our imagination, creative ability, and desire to improve the quality of our lives. The shorter and shorter intervals in the development of communications technology reflect an intensification of innovative thinking and a deep expansion of the knowledge base we have accumulated. Similar trajectories exist in all technical fields.

Does the massive technological growth we've achieved improve our quality of life and make us more secure? Impressive research data indicates that Sapiens have become healthier, happier, and far less violent over time.[40] But as the rate of technological change accelerates, we nonetheless remain mentally adapted to life in the past. Today's technologies can wipe out the entire global population. Nuclear weapons, environmental destruction, artificial intelligence, bioengineered pandemics, and unregulated social media all pose serious threats to our common humanity.

Digital Communications Technology

> When wireless is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being part of a real and rhythmic whole. We shall be able to communicate with each other instantly, irrespective of distance. Not only this, but through television and telephony we shall see and hear one another as perfectly as though we were face to face . . . and the instruments through which we will be able to do this will be amazingly simple compared with our present telephone . . . [A] man will be able to carry one in his vest pocket.
>
> Nikola Tesla (1926)[41]

By far the most useful personal communications technology invented so far is the smartphone, which had been predicted by Nikola Tesla nearly a century ago.

The Digital Advantage

The digitization of communications media began long before smartphones appeared. Digital technologies transform continuous analog information (for example, audio and video signals transmitted by electronic media) into discontinuous mathematical expressions—zeros and ones. Digital signals travel farther than analog signals, do so more efficiently, and cover distance without distortion. Because digital technology dramatically improves the quality of image and sound, the broadcast industry gradually had to convert to digital technology just to survive in the media marketplace.

Personal Communications Technology

Further fueling the digital revolution, personal communications technologies burst onto the scene late last century. These ubiquitous technologies appeal widely because they have properties that enhance our potential to survive, reproduce, and express ourselves.

Smartphones, tablets, laptops, and other digital devices function uniquely as communications technologies because they empower their users to be senders as well as receivers of messages. Being able to call or text, take photos, make videos, and post them immediately from almost anywhere has forever changed the limits that space imposes on our communicative potential. From the

TABLE 7.1 Personal Communications Technology

Technological Property	*Communication Effect*
Speed	Voice, image, and data travel long distances quickly
Range	Global coverage
Multifunctionality	Smart devices, internet access, camera, video, GPS, messaging, etc.
Signal quality	High resolution audio and video
Mobility	Transportability of small devices
Convenience	Ease of use
Sociality	Unlimited connectivity with multiple users
Interactivity	Send and receive messages, images, posts
Collaborative	Encourages creative cooperation
Emotional capacity	Engages full range of human sentiment
Reliability	Dependable performance
Status	Social and cultural currency

first Kodak still camera, audio cassette recorder, transistor radio, and portable video camera to the Walkman, MP3 player, laptop computer, cell phone, and today's integrated digital devices, communications technology has become increasingly personalized and mobile.

Criticism of Digital Media

The advantages afforded by digital media are unmistakable. But so are the problems. In this section we briefly discuss the major critical issues that have been identified with digital communications technologies and the industries that inhabit them. We examine the problems of concentration of ownership, access, privacy, the psychology of social media, and Internet addiction.

Concentration of Ownership

The digital media industry is dominated by a small number of corporations.[42] Two corporate monoliths—Google and Facebook—claimed at first to do business with the best possible intentions. Google implored, "Don't be evil" and then changed that mandate to "Do the right thing." Twenty years after its founding, Google has become the gatekeeper to information on the Internet. It controls more than 90 percent of the search engine market and ranks search results in ways that favor their clients. Nearly three-fourths of American adults also use YouTube, a Google subsidiary.

Facebook said at first it simply wanted to "Connect the World." That happened. Even after the problems that have plagued Facebook in recent years and after suffering a decline in the number of young users, the company still maintains more than two billion followers worldwide. The messaging app WhatsApp, a Facebook subsidiary, counts more than one and a half billion users in 200 countries. Google and Facebook together take in more than 60 percent of all social media advertising revenue. More than two-thirds of American adults continue to use Facebook, and nearly half the population gets at least some of their news there.

Digital media concentration is not about hardware ownership (like control over TV transmitters or phone lines) but about information and how the information is presented and managed.

Ownership concentration exists in the online retail business now too. One company—Amazon.com—has economic value that surpasses Walmart, Costco, Target, Macy's, and eleven other major retail corporations combined.[43]

Access

Nearly half the global population still has no reliable access to the Internet.[44] Global ownership of smartphones ranges from more than 95 percent in South Korea to about 40 percent of people living in sub-Saharan Africa.[45] Cell phones—not smartphones—represent the highest growth area for personal communications technology in poor countries.

Income, age, and gender are the best predictors of who is on the Internet and active on social media in the more and less developed parts of the world. For example, males are much more likely than females to have Internet access and advanced communications devices in Japan, India, and several African countries.

Within relatively developed countries, including the United States, elderly, poor, less educated, and rural people are least likely to be online.[46] Many American families have access to the Internet only by smartphone if at all. That underclass of users suffers limited opportunity to learn new career skills, take classes, or get health information, for instance.[47] Most Americans who are online strongly believe the Internet has been good for them personally and for society as a whole, though that favorable sentiment is declining.[48]

Privacy

People have become increasingly aware that confidentiality of their personal information is jeopardized by the clicks, likes, and purchases they make online. The privacy issue came to the forefront when the U.S. government revealed that the profiles and activities of Facebook users had been greatly compromised. Within a year many Facebook users adjusted their privacy settings. Others took a break from checking their newsfeed for several weeks or more. Young users were most likely to delete the Facebook app from their phones altogether.[49]

Facebook and many other social media sites promote the idea of community. Basic trust in the integrity of any community is an evolutionary necessity. But the implications of the massive privacy violation by social media confound these goals. The entire system of Internet commerce is founded on sharing consumer information. The profit-driven goals of social media companies remain fundamentally at odds with privacy and security.

Psychology of Social Media

Most people use social media in healthy ways. Authentic self-representation and respectful online socializing can be beneficial. Connecting with friends, meeting people with similar interests, and finding useful information are rewarding behaviors. But psychological distress experienced by some social media users has become a serious problem.

The social validation feedback loop that propels activity on social media—the likes, shares, and emojis on Facebook, likes on Instagram, re-tweets on Twitter, and views and comments on YouTube, for example—exploits the psychological need we have to be positively reinforced.

Yet not everyone feels personally gratified by their experiences with social media. A significant number of Facebook users say their satisfaction with life and emotional well-being are negatively affected by the time they spend on the site. Heavy Facebook users and those who lurk rather than participate suffer the most.[50] Some Instagram users also say comparing

themselves to others negatively affects their self-esteem, causing them to feel jealous and sad, even depressed.[51]

Young people are the population most likely to be affected by social media.[52] Overall, teenagers tend to rate social media's effects as more positive than negative, but most of them don't have a strong opinion on the issue.[53] A conformist mentality has emerged; teens have the most friends on social media and feel most rewarded when they receive positive feedback. At the same time personal unhappiness is associated with a high amount of social media use for teens. Furthermore, teens follow the crowd. They are more inclined to like posts or comments that already have lots of likes.[54] Many pre-teens become so mesmerized by their devices that they have a strong emotional reaction when their technology is taken away.

Technology companies and app developers use principles from behavioral psychology to increase social media dependence and make online communication addictive. By presenting engaging content, personalizing the content, and giving users more control over their experiences online, the more difficult it becomes to turn the devices off.

Internet Addiction

An illness has emerged from the ceaseless temptations offered by social media: Internet Addiction Disorder.[55] Some of the symptoms include the inability to physically stop checking social media, excessive playing of video games on the Internet, and compulsive online shopping. Even just waiting to see the next reaction to a post or text message can be compelling. Our brains chemically reward uncertainty and anticipation.

Internet addiction negatively influences sleep patterns. Teens, in particular, sleep less because they find it difficult to turn off devices that promise endless entertainment.[56] The consequences of Internet Addiction Disorder include a significant reduction in face-to-face time and less time with nature. Young regular users of communications technology are less likely to date, drive, drink alcohol, or have sex. They mature later into adulthood than previous generations.[57]

An influential book published in the 1980s was *Amusing Ourselves to Death*.[58] The author argued that the seductive nature of television harms individuals psychologically and is detrimental to the quality of public discourse. The constant distractions and diverse entertainment that make television so appealing also explains the magnetism of Internet-based communications technology, even more so.

The many problems associated with online overindulgence have not been lost on the leaders of the communications technology industries. Steve Jobs and Bill Gates strictly limited their children's time with media and communications technologies. Many Silicon Valley executives forbid or greatly restrict their children's time with technology.[59] Responding to growing public concern, the technology companies had to respond. Apple added an app that tracks users' usage and sets daily time limits for specific online activity. Google's Android operating system tracks app usage and can be used to limit time on smartphones. A whole new industry has sprung up to help teens, adults, and families learn how to manage time with their devices better.

Chapter Summary

The social history of our species can be characterized by how we continuously expand our ability to communicate. Beginning with spoken language, Sapiens' innovative spirit and industriousness have responded to the pressing need to communicate by creating increasingly complex technological forms.

Technological innovation extends the principles of biological evolution to the production of material artifacts, including the focus of this chapter—communications technologies. From simple stone utensils to sophisticated digital media, technology functions to increase our survival prospects, invigorate our reproductive potential, and support the innate desire we have to express ourselves.

Tools and tool making mark the start of our technological development, demarcate key transitions in human evolution, and illustrate the close connection we have with other advanced species. Evolutionary processes that underpin biological heredity can be seen in the way communications technologies continue to be created, adapted, and improved. The parallels between biological and technological evolution are clear. Small biological changes correspond to incremental advances that are made in technology development.

The digital revolution made it possible for ordinary people to have access to the Internet and communicate at a global level. Finding ways to increase computational speed motivates the work of technology developers everywhere. For most people in more developed countries, the advantages of personal communications technologies are manifest.

But serious problems have cropped up with digital communications technologies. Similar to major mass media corporations, the big social media companies have amassed tremendous economic and cultural power. Most of the world lags far behind nations with advanced economies in access to the Internet and adoption of smartphones, privacy has been compromised, and people become addicted to the Internet and smartphones. Many young people suffer psychological damage from social media.

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8

MEDIA

Gesture, speech, and early writing represent limited communications forms; their capacity to reach a large number of people was greatly restricted. But beginning with the printing press 500 years ago, media technology began to disseminate information and entertainment to readerships and audiences, which would eventually cover the globe.

This chapter describes the evolution of mass media as technological developments driven by Sapiens' desire to communicate in ways that radically conquer time and space. It explores how media function in modern societies and the complex relationships they have with their audiences. Functionalist media theory is presented and critiqued. To conclude the chapter, we explain how the individual person today lives in a hub of activity made up of four spheres of modern communication.

Defining Media

We all have a commonsense idea of what "the media" are. But we must be precise in the way we use a term that is so fundamental to the communications field and everyday life. What exactly are communications media?

The term "**medium**" refers to *any single one* of the various channels that carry messages inside a communication system. Medium is singular for media. The *Oxford Dictionary* defines "medium" in various ways. For our purposes, the following definitions apply:

1) A means by which something is communicated or expressed.
   Example: "Here the Welsh language is the medium of instruction."
2) A particular form of storage material for computer files, such as magnetic tape or discs.
   Example: "Copy files to and from the device as you would with any other storage medium."
3) The material or form used by an artist, composer, or writer.
   Example: "Oil paint is the most popular medium for glazing."

A medium therefore is any individual means, form, or material that transmits, stores, or otherwise facilitates the production and reception of a message. A medium does not have to be technological. It can be spoken language (definition #1). A medium doesn't have to move information from one place to another. It can be a piece of equipment or digital space where information is

stored (definition #2). A medium doesn't have to connect one person to another directly. It can serve as a resource that is used to create an abstract form of human expression (definition #3).

Medium is always a correct way to refer to a single communications channel. But by the sheer weight of popular use, the plural term "media" now can also be used interchangeably with "medium" when referring to the any means, forms, or materials that facilitate communication—singular or plural.

Mass Media and Mass Communication

"Mass media" is a pre-Internet term that refers to communication technologies that disseminate messages over broad expanses of time and space and reach many people. Traditional mass media include newspapers, magazines, film, radio, and television. Books, pamphlets, and other print publications can also be considered mass media if they circulate widely enough to have large readerships. The Internet became a special kind of communications medium that is often grouped together with traditional mass media.

A **mass communication** system is comprised of a limited number of message sources (mass media outlets) and many message receivers (consumers of mass media content). Websites and social media interact with traditional mass media to further circulate and amplify messages. Although media audiences today are more fragmented, dispersed, and distracted than ever before, they are still numerous and powerful.

From the start, the mass media's relationship with audiences has been one way. Readers, listeners, and viewers have had little opportunity to provide feedback to the sources of information and entertainment they receive every day.

Early Mass Media

In the following section, we explore the early stages in development of today's global communications media. We examine the origins of print media, interpret the roles of the Enlightenment and the Industrial Revolution in early media development, describe how media took hold in colonial America, and explain why the content of mass media developed the way it did.

Print Media

The antecedents to print media technologies were simple tools—a stylus and clay tablet, a quill pen and papyrus. The invention of writing technologies and the production of written scripts were prompted by the need to document, preserve, mobilize, and control information during the Agricultural Revolution (**Chapter 5**). The leap from basic writing tools and simple documents to print media technology did not take place for thousands of years. Throughout the intervening years, the vast majority of people on earth remained illiterate.

Major transitions in the evolution of communications technology always transform culture. That became clear when print media first appeared in the 1500s. Medieval European culture was giving way to advances brought on by modern civilization. Challenges to the established cultural and political order were being launched in philosophy, art, literature, and religion. Humanistic and secular ideas were taking hold. Science and technology were on the rise.

Drawing inspiration from the entrepreneurial spirit of the time, the German metal worker Johann Gutenberg invented a mechanical printing press that featured a revolutionary technological innovation—movable type. Gutenberg's press could produce multiple copies of a printed page. He first experimented by printing grammar manuals and poetry. But Gutenberg and other printers

needed to raise enough money to make publishing economically viable. Printing the Bible proved to be the best early investment. Until then, handwritten copies of the Bible were not read outside the Catholic Church hierarchy.

Many people today don't regard the mass media as honest brokers of truth. But that's not how media's reputation got started. Invention of the printing press ushered in an extended era of high credibility in public communication. The impressive physical appearance of books—printed words arranged in straight columns, pages of text bound in beautiful volumes—conveyed an impression of moral uprightness.[1] Books seemed more credible than speech. *Books were considered to be truthful because they were thought to contain solid factual information.* Readers could gain real knowledge by reading books.

Print technology accelerated and diversified the pace of cultural development. Books, pamphlets, and magazines made up an expanding stream of information. Valuable information of all kinds was being stored, shared, evaluated, revised, and turned into useful knowledge. Regular newspapers appeared in Germany, France, Holland, and other parts of Europe. Secular libraries and archives were established.

Rigorous and innovative thinking characteristic of the Renaissance period was maturing into a scientific revolution in Europe during the Enlightenment (also called the Age of Reason)—the middle 1700s. Stimulated in large measure by publications that had begun to circulate widely, human consciousness was ascending to new heights. Levels of education and intellectual life were expanding. A Protestant uprising challenged the political and cultural authority of the Catholic Church.

Print media circulated fresh ideas that could be talked about in a much more tolerant and open atmosphere. The fast-growing population of many European cities created opportunities for intellectually curious people to interact. The **public sphere**—a space where people could freely debate ideas and opinions about politics, culture, and social issues—was taking form.[2] Many of these lively conversations took place in the coffee houses and bars of urban England and France (**Chapter 5**).

Industrial Revolution

From the very beginning of our planet's natural history, the "watery origins of life" created conditions for organic elements to move around and collide with each other.[3] Those dynamic interactions sparked life. Conditions have to be right for novel ideas and new technologies to appear too. Innovative thinking and experimentation were encouraged throughout Great Britain and Western Europe. The stage was being set for significant breakthroughs in the evolution of communications media.

The Industrial Revolution that was underway in Europe from the mid-1700s to the mid-1800s later spilled over to the United States. Enlightenment values based in scientific reasoning—secularism, innovation, progress, and the idea that humankind could dominate nature—were taking hold in the enterprising Western world.[4] Technological breakthroughs were brought about by the ingenuity and hard work of innovative craftsmen—the tool makers of the Industrial Revolution.

The Industrial Revolution unleashed an entrepreneurial spirit among investors, inventors, and craftsmen in Europe and North America. Nineteenth-century industrialists made up the first economically dominant class to identify with the irreverent idea of a dynamic secular society driven forward by constant technological change.[5] Set into motion by the force of the human imagination, the fruits of the Enlightenment were maturing in material and cultural form.

The Industrial Revolution was well underway in England when Charles Darwin compiled and interpreted the observations he recorded on his journey around the world and from subsequent research conducted at his home outside London. Darwin published *The Origin of Species*, the book

that established evolutionary theory as a major scientific breakthrough, in 1859. At the time, he didn't attempt to apply evolutionary theory to technological change. But Darwin later came to believe that the diversity of biological production can be compared to the processes of industrial production and that both are crucial to human evolution.[6] Diverse biological species arise from random variation in nature; the process is undetermined and self-sustaining. Diverse industrial production results from entrepreneurial efforts in the technological and cultural arenas; the process is goal-oriented and driven by human agents.

Media in Colonial America

Development of print media in colonial America grew rapidly after a pattern of industrial progress had been firmly established in Europe. Favorable social conditions, a booming industrial economy, and an accumulating array of foregoing technological achievements prepared the ground for mass media to emerge in the United States.

At first, newspapers and other print publications were read by only a tiny minority of people in American society—a highly educated and economically elite class of men who thought they could better control their destiny by participating in political matters. To do so, they needed information. Besides news accounts and financial reports, the elites read essays on a wide range of political, philosophical, religious, and literary topics. Individual newspapers were aligned with political parties.

Revenue generated by the extraction of raw natural resources and the availability of cheap labor created economic conditions that were favorable to the young print media industry. American culture was changing dramatically. Laws that required public schooling (for non-slaves) increased levels of basic education. A growing sector of ambitious citizen consumers began to take shape. Many potential print media readers were being created.

Literacy rates increased as books and other printed matter became available, especially in the northern states. But very different levels of print literacy and disposable income widened the gap between the social classes. Lots of people wanted to read but couldn't because of vision problems. That deficit created demand for the mass manufacture of reading glasses—the first technology that people would wear regularly on their bodies.[7]

Printing technology got better while advances in other industrial sectors also improved. Forms of transportation progressed so that printed material could be moved around faster than before. Banking and financial institutions made it easier to invest in the young nation's industrial and technological base. Electricity was harnessed and applied to an emerging communications technology—the telegraph.

Popular Content

Dense content, a dull writing style, and the high cost of early American newspapers limited wide readership. But tabloid "**penny press**" newspapers introduced in the early 1800s greatly changed the first system of mass communication in America. Newspapers started to be available to larger and more diverse reading publics.

This new kind of newspaper offered popular content as an alternative to the highbrow material consumed by the upper classes.[8] The four-page tabloid papers were written for the growing working class. The content of news items and the way the articles were written were sensationalized. Political scandals, crime, sex, and disasters were highlighted. The human-interest story—featuring cute animals, children, and other topics that could reliably provoke sentimental responses—became a journalistic staple. Local news was emphasized. Humor and cartoons lightened up the mix.

Bigger headlines, shorter stories, flashier page composition, and photographs made popular newspapers visually inviting. The tabloid style appealed to a newly enfranchised category of readers who didn't have the time, money, high level of literacy, or interest in contemplating the typical tedious essays that appeared in the elite press.

Popular newspapers redefined news and set the stage for trends in American commercial media that remain with us today. *Information became a consumer commodity*. A profit-driven sense of what constitutes **mass taste** was being formed. The characterization of the popular press reader as someone who has little interest in nuances or details guided editors' selection of stories and how they would be presented. The idea of the "unusual event" became the main criterion for news selection: A story qualified as news if it was likely to surprise, threaten, or otherwise excite the reader.

Defining news as events out of the ordinary makes sense evolutionarily. People naturally scan their environments for possible threats. Normal conditions are perceived not to be a threat. Abnormal conditions might be. The popular press exploited these fears and anxieties. Many media outlets continue to do so today.

Economic factors also converged to push the trend toward production of popular content. The penny press got its name because tabloid newspapers cost one penny. Elite papers cost six times that amount, which was too expensive for working people. Print technology had improved so that press runs could be large enough to recoup investment costs. Rolls of cheap pulp paper were being mass produced for use as newsprint.

Lower newsstand prices and big press runs of popular newspapers became economically sustainable because of another cultural change—the advent of commercial advertising. The first newspaper ads were simple classified announcements. But urban business owners wanted to promote their goods and services more attractively and extensively. Unclassified advertising started to appear on every page inside the popular papers. Commercial advertising agencies opened up in cities along the East Coast and later throughout the country. Through it all, newspaper circulation grew precipitously.

Audio Media

The next major step in the evolution of communications media—the electronic stage—developed on momentum that had been created by print media. Electrical engineers set out to transform audio signals, especially the sound of the human voice, into information that could be transmitted long distances. Radio would become the first electronic mass medium and a major part of the popular culture landscape in America by the 1920s. But the telegraph and telephone were invented first.

Sound

As we've seen, Sapiens are not the only species that exploits sound to communicate (**Chapter 3**). Besides mating calls and warnings, some animals identify themselves to others by emitting signature vocalizations. Whales and dolphins hunt and navigate by sending audio signals that bounce off underwater objects back to them—**echolocation**. Bats do the same thing to fly safely through the night air. Humans also use echolocation technology—sonar—to find schools of fish, map underwater terrain, locate icebergs and submarines, and discover underground oil reserves. Ultrasound echolocation can identify organ defects inside the human body and determine the sex and physical condition of a fetus.

Voice

The search for ways to alter and magnify the human voice began more than 50,000 years ago. The idea didn't occur to Sapiens first. The earliest audio amplification likely took place in European

caves occupied by Neanderthal tribes before Sapiens arrived.[9] Some archaeological evidence suggests that Neanderthal groups intentionally used the echo-producing deep recesses in the caves to create particular kinds of resonant sound. Shamans sang, preached, and performed cultural rituals in these places (**Chapter 11**). Sapiens followed thousands of years later, often in the same caves, and exploited the unique acoustic qualities of the caves for the same reasons. Some of our Sapiens ancestors may have created a multimedia effect by painting the walls in the chambers of caves that produced the most enchanting echoes.[10]

Natural sound has a captivating quality that continues to be exploited today. Cathedrals and concert halls are constructed in ways that allow unamplified voices and musical instruments to resonate throughout the chamber with chilling effect. "Unplugged" is a pop music option that features the delicate, unamplified sound of acoustical instruments. Distinctive natural sounds of forests, oceans, animal communication, and other settings and events are recorded for playback on audio media.

Technologically amplified sound has been exploited in the Western world since formation of the first democratic political state and the origin of theater and rhetoric in Greece nearly 3,000 years ago. Megaphones made of natural materials were used by politicians to speak to large gatherings of citizens—the first forms of **public address**. Actors wore masks with built-in megaphones to project their voices in theatrical rituals.

Telegraph

The first big challenge in manipulating sound with technology was to send audio signals from one distant location to another. The right resources had to be in place in order to capture, amplify, and transmit sound. Engineers in the entrepreneurial West had discovered that electromagnetic energy—electricity—could be used for this purpose.

By the mid-1800s the American Samuel Morse and other inventors found they could transmit messages long distances by manipulating the sound of electrical buzzes that traveled along an insulated wire. The telegraph ("distance-writing") was invented. To compose telegraphic messages, the Morse code—a binary system composed of dots and dashes—was created. A trained person tapped out a message that was decoded by another individual on the other end of the line.

Speed of transmission in Morse code was accomplished by pairing the letters of the alphabet with varying electrical sounds that were sent along the wire. Each letter was assigned an identifying audio signal (a dot, dash, or combination of dots and dashes). Dashes take three times longer to transmit than dots. To maximize efficiency, the more frequently used letters were given shorter signals. For instance, the commonly used letter *e* was represented by one dot, while the less useful letter *y* was assigned one dash followed by a dot and two more dashes. Morse code could be sent very long distances by wire, even across the Atlantic Ocean via underwater cable.

Wire reports sent to newspaper offices by telegraph became the first means by which news could be transmitted from one geographic location to another.

Telephone

Transmitting voice by wire was the next big step taken in the evolution of communications media. Telephone ("distance-sound of voice") transmission began in the late 1800s. A person spoke into a crude microphone that was attached to an electrical wire. The vibrations of the speaker's voice were transformed into electromagnetic waves that could be decoded and reproduced on the other end of the line to approximate the sound of the originating voice. Although the American Alexander Graham Bell is commonly credited with inventing the telephone, innovators in many other countries

were on the same track even earlier. The telephone was one of those inevitable and simultaneously invented technologies.

Later, Bell figured out how to make telephones function for two-way conversations. With that improvement, the bulky landline telephone became the first personal communications medium. Expensive telephone lines were installed between selected locations but used exclusively by people with the necessary financial resources to conduct business and communicate with their families this way.

Radio

Technologists utilized the dynamic properties of electromagnetic current to bring about the next development in the evolution of communications media—the transmission of audio signals from one place to another through the air. Electromagnetic energy could be shaped into various wave lengths and transmitted directionally. Certain wave lengths could be modulated in ways that would hug the Earth's surface and travel long distances. That technology gave birth to the first electronic mass medium—AM (amplitude modulated) radio.

Radio technology was taken over, further developed, and deployed by the American government for military communication during World War I. After the war, radio stations sprung up and began to transmit voice and music to the general public. The consumer market for radio sets exploded.

Regulation

The Federal Radio commission was established in the United States to regulate the chaotic technical aspects of broadcasting—assigning frequencies, hours of operation, and power levels. Concerned about abuses of the persuasive power of electronic media, lawmakers also established what would become a core principle of telecommunications in America: The airwaves belong to the public.[11] According to the government, citizens' rights to be served by the powerful new communications technology should override whatever free speech rights station owners might assert.

Legislation specifically protected citizens' "public interest" (their general good and welfare), "convenience" (making sure people get the information they need—especially news, farm reports, and weather—in a timely way), and "necessity" (safeguarding the public from outside threats and attacks, but also assuring that common citizens have free access to radio programs). In evolutionary terms, the shared interests of the general public were being protected against the potential for radio station owners to act in ways that could undermine the well-being of the overall community.

With its insatiable appetite for program content, radio fueled the rapid rise of many new entertainment industries. American popular culture entered a flourishing new phase of development.

Listening to Radio

Radio changed family dynamics. Radio became the hearth of many homes as families gathered around their radios to listen to their favorite programs. That seemingly cozy situation required a series of adaptations. Meal times and other family routines were arranged around broadcast schedules. Sorting out listening habits became family work because everyone didn't always agree about what programs they wanted to hear. The eventual solution for many families was to buy multiple sets, setting the stage for the individualization and privatization of media consumption, a trend that intensified greatly as communications technologies evolved.

At first, radio stations presented block programming—30- and 60-minute shows mainly—that featured drama, comedy, soap operas, vaudeville (variety), sports, news, music, and religion. People

gained a regular source of news and no longer had to leave their homes to hear music, follow sports live, or attend religious services.

As the content of programming diversified and the number of radio sets owned by families increased, individual listeners began to listen more selectively. Radio programmers and audiences co-evolved as a communications system. The programmers determined what would be aired. But to win high ratings, they had to develop formats and content that appealed to diverse audiences.

Mobility

Radio added a crucial new dimension that would foreshadow another future media development—mobility. Two technological innovations led the way. First, radios were installed in cars beginning in the 1930s and soon thereafter became standard equipment for new vehicle sales. Americans could no longer imagine going anywhere without their "constant companion." As time went on, car radios also became a great way to attract attention—a modern form of male sexual signaling. That tactic has been amplified today with the unavoidable presence of subwoofer-driven sound systems that deliver deep bass beats from vehicles cruising through public space.

Second, invention of the transistor—a tiny semiconductor that amplifies audio signals—further accelerated the trend toward mobility. Transistors were inserted into the circuitry of portable radios so that no external electrical source was needed to power the device. Transistor radio popularity skyrocketed in the 1960s and 1970s, representing a significant stage in the evolution of electronic media. Radio—the mobile medium—made it possible to listen in the car, bedroom, office, or beach—anywhere signals could be received. Radio's mobility gave people a significant measure of control over their experiences with media.

Television

Sending visual information through space was the logical follow-up to wireless audio and radio broadcasting. Experimental video transmission began in the 1920s—around the time commercial radio stations began to operate. By the early 1940s the American government granted licenses to owners of television stations, who were subject to the same basic regulations as radio. However, the government slowed down the frenetic growth of the industry when the United States entered World War II. Once again, advanced communications technology came under government control for national security purposes. The Golden Age of Television—a period of rapid expansion of the industry and penetration of TV sets into nearly every American home—ensued after the war.

Like biological organisms, communication technologies and the symbolic forms they transmit evolve conservatively. Proven solutions are replicated. The first popular television programs—quiz shows, adventure programs, soap operas, Westerns, and variety shows—were copied directly from radio. Following the precedent set by popular print media and radio, commercial advertising became the primary means for financing television. The major commercial television networks—NBC, CBS, and ABC—were formed out of radio networks that were already in place. Corporate owners of print media and radio stations bought up television facilities to the point where the government had to limit the number of stations one company could possess. Had that not been done, the media landscape would be dominated by an even smaller number of media conglomerates than it is today.

For families, owning a new black-and-white television set quickly became a status symbol. The same thing happened when color television was introduced in the 1960s. Families enthusiastically integrated television into domestic life. Because television was such a novelty and the vast majority of families had but one set, the television typically was positioned as the centerpiece of the living space in most homes. Even more than radio, television changed routine family behavior—including

the "TV dinner" (pre-prepared food packaged on an aluminum tray that could be heated up in an oven and consumed in front of the television set) as a mealtime option.

Evolving Television Technology

By the late 1950s most people could receive a handful of television signals that were transmitted over the air. But people who lived in rural areas or where the signals were blocked—such as mountainous regions and dense urban settings—could not reliably watch television. To solve these problems, forward-thinking cable television operators captured over-the-air television signals and redirected them to subscribers' homes for a fee. Cable television was originally called CATV—community antenna television.

Cable television built on the success of over-the-air broadcast television. Ultimately, cable proved to be a superior delivery system because it overcame the technical problems of conventional broadcasting and offered consumers many more channels. Eventually, subscribers could watch local channels and specialty programming from CNN, ESPN, MTV, HBO, and many other program providers on cable. Some early cable providers also experimented with "interactive TV," where people at home gave their opinions about television programs, political issues, and cultural preferences in real time. The experiment failed because most people didn't want to be inconvenienced or have corporate media tracking their personal data.

The next stage in the technological development of television extended the functionality of cable TV but discarded most of its hardware. In direct satellite broadcasting, signals are transmitted from land stations to geostationary communications satellites. The signals are captured, amplified, and re-transmitted back down to subscribers.

From the start, television transmission occupied only a small part of communication satellite capacity. Today, most satellite communication transports encrypted business data from one place to another and facilitates the flow of information on the Internet, including telephone and messaging services. Governments of modern major countries use communication satellites to gather foreign intelligence and conduct routine domestic business. Developing countries use the satellites to

TABLE 8.1 Communications Technology Timeline (*Note*: Dates are approximate and represent the period when the various technologies became established in the consumer market)

Year	*Technology*
1830	Popular newspapers
1850	Telegraph
1876	Telephone
1880	Magazines
1900	Film
1920	Radio
1952	Television
1975	Cable television
1980	Satellite television
1983	Cellular phones
1995	Internet
2007	Smartphones

combat illiteracy, raise educational levels, disseminate health information, administer disaster relief, plan agricultural activity, and transmit cultural programs.

Path Forward

Newspapers, telegraphy, and telephony made it possible to circulate information widely and rapidly for the first time beginning in the early 1800s. Radio extended that potential last century. Technological advances brought greater efficiency to the way television signals are sent and received, from over-the-air telecasting to cable and satellites. The Internet, mobile devices, and social media further increased and diversified the functionality of communications technology.

Each new media technology draws from the structure of previous modes of communication. The Internet absorbed the functionality of satellite and cable television, which had absorbed broadcast television, which had absorbed radio and film, which had absorbed print media, which had absorbed oral communication.

Media content is likewise appropriated by new technologies as they develop. Especially in its early days, radio challenged newspapers as a major news medium. Electronic media refreshed the primordial roots of human communication by emphasizing orality, popular appeal, emotion, storytelling, and ritual. Television executives developed versions of the news and entertainment programs that had been successful on radio. Cable television reproduced broadcast television programming and expanded popular program genres into 24-hour channels that feature news, sports, music, and movies, and many other formats. Satellite TV gave even greater range to what cable was already doing.

Mass media content gets reproduced on social media and vice versa. Music, film, and television stream onto smartphones. Video shot with smartphones is regularly uploaded to television stations and networks, a technological interface that propels some images to go viral. Spotify and iTunes stream music in formats that resemble the way radio stations are programmed.

Unintended Consequences

When Thomas Edison invented the phonograph in 1877, he listed the ways he thought the device could be used as a consumer appliance. He believed the main purpose of the phonograph would be as a dictation device, eliminating the need for a stenographer. He imagined talking books for the blind; examples of perfect oratory that could be used to teach public speaking and learn foreign languages; and a means to record family memories, popular sayings, and the last words of the dying. Edison also thought the phonograph could be used to record telephone messages. He imagined that clocks announcing the time would appeal to the public.[12]

Yes, Edison did also suggest that the phonograph could be used to play music. He placed that option fourth on his list of possible applications. Against Edison's wishes, the phonograph was quickly adapted into a coin-activated juke box machine, an application of new technology that eventually led to formation of the music industry. Recording and reproducing music quickly became a global phenomenon. In time, the dictation device, audio books, recorded language lessons, audio-equipped classrooms, telephone answering machines, and musical toys became successful technologies too.

Priorities

Many major breakthroughs in electronic and digital communications media were diverted during the early stages of their development by the American government to serve military

purposes. The first applications of Morse code were appropriated by the military for national security. Advances in radio technology were motivated by the government's need to communicate with ships at sea when World War I broke out. Television technology was developed to spy on enemy installations and troop movement in World War II. Communications satellites today survey every inch of the earth's surface in the interest of protecting the homeland and America's business interests.

The Internet—which originated in government and academic circles—has also been incorporated into every aspect of national defense. When Russia hacked into private email accounts and used social media platforms to spread disinformation, the American government and other nation states invested additional resources into creating sophisticated digital technologies to mount an improved cyber defense.

Media industries must adapt when new technologies arrive. Newspapers lost advertising revenue when commercial radio appeared. In response, publishers fought to keep broadcasters from reading news on the air that was taken from their publications. Radio transitioned from block programming to continuous music and talk formats when television took over radio's most popular genres—soap operas, Westerns, situation comedies, serious drama, and variety shows. Cable television offered alternative programming that liberalized over-the-air television content. Satellite television competed with cable by expanding the number of channels made available. The Internet fought with mass media for market share and eventually merged its digital platforms with mass media—from network news sites to streaming audio and video.

When media technologies enter consumer markets, they are adopted first by individuals with adequate financial resources and interest. Then they spread into the popular social classes, traditionally beginning at the household level and later splitting off for more private use. The first telephones, radios, televisions, and computers were situated centrally in domestic space—a sharp difference from the way most personal communications technologies are used now.

Media Audiences

In past centuries, people had few places to turn for information and entertainment. Over the past 200 years, newspapers, radio, and television filled that void and changed social and cultural life in the process. People unwittingly became members of a new social phenomenon that was taking shape—the media audience.

In this section we briefly describe the two primary lines of empirical research that were conducted in response to the presence of mass media in the lives of their audiences—media effects and the active audience.

Media Effects

Reaction to the presence of mass media in society wasn't entirely positive, especially after radio became a popular consumer commodity. Some critics feared that people would spend too much time listening to the radio and would be seduced by persuasive messages emanating from the talking box, especially political commentaries and product advertising. Those concerns were magnified when television came along. While radio could attract and amuse listeners for hours, television seemed able to hypnotize audiences for longer periods of time and with greater impact.

Academic researchers set out to scientifically assess the influence of the new electronic media on society. The early studies of radio and television were referred to as **effects research**. Investigators

tested the proposition that a stimulus-response relationship exists between what the media present and what audiences do in response. A particular concern was fear that violent television programs make television's most vulnerable audience members—children—more aggressive. Several empirical studies supported that hypothesis.[13]

But beyond some studies about negative effects on children, academic researchers could not identify a strong causal link between media content and human behavior. Social scientists began to realize how difficult it is to isolate and measure radio and television's psychological and social impact from the rest of human behavior.

Claims made by scholars about the social effects of electronic media could only be stated in highly equivocal terms. For instance, researchers said that electronic media influence "some people, some of the time, about some things."[14] The "couch potato" television viewer, the soap opera addict, and the beer-drinking-television-watching football fan were proving to be misleading stereotypes. Experts began to realize that electronic media actually may do more to simply reinforce preexisting thought and behavior than create or change it.[15]

The Active Audience

Another line of research opened up. Instead of focusing on what electronic media do *to* people, researchers turned the question around: *What do people do with the media*? This question prompted research and analysis that led to **active audience theory**. According to this view, mass media should not be thought of only as technological forces that shape people's behavior.

Although media influence the thinking and behavior of their audiences in some ways, the media also function as resources that individuals can use to advance their personal interests and objectives. For instance, radio listeners in the 1940s watched quiz programs and soap operas to get advice for solving personal problems and learn social roles generally.[16] Radio listeners employed the audio medium to establish moods, structure their daily lives, find companionship, put themselves at ease socially, and be entertained and informed.[17]

Television gave audiences even more resources to work with. Program content and the shared viewing experience can both be put to advantage by viewers. For example, from the beginning of television, in American homes families used the special experience of watching television to entertain visitors and give people interesting topics for conversation. Audience members referred to themes from television programs to express their opinions about many things at home, school, and work. Young children re-enacted programs and the roles of their favorite characters on the playground.[18]

Family discussions about television programs helped people define and reinforce their gender roles, solve everyday problems, and chastise social institutions.[19] Viewers relied on television to structure and regulate their lives, facilitate interpersonal interactions, gain access to some people and avoid others, and give opinions about what they're watching, sometimes in competition with other viewers.[20]

Moreover, the patterns and meanings of television viewing differ from one culture to another.[21] For instance, Venezuelans television viewers typically focus on prime-time soap operas and watch programs communally. German viewers tend to engage in a far more individualistic style of media consumption. Watching nighttime television in rural India creates opportunities for shared experiences in families where gender roles traditionally keep men and women separate. Television viewers in China choose programs from a limited range of content authorized by the government but interpret what they watch in far more personal ways.

EXPLOITING THE SENSES

A rush of dopamine courses through our brain when we feel threatened or uncertain about what might be about to happen to us.[22] These instinctual reactions have been exploited by storytellers throughout human history. Shamanistic and religious rituals create and reinforce the fear of god and the unknown. Soldiers react anxiously when the shooting starts. Criminals feel a rush when they commit their offenses.

Terrifying experiences are sometimes sought out for fun. Roller coasters elicit a fearful reaction. Peering over a cliff can be thrilling. Most kids love to hear and tell ghost stories. A spooky setting—like a campfire at night or darkened room—adds to the allure of being "scared to death."

Media exploit emotional vulnerabilities like these by attacking our senses. The best example may be how we react to the constant feeling of impending danger represented in horror films. Frightening plot lines, fearsome animation, suspenseful music, and clever editing enhance horror stories' scary effects. High-definition imagery and Dolby surround sound heighten the sensory impact.

Movies, television programs, music, novels and other forms of popular culture succeed in large measure because they stimulate our emotions. The path to emotional stimulation is through the senses. We go to movies fully expecting to experience the emotional power of *sight* and *sound* in a darkened space shared with anonymous other people. Three dimension and IMAX formats elevate the senses even more.

In the 1960s, Hollywood tried to add a third sense to the movie-going experience—*smell*. Smell-O-Vision synchronized action on the screen with the release of 30 odors through air vents in movie theaters in a film titled, "Scent of Mystery." The idea failed as a long-term project because ticket buyers gave the movie mixed reviews and the infrastructure of movie theaters across the country would have had to have been substantially modified in order to excrete the smells.

Our fourth sense is *touch*. The 1974 film "Earthquake" used super deep audio to vibrate rooms when the tremors began. Despite the novel appeal, moviegoers rejected vibrating movie seats, especially when the film that shook the building was playing in the room next door. The fifth sense, *taste*, has turned out to be the most difficult for filmmakers to re-create and exploit—except perhaps for the popcorn machine in the lobby.

Media Functions

Technology began to benefit our ancestors from the moment someone got the idea to craft a stone into a useful shape. Since then we've been driven to create new tools and improve the ones we've got. When tools, technologies, and media perform well, we say they *function* for their intended purpose and for the people who use them.

Technology drives economic and cultural production. That's why improving communications media has been a top priority ever since the first forms of written expression—commodity tokens and clay tablets—were invented more than 5,000 years ago (**Chapter 6)**. We surround ourselves today with a diversity of media because each medium helps us accomplish things we consider important.

The original ways that modern media function for the overall society are surveillance, correlation of response, and cultural transmission. Entertainment and economic functions were added later.[23]

Surveillance

Effective functionality of any communications technology begins with protecting lives. Our early ancestors depended on each other to warn them of impending danger—especially potential attacks by wild animals and other human groups. The only communication channels available for sounding an alarm were noise-making actions, gestures, and voice.

The threats we face today have become far more numerous and menacing. In response, journalism and media news reports have been developed as forms of **surveillance**. Terrorist attacks, international conflicts, pandemics, corrupt politicians, natural disasters, and economic crises receive extensive news coverage because they pose direct threats to communities. Updated weather reports prepare people for anticipated hurricanes, tsunamis, heat waves, blizzards, and other severe weather conditions. In case of a military attack on the homeland, radio and television stations would broadcast emergency signals using the Emergency Alert System.

Surveillance has been considered a fundamental media responsibility from the time the government began to regulate broadcasting in the United States. The Radio Law of 1927 and Communications Act of 1934 required station owners to warn people of danger and keep the population informed with regularly scheduled newscasts. Although the Internet has *de facto* taken over the surveillance role to a large extent today, implementation of the electronic media Emergency Alert System and other legal requirements compels the speedy dissemination of information during times of crisis.

Correlation of Response

The media don't just dispassionately dispense news. They also explain news events in ways that guide the ways their readers, listeners, and viewers come to understand the reported information. Making sense of the news is the **correlation of response** function of mass media. Media professionals decide what to pay attention to and what to ignore. They connect streams of information and interpret what the journalistic reports mean.

In order to protect the integrity of objective reporting, most news media managers try to partition the surveillance function from the correlational function in their professional practices. For instance, major newspapers maintain separate "News" and "Editorial" divisions. Program managers in the television news industry distinguish between "news" and "commentary" programming.

Still, the dividing line drawn between information and opinion can never be completely clear, especially not in today's media environment. Just the way information is selected, prioritized, and framed creates a point of view. Cable television news channels emphasize stories and spin information differently. Asserting a strong political position attracts a sizable audience. Media bias reflects the economic incentives and political biases of their owners and managers.[24]

The original intent of the correlational function of media was to promote a common understanding about news events so everyone could have a comprehensive idea of what's going on in the world and in their neighborhoods. But the sprawling nature of technological evolution—especially cable and satellite television, the Internet, and social media—has made the unifying potential of media less tenable. Most major news organizations operate with high standards of objectivity and fairness. But partisan media attract and reinforce fragmented, often polarized audiences that have little interest in consensus unless it's on their terms (**Chapter 10**). This situation makes the correlational function of media much more complicated.

Cultural Transmission

Cultures endure and grow when their characteristic rules, rituals, and histories are passed on from one generation to the next. The third media function—**cultural transmission**—reflects the media's role in cultural socialization.

Originally, cultural knowledge was transmitted through oral histories and storytelling. Written documents controlled by religious and government institutions became the first medium used to transmit culture (**Chapter 6**). Print media, libraries, and archives were created within just the past few hundred years. Radio, photography, film, and television added audiovisual dimensions to cultural content in ways that can be archived. Digital media preserve and circulate every kind of cultural information in an on-demand basis.

Entertainment

The global culture industries would not have grown to such extraordinary heights had there not been tremendous demand for popular entertainment. The fourth function of the mass media is to provide society with **entertainment**.

We are wired to enjoy ourselves. Shots of dopamine light up our brains when our emotions are stimulated. We consume tons of media alone, but we also watch television, go to movies, attend concerts, dance, share images on our phones, and participate in multiplayer video games with partners, friends, and family members. Keeping people amused individually and collectively contributes to the stability of the social system.

People need ways to relax, no matter where they live. Knowing this, when the government of the Peoples' Republic of China expanded the national television system in the late 1980s, they made sure to feature entertainment programs. Very few other forms of relaxation—city parks, board games, short vacations—were available to ordinary people in China. Movie theaters and the movies shown were of low quality. Communist Party officials feared social unrest might erupt if the country didn't expand its television system to include drama, sports, music, comedy, variety shows, and films. The Chinese government even gave television sets to poor families to assure they could have information and entertainment transmitted directly to their homes.[25]

Commerce

Mass media and the culture industries have performed as powerful engines of the domestic American economy for decades. American popular culture continues to be a lucrative export to the rest of the world. Computer hardware and software industries drive the world's economies in other ways. Global advertising and marketing industries provide economic incentives to keep the media activity going.

Communications media thus function in ways that stimulate **commerce**. The content of mass media, attractions offered by the culture industries, and global connectivity facilitated by the Internet and personal communications technology all feed off each other financially. The massive structures of economic power these industries generate help sustain the economic health and social stability of modern nations but at the same time contribute to income inequality inside and between countries.

Functionalist Theory

The word "function" appears both as a noun and verb in this chapter to describe the many roles played by media and communications technology in society. The scientific meaning of function derives originally from Darwinian evolutionary theory concerning the integrated nature of

sustainable biological life. In biological evolution, *each part of every living organism evolved because it functions in a particular way that helps keep the entire organism alive*. For example, West African giraffes have a nearly two-foot-long tongue, which allows the majestic species to pluck succulent leaves out of thorny acacia tree foliage without damaging their mouths. In the botanical world, tiny openings on the leaves of land plants (stomata) absorb carbon dioxide from the air, which is needed for creating life-giving photosynthesis. The giraffes' unique tongue and the land plants' invisible stomata *function* to help keep individual animals and plants alive in their respective habitats.

Functionalism

Functionalism is a social theory that describes how a society's main institutions keep the community stable. Functionalist theory draws originally from the philosophy of the French sociologist Emile Durkheim and the American sociologist Talcott Parsons. They were among the first scholars to explain why modern democratic societies have been able to stay together and flourish.[26]

According to functionalist theory, the primary institutions that modern societies have created (especially government, religion, education, economy, and family) function in ways that keep the entire social system orderly and productive. Each institution does its part. For instance, educational institutions should assure that the general population is prepared intellectually and vocationally to contribute to the economy and culture. Government agencies regulate areas like food and product safety, environmental protection, and homeland security. The economic system provides incentives for technological innovation and allows citizens to invest in the financial prosperity of their country. Religious institutions play a role in keeping society stable through shared dedication to a supernatural entity, especially in nations such as Iran, Saudi Arabia, India, Pakistan, and Israel, but also the United States.

Functionalism can describe a beneficial relationship that develops between physical elements (like organs and body parts) or social actions (educational strategies, government initiatives, economic policies, religious dictates) and their corresponding structures (biological organisms, human societies). Biological organisms and social systems adapt and flourish when their components function harmoniously and productively.

Mass Media Functionalism

Beginning with popular print media, mass media traditionally have functioned as institutional forces that help maintain social stability. The media play a uniquely consequential role for the following reasons.[27]

1. *Media exist in the first place because they respond to our individual and collective needs*. Our needs align with our basic survival instincts, motivating people to use media to stay informed. Like spoken and written language, communications media enable people to connect with others and form social alliances. Media socialize populations into common values and identities.
2. *Media have become fundamental social institutions*. For more than 200 years, the trajectory of media development as economic and cultural forces has gone steadily upward. Today, media take a recognized place alongside education, government, religion, the economy, and family as the most influential social institutions.
3. *Media perform the necessary tasks of maintaining social order, control, and cohesion*. By means of their primary functions—surveillance, correlation of response, cultural transmission, entertainment, and the conduct of commerce—the media help create social order and continuity.

4. *Media are necessary for social adaptation and change.* No society can keep going without adapting to changing social and cultural conditions. Mass media in a democratic political system function as sources of information that represent diverse viewpoints. People collectively negotiate the direction and terms of social change in part through discourses made public through media channels.

Dysfunctions

Expert commentators realized years ago that despite the functional advantages, mass media also generate negative functions, or **dysfunctions**. For example, some early observers worried about what they called the "narcotizing dysfunction" of media. They argued that when people feel completely saturated with information about something, they may be less motivated to act on that issue.[28] For example, too much information about politics and politicians might overwhelm people and make them less likely to vote.

The idea that social institutions can lead people toward narcotic-like passivity has strong precedents in social theory. In his classic critique of capitalism in the 1800s, the German political theorist Karl Marx called religion "the opiate of the people."[29] He argued that religion and religious institutions encouraged oppressed people to tolerate their miserable conditions by promising them a glorious afterlife.

Mass media and social media are subject to the same criticism—they create a narcotizing dysfunction. Mass media occupy people's time with shallow entertainment. Social media may displace meaningful political action by creating the "fantasy of political action" instead of encouraging people to act in a sustained way.[30] Although mass media and social media serve as necessary tools for organizing and promoting causes that animate social movements, the bigger challenge is to keep people engaged in struggles for meaningful change over time. For instance, the #metoo movement and the student uprising over gun violence in the United States make clear how necessary it is to keep critical ideas at the forefront of social consciousness.

Media function as engines of commerce, but the amount of material goods and services consumed in modern countries greatly exceeds what is required by our biological and social needs. Theories of human motivation stress the need for social connectedness and belonging for a person to maintain a sense of well-being.[31] But in response, advertisers try to cultivate fears, anxieties, and feelings of personal inadequacy, especially when it comes to sexual attractiveness.[32] Commercial solutions are proposed as ways to gratify a range of media-manufactured "false needs."[33]

Media can be functional and dysfunctional at the same time. For instance, media inform the community about emergency procedures when a natural catastrophe, like a massive wildfire or flood, occurs. With that information, people can respond in ways that save lives—a media function. But the same newscasts and emergency alerts can also induce panic or antisocial attempts at survival among individuals and subgroups, such as looting in the wake of the disaster—media dysfunctions. In another example, television provides news and entertainment, generally considered a positive function. But media depictions of violence can provoke aggressive behavior among some viewers or lead to a gradual desensitization toward violence among the viewing public generally—dysfunctions.

Criticizing Functionalism

In key respects, the mass media are functional or dysfunctional in the ways and to the degree that audience members use them. But assessing the benefits and costs of media performance along the

conventional functional/dysfunctional divide does not adequately explain the larger impact media have on society.

Functionalist theory posits that even with some dysfunctions, the media help keep the social system stable over time. Keeping society running along smoothly is assumed to be a good thing. *But maintaining the stability of any social system does not serve everyone's best interest*. Was the American social system functioning well when slavery was part of it? When women couldn't vote? When gay couples weren't allowed to marry?

While common sense may suggest that technological development brings progress, the benefits of progress do not distribute equally. Individuals and institutions in power attempt to protect their interests. Communications technologies become resources for them to exploit. Early signs of this problem emerged when written language emerged in Mesopotamia 5,000 years ago (**Chapter 6**). Few people were allowed by the authorities to learn how to write and read. Only the elites had access to written documents.

The same kind of power imbalance continues between individuals and groups that control communications media and everyone else. Today's social elite include government and political leaders but also the gatekeepers of information—owners and managers of media. Ownership of print media, radio, television, cable, and satellite systems is concentrated in the hands of fewer and fewer individuals and corporations in the United States and many other countries.[34]

Although social scientists have had difficulty establishing clear causal relationships between media content and human behavior, that doesn't mean valid criticisms of media influence don't apply. For instance, the media still reinforce positive and negative stereotypes according to gender, race, age, and nationality. Commercial media incessantly encourage people to find happiness by buying things. Children are singled out as little consumers in training. Alternative political candidates and parties become marginalized or made invisible. The media's focus on sensational news contributes little to our collective well-being. Copy cat crimes are prompted by sensational media accounts. Many people simply waste too much time consuming media.

"Function" is a loaded term. If a social system is thought to be functioning well, then changes to the system—the essence of evolution—often is considered threatening. Those in power typically resist change or try to manage it to their benefit. They have formidable economic and political tools to work with. Social systems may eventually adapt in the face of disruptions, but major transitions are stressful, and nothing guarantees that the changes will fix a problem for the benefit of the community overall.

Spheres of Modern Communication

The introduction of every new communications technology represents a transition in human evolution. Speech led to development of spoken languages. Spoken language was expanded into written language and mathematical notation. Printing technology transformed handwritten scripts into published documents and newspapers. As modernizing societies became more educated and democratic, an insatiable market formed for new technologies of information and entertainment—electronic and digital media. Today's information-based societies depend on mobile and personalized communications technologies.

Transitions in the evolution of communications technology alter the ways people gain access to sources of information and connect with other people. Except for restrictions that limit freedom in authoritarian political regimes, trends in communication generally open up more and better ways to get information and interact with others.

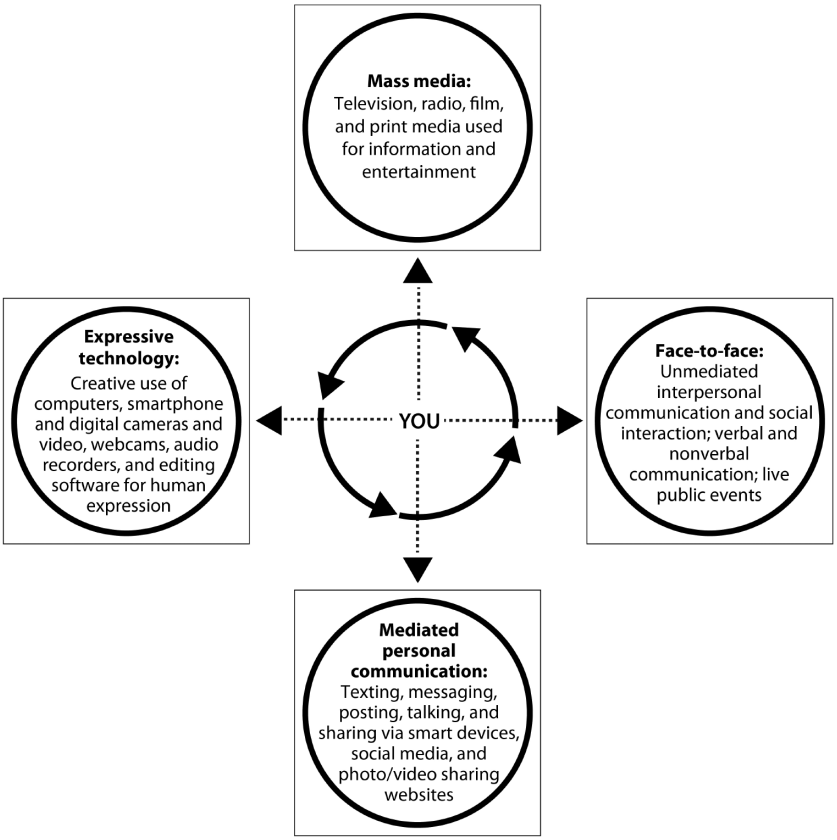

FIGURE 8.1 Spheres of communication. Adapted from Coopman and Lull (2018)

People in modern nations today communicate in ways that fall roughly into four spheres (**Figure 8.1**).

- *Face-to-face*. The original form of social communication remains the most frequent kind of interpersonal interaction and is composed of the original technology—spoken language.
- *Mass communication*. This is the least interactive sphere yet still a very convenient way to get information and entertainment. Traditional sources include newspapers, magazines, radio, and television. Computers and smartphones also function as sources of mass communication when used to consume information and entertainment.
- *Mediated interpersonal communication*. Mobile technologies combine with the Internet to serve as dominant forms of social interaction for purposes of everyday communication. Texting, talking, posting, emailing, and using photo/video sharing websites represent this sphere.
- *Creative expression*. Digital technology has opened up endless ways for people to express themselves. The creative use of computers, smartphones, digital cameras and video, webcams, audio recorders, editing software, and social media gives people ways to express themselves with spoken and written language, photos, video, and music.

People often communicate in multiple spheres simultaneously. We live in a **pervasive communication environment** of diverse communications technologies that can be accessed in remote locations at any time, allowing people to overcome conventional limitations imposed on them by time and space.

Chapter Summary

Following the creation of simple writing instruments, the development of communications technology didn't speed up until after the printing press was invented. Then things started to happen fast. The Enlightenment and Industrial Revolution fostered a climate of innovation. Technological and cultural breakthroughs soon led to the emergence of popular newspapers as the first mass medium. Electricity was harnessed for communications purposes. The telegraph and telephone spurred creation of the original electronic media—radio and television.

The new mass media began to draw enormous audiences and become major forces in the American and global economy. Advertising and marketing agencies opened up. Researchers investigated the social and political impact of electronic media. While some direct effects were observed, scholars also documented how people use the media for their own purposes—the "active audience."

The basic functions of media—surveillance, correlation of response, cultural transmission, entertainment, and commerce—have been well documented. These and other functions help keep societies stable. But critics also note that the media can be dysfunctional and appear to be structurally biased against marginalized groups in society.

Communications technology has passed through evolutionary stages, beginning with spoken language. Today we communicate within four major spheres of communications activity: face-to-face interaction, mass communication, mediated personal communication, and the use of technologies of creative expression. Overall, people respond enthusiastically to opportunities that extend the reach and quality of their communicative potential. Mass media, personal communication technologies, the Internet, and social media converge for people to actualize their need to interact with others and explore the world.

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PART FOUR

What We Communicate

9

CULTURE

Communication drives human evolution by facilitating social interaction. As interactions become increasingly complex, they accumulate to form patterns of meaning and behavior. Some of those patterns prove to be evolutionarily beneficial. Cultures formed around the productive patterns long before our ancestors left Africa.

But culture never stands still. Cultural change results from the restlessness of human nature and the way people adapt to the challenges and opportunities posed by their social and physical environments. Cultural change picks up speed as people become more mobile and communications technology advances. A natural synergy between communication and culture developed over time. Communication drives cultural change. Cultural development leads to the invention of new communications technologies.

In this chapter, we explain how communication creates, maintains, and changes culture. First, we narrow down the meaning of culture to focus on human groups. Then we trace the origins of culture and discuss the core elements that make up traditional cultures. Next, we show how individual initiative and communications technology are changing cultural life in the ever-expanding globalized environment. Finally, we analyze how memes function as the compositional unit of contemporary culture.

What Is Culture?

Traditionally, **culture** has been defined as the characteristic values and behaviors shared by an identifiable group. Culture becomes the perceptual and emotional framework through which we come to know ourselves and others, providing security and a sense of belonging. What we consider to be "our culture" is what we have in common with each other, often in contrast with other groups. Accumulated beliefs, behaviors, knowledge, symbolic forms, material artifacts, and practical skills—the primary components of cultural inheritance—demarcate one society from another.[1]

Animal Cultures

We tend to think of cultures as uniquely human, but some animals also have forms of culture. Owing to our common genetic heredity, apes and monkeys live in ways that most closely resemble human cultures. Like us, their individual groups differ from each other—including their typical

communication behavior. For instance, chimpanzees inhabit stable groups that vary regionally in how they make and use tools, what they eat, how they groom each other, and how they hunt.[2] They differ culturally in the ways they communicate too. Chimps that are transferred by zookeepers from one part of the world to another even pick up and use the vocal accent of the chimps residing in the new location.[3]

Gorillas acquire and pass along more than 40 skills, which include communication signaling, tool making, and ways of seeking comfort that demarcate one group from another, depending on environment.[4] Among many culturally differentiated behaviors, some orangutans learn from each other how to crack open nuts with stones, while other groups nearby do not.[5]

Whales live in distinct groups, learn from each other, and transmit their culturally acquired skills to subsequent generations.[6] Elephants living in desert habitats differ from those on the African savannah in the ways they cope with their environments.[7] Birds of the same species develop varying habits based on where they live. Many songbird species sing different tunes depending on geographic location.[8]

Social Learning

For human cultures to form and endure, individuals in the groups must be able to communicate values, knowledge, and behavior from person to person by means of social learning.[9] Our capacity to teach intricate skills to others with precision over many generations and the ability to use the accumulated store of knowledge to create solutions to new challenges give Sapiens unique status as cultural beings. Human cultures are in effect "operating systems for life" composed of accumulated behaviors and the artifacts those behaviors produce over time. *Optimizing the flow of useful information creates complex cultures.*

Our highly developed cognition allows us to learn behavior by (1) observing others carefully and (2) reflecting on the learning process as we imitate what we are being taught. The learner-imitator has to have the ability to grasp the *intention* (or goal) and the *meaning* of the observed act.

Social learning differs from modeling behavior. In modeling, the individual organism simply copies task-oriented behavior without understanding why it was done or what advantage it provides. For example, animals learn from experienced members of their groups where to find the best food, areas to sleep, or places to avoid. They build up cultural knowledge that is passed through generations and improves over time. But animals copy each other's actions without considering whether or not the imitated behavior represents the best solution to a problem. Conformity determines their responses. For instance, chimpanzees are more likely to copy an action if they see three or more individuals do it rather than one individual doing the same thing three times.[10]

Sapiens' unique ability to learn socially gave our ancestors effective ways to develop tools, hunting techniques, and child-raising skills, among other behaviors. Today, people routinely use social learning to acquire vocational skills, refine sports techniques, or boost their competencies with technology, for example. Social learners can modify observed behavior, even if just slightly, to improve it. Constant tinkering and the ability to pass information from one generation to the next energize cultural change and development.[11]

Cultural Origins

The very first ancestral groups formed loose coalitions in order to protect themselves from environmental threats. Ever-present danger—including threats posed by other cultural groups—fused cultural belonging with improved chances for survival. Fear drove the process, compelling individuals

to group together physically, learn necessary social behaviors, and forge tribal identities in competition for territory and resources.

The antecedents of our complex cultures had formed before Sapiens evolved. Habilis lived in cooperative groups. They developed material culture in the form of simple technology—stone tools. Erectus maintained campsites, controlled fire, cooked food, and hunted together.[12] Our Neanderthal cousins wielded fire, ventured deep into caves, shaped rocks into simple tools, and made ritualistic sites out of natural materials.[13] But no compelling evidence so far indicates that any of these species advanced beyond copying to social learning.

Anatomically, modern Sapiens evolved in Africa beginning about 300,000 years ago (**Chapter 2**). The behavioral patterns and material artifacts produced by early members of our species began to define early Sapiens groups as primeval cultures.[14] Patterns of more intricate cooperative behavior gradually shaped the groups into complex cultures.

Great apes also form social groups for protection and to cooperate. But ape behavior mainly advances their individual interests. No scientific evidence suggests apes realize they have responsibility to the wider community. Early Sapiens may not have had any reflective understanding of their collective social conditions either.[15]

We know *why* human cultures emerged: Stable social groups increase individual chances to survive and reproduce. We can estimate roughly *when* cultures emerged: Our Habilis and Erectus ancestors led the way for Sapiens' cultural formation. But *how* do complex cultures develop and change? What role does communication ability play in making it happen?

Communities of Descent

The proliferation of plant and animal species over time and through space represents "descent with modification" (**Chapter 2**). The direction of change travels downward ("descent" instead of "ascent"), because all living organisms trace their biological origins back to a common ancestor. Traits are passed down from the ancestral species to new varieties, much like the way parents pass genetic information down to their children—their descendants.

As they evolved, our ancestors cooperated to create **communities of descent**—another way to refer to culture. Human cultural groups, no matter how diverse, complex, or antagonistic toward each other they may become, all manifest a unified nature underneath their differences. The essential biological and genetic commonalities that all people share are innate and universal. Our cultural characteristics are not.

Group Size

Humans are extremely social creatures, a fact that has helped make Sapiens such a dominant species. But even our hyper-sociality has limits that were formed in our evolutionary past. The first organized human groups were small hunter-gatherer communities that grew to no more than 150 members. To establish oneself as a trusted member of a community, each individual had to have been known by the others as a contributor to the overall welfare of the group. Even today when group size exceeds 150 individuals, community members lose track of each other and become suspicious.[16]

We see the same tendency among the great apes. Chimpanzee troops maximize at 150 individuals and are usually much smaller. Bands of gorillas don't exceed 50 before they split up. Orangutans form loose groups of no more than five members. None of the ape groups has routine friendly contact with other groups.

Migration

After Sapiens groups migrated north out of Africa and others spread out in every direction throughout the mother continent, the groups gradually developed distinctive stores of accumulated knowledge, customary behaviors, and technical skills that reflected the conditions where the various groups settled.[17] They differed in spoken languages, tool making and use, food gathering and cooking skills, religious myths and rituals, art, music, dance, and self-decoration.[18] Language development, social development, and material development evolved interactively in cultures, each contributing to the growth of the others.

Every cultural idea was introduced, adapted, and maintained by collaborative activity that is facilitated by social communication. Along the way our human ancestors developed appreciation of their interdependence and cultural belonging—their conscious sense of "groupness."[19] This growing consciousness further encouraged them to act collectively, with shared intention in order to accomplish progressively challenging goals.[20]

The Great Leap Forward and Beyond

Complexity emerges slowly within a population. But an unprecedented spike in Sapiens' cultural production took place inside and outside Africa from 45,000 to 10,000 years ago.[21] This critical period in cultural evolution is known as the Great Leap Forward. Innovation was on the rise.

Testosterone levels had lessened, encouraging a more cooperative and tolerant temperament and the rise of behavioral modernity.[22] People lived closer together and developed a greater number of social alliances. Trade relationships and other social networks formed, increasing cultural members' range of physical movement and prompting more frequent interactions with other populations.

The best evidence of the Great Leap Forward was left by our hunter-gatherer ancestors who migrated into Europe.[23] Tools became more complex. Materials used for hunting, trapping, and fishing grew more sophisticated. Fire-building and cooking methods improved. New domestic practices, including the making of clothing and creation of more elaborate living areas, appeared. Vocational specialization and social hierarchies emerged. More information was being passed around to contemporaries and down to subsequent generations.

Most important, the symbolic dimensions of culture were emerging full force. By now our ancestors spoke with each other in languages that had developed sufficiently to facilitate multiple levels of social bonding, learning, and cultural transmission. Intricate and often exquisite symbolic forms of art and expression were created. Early traces of the first civilizations were starting to appear.

Increasingly complex forms of human communication—especially spoken language, visual art, and music—drove the symbolic aspects of cultural development from the start of the Great Leap Forward right up to the Agricultural Revolution 12,000 years ago.

Cultural development diversified and speeded up again after the Agricultural Revolution. Still-improving cognition and language skill combined to give individuals and groups greater ability to think logically, draw inferences, and decide on courses of action based on increasingly complex reasoning. Written language and the establishment of cultural institutions that included governments, places of worship, schools, and business enterprises cropped up and began to spread throughout the Middle East and beyond (**Chapter 6**).

Communication ability, technological innovation, social cooperation, and trade evolved interactively. Simple barter and exchange became key mechanisms for cultural contact and internal development. The invention of money set up systems of mutual trust. A preference for negotiation over

annihilation began to seep into the human genome, progressively dulling, but never eliminating, the sharp edge of inter-ethnic confrontation.[24]

Biological-Cultural Interaction

There is nothing clean or simple about biological or cultural evolution. We cannot point to any single cause for changes in human physiology or behavior. Everything evolves in robust complementarity. Bodies and cultures each adapt to their changing environments and influence each other in a never-ending process of biocultural feedback.

Nothing in biology or culture is determined by genes alone. No individual gene drives any biological or behavioral trait; genes work together in unfixed, adaptable networks.[25] The way individual genes and genetic networks are expressed depends largely on the external context. For example, if a foreign person brings a new disease into an indigenous group, as has been the case many times in world history, the genetic networks of the indigenous population, along with other biological factors, including hormones and nucleic acids, react detrimentally to the intrusion.

Nonbiological factors influence the behavioral trajectories of cultural groups too. Cultural differences among human groups are constructed on top of their common biological inheritance. For example, those foreigners who brought diseases to indigenous cultures also brought their cultural traditions. Imposing cultural values and beliefs on subjugated others is **cultural imperialism**. After long periods of exposure, those extrinsic cultural modalities fuse into the victims' DNA. Of course, horizontal cultural transmission like this isn't always negative. Good ideas travel from place to place, too.

Genetic heredity, biology, the existing cultural pattern, and situational experience interact to shape and reshape the ongoing processes of cultural evolution. The interplay of genetic and cultural change—**co-evolution**—forms the broad platform for human development.[26]

Traditional Cultural Elements

Biological trajectories are slow to change. Long-established cultures have real staying power too. Before we explore the ways culture is changing today, let's outline the main elements of culture in traditional terms.

Geographic Locations

Cultural groups formed because individuals learned they could live more safely and productively by inhabiting common space and working together. The size of those groups expanded over the millennia. Today we might think of culture in terms of an entire nation (for instance, "French culture") or a region (like "Latin American culture").

Cultural groups have been traditionally identified by their members' typical physical appearance, language, and perceived characteristic behavior. So, for instance, when "the Jamaicans" or "the Russians" are referenced, it's still common to invoke a stereotypical image that associates particular kinds of people with a geographic location.

Languages

Pre-languages and protolanguages evolved because sharing information dramatically improves survival prospects (**Chapter 5**). Our early ancestors—not unlike people today—wanted to know where danger lurks and how to get food. That valuable information often arrives in the form of a communicated message.

Early cultures became progressively more cohesive and productive as language developed. Spoken language helped primitive cultures overcome myriad challenges faced by their growing populations. Speaking the same language indicates cultural membership. Untrustworthy outliers, invaders, and cheats often can be identified by the way they speak.

Shared Values

Shared values represent deeply held and enduring beliefs and attitudes that characterize a culture's fundamental principles, moral codes, and manner of communicating. For instance, when foreign students prepare to study in the United States, they are taught that Americans traditionally value individual freedom, hard work, human equality, optimism, informality, and directness.[27]

Core cultural values are reinforced and spread through socialization processes. Traditional cultural values endure in part because they are internalized by children at a very young age. As they grow older, people demonstrate loyalty to their cultures by at least appearing to live in ways that reflect the group's shared values.

Social Rules

Shared cultural values permeate populations as formal and informal rules that prescribe behavior. Some rules **constitute** cultural realities by asserting what beliefs and behaviors are normal, acceptable, or preferred. Constitutive rules are often implicit. For instance, traditional gender or age-related roles reflect cultural expectations that endure simply because they have always been there and (until lately) have gone largely unquestioned. Other rules **regulate** social conduct. These rules tend to be more formalized. For example, a school or work dress code requires compliance with expected physical appearance set by authority.

Cultural members internalize rules by conforming to what other people—especially those with power and control, including parents, teachers, and religious leaders—say and do.[28] Social rules become the basis for moral, ethical, and legal judgments. Strict cultural conformity is especially strong in low-information, economically poor, and strict religious environments.[29]

Behavioral Patterns

People are expected to engage in social behavior that reflects their culture's values and conforms to the rules that govern their execution. Over time those behaviors congeal into recognizable patterns of social interaction. Routine communication among cultural members facilitates the interactions that produce the patterns. The behavioral patterns give rise to cultural norms, which further reinforce the values that underlie and prompt the behavior. Being able to recognize patterns is a survival skill because it helps individuals discern and predict what's going on around them. They can then respond in ways that protect and advance their interests.[30]

Pattern recognition has also made computer simulations of human behavior possible. Like humans, machines must be able to learn from experience and adjust their behavior accordingly. Artificial intelligence software and other machine learning systems identify patterns in order to comprehend situations, predict outcomes, and make good decisions.[31] Language processing, facial and speech recognition, and videogame programming all depend on the pattern-based "deep learning" capability of machines.[32]

Religion

Many of the shared values and behavioral patterns that are representative of a cultural group intertwine with the group's historical ties to religious belief. Religion developed as a way to bind

people together as communities. Religious bonding serves evolutionary purposes because it protects people and makes them accountable to others. For example, many Hindus in India don't think of religious belief and behavior as *part* of life. Instead, they consider religious beliefs, practices, and rituals to be the *very foundation* of life.[33] Although its cultural influence has declined in most modern Western societies, religion continues to play a significant role in global culture and politics (**Chapters 11 and 12**).[34]

Cultural traditions rooted in religion can be traced to our ancestors' fascination with the supernatural. From shamanistic rituals, early written language, and the widespread presence of mass media and social media, the cultural influence of religious belief has always been expressed prominently through predominant communication channels.

Material Artifacts

Cultural anthropologists and other researchers have pieced together explanations of how our hominin ancestors lived by examining their primitive tools, weapons, and living spaces. Material artifacts produced by early Sapiens included scrapers, spearheads, knives, arrows, sculptures, and musical instruments made from stone, bone, ivory, and antler. They made fire pits, hearths, and kilns. They fashioned clothing out of animal fur.[35]

After the Agricultural Revolution, essential material artifacts included farm implements. Schools, residences, temples, and stores began to appear. The Industrial Revolution was driven by the desire to create abundant material culture.

Discourses

Culture also takes shape as a system of discourses—subjects that are repeatedly spoken, written about, or otherwise communicated within a group. We learn a lot about "who we are" through discourses because they routinely refer to our culture's core values, behavioral patterns, social rules, religious beliefs, and artifacts.

Schools, government agencies, religious institutions, and the mass media all express and reinforce cultural discourses through lessons, rules, laws, documents, rituals, myths, news and entertainment programs, among other communication channels. The discourses circulate further in routine chains of social interaction taking place among families, friends, religious communities, workplace networks, neighborhoods, and in online conversations.

Stories and Narratives

People love stories. Part of the reason is chemical. Stories provoke the full range of human emotion. Laughter, shock, and suspense release endorphins in the brain that bind the storyteller to the audience.[36]

Stories benefitted ancestral groups because they transmitted valuable information. The need to tell stories for survival purposes helped spur the development of spoken language. Oral storytelling became the main channel for passing along vital information and creating cultural histories. Written language formalized and extended stories, making cultural histories more widely accessible. All cultures still have creation myths, parables, folk tales, and legends. We internalize those stories—often unconsciously—as major parts of our cultural identities.

Cultural stories do not depend on factual accuracy. They often persist in consciousness even when objective evidence disproves them. That's because the evolutionary benefits of stories have been evident for many centuries, and we've learned how to deceive ourselves when necessary.[37] Stories offer an explanation of our place in the world, connect our sense of self with our cultural

community, structure everyday events into a coherent order, and help us envision possible futures.[38] Cultural allegiance often results from buying into the same stories, even when those stories are provably fictional.[39]

Symbols

To be viable, cultural groups must be able to produce symbolic forms, give them meaning, weave them into discourses and narratives, and circulate the forms widely. For instance, anthems and flags become associated with national cultures. Religious cultures are represented by iconic symbols, including the Star of David, Christian cross, Islamic crescent moon, and the seated Buddha.

Cultural symbols become highly valued and protected. For example, rules prescribe how a national flag should be handled properly. To burn a national flag is considered a crime in most countries.

FIGURE 9.1 Religious and national symbols

Rituals

Cultural values become codified and institutionalized through rituals of collective expression. Rituals are organized symbolic practices and ceremonial activities that define and represent the significance of particular occasions or events.[40] Rituals formalize and maintain cultural traditions through repetition and the expectation that cultural members will participate in the activities. For example, Native Americans hold seasonal corn festivals and powwows to reinforce their tribal allegiances.

Religious organizations and nation states are particularly motivated to keep their traditions going. They often work together. Religious holidays are celebrated within national frameworks, so, for example, people in many Western countries have a "Christmas break" and an "Easter break" from public schools and other government institutions.

Some rituals help define a person's place within the cultural community. When directed toward individuals, rituals mark life's typical major transitions—childbirth, puberty, marriage, and death. Of particular significance are rites-of-passage rituals.[41] These rituals often mark life's transitions into various stages of "manhood" or "womanhood." For instance, *bar* and *bat mitzvahs*, *quinceñeras*, Sweet 16s, *ji li* and *guan li*, and "turning 21" parties represent different ethnicities and levels of formality. Burial rituals are among the original human rituals and date back at least 40,000 years.[42]

Culture, culture

We can best understand how daily life is changing today by differentiating "Culture" from "culture."[43] The classical idea, Culture, is rooted in geography, ethnicity, history, and tradition. Culture with a capital *C* refers to observable patterns of long-term behavior and accumulated artifacts that are commonly associated with a specific population and, originally, with a particular geographical location. By contrast, culture without the capital *c* expands the meaning of the term by focusing on contemporary trends.

Historically, Cultures are slow to change. They are protected vigorously. Many people invest in, maintain, and rely on established visions of the world and the everyday activities, rituals, and identities that animate and preserve their Cultures and Cultural Identities. Economically powerful individuals and institutions have a strong vested interest in maintaining traditions that support their Culture (**Chapter 11**).

Despite the tendency for Culture to persist through the sheer force of habit, ways of life inevitably change over time. Greatly accelerating growth in the size of population groups over the past 50,000 years has created more opportunities for people to interact and adapt culturally.[44] Communications technologies have altered the boundaries of time, space, and place customarily associated with Cultures.

The second meaning of culture—without the capital C—refers to the unprecedented range of cultural resources and identities that are available today in our globally interconnected world. People regularly engage in cultural activity that extends way beyond what their Cultures offer and sometimes require.

To understand how people actualize their cultural potential today, the traditional idea of Culture as a unifying concept must be considered in relation to more personalized cultural experiences that respond to individual needs and interests. Culture and culture often compete, but they do not negate each other. A Sikh teenager living in Bombay may be a die-hard fan of Metallica and the New York Yankees. An American teen from the Midwest might crave Indian food and find spiritual comfort in Buddhism.

We have roots and wings. We live in Culture and culture. We can get a good picture of how people navigate between Culture and culture by employing a familiar figure of speech—"push and pull"—to compare the contrasting domains of cultural experience.

Push and Pull of Culture

Making a distinction between "push and pull" cultural activity draws from the world of digital information technology and marketing. In that world, **push** refers to the practice of bringing information to the awareness of people without their prior knowledge or consent—essentially by forcing it on them. For example, a push intrusion could be the appearance of unwanted pop-up ads on social media, channeling a search engine request to a sponsored link, or flooding targeted consumers with Internet spam. The *sender* initiates the push experience and expects to benefit from the effort.

By contrast, **pull** represents the user-driven side of the model. In an online pull experience, people log on to a communications device at a time of their choosing. They consciously search and select ("pull") content into their cultural experience to fit with their own personal interests and priorities. The *user* controls the pull experience and expects to benefit from it.

Now let's match up the primary domains of Culture and culture discussed in the previous section with the dynamics of push and pull cultural experiences (**Table 9.1**).

Push

Push refers to the common influences that unavoidably become major parts of our everyday lives—Culture. Primary languages, religious or spiritual orientations and practices, gender relations, and types of food are among the cultural elements that are pushed our direction from birth and over which we have little control. Steeped in tradition and backed by socializing institutions like schools, big business, government programs, and religious organizations, push culture frames our basic orientation to the world. Push is about uniform thinking, normative behavior, and a shared sense of community.

Because push culture tends to be relatively closed and slow to change, it provides a lasting measure of stability and security for most people. Push influences can never be completely extinguished no matter how hard we may try later in life. Push traits keep Culture alive.

TABLE 9.1 The Push and Pull of Culture

Push	*Pull*
Culture	culture
Collective	Individual
Involuntary	Voluntary
Security	Risk
Slow paced	Fast paced
Gradual change	Rapid and flexible
Traditional	Contemporary
Closed	Open
Community	Habitat
Uniformity	Diversity
Social norms	Personal wants/needs
Coherent	Fragmented

Pull

People have always sought experiences that don't just reflect lifelong immersion in their primary Cultures. The pull side of culture represents the active role of individual persons as conscious creators of cultural experience—culture without the capital letter.

We live in Cultures, but we integrate other cultural resources into our lives, sometimes in contradiction to, even defiance of, Culture. That's not always easy to do. Culture with a capital *C* has shaped people to live together in prescribed ways for thousands of years. Those traditional communities provide individuals with distinct evolutionary benefits nested in predictability and security.

Mass media, the Internet, and cultural globalization disrupt the Cultural status quo by offering a constant flow of attractive stimuli that encourages individuals to expand their lives beyond the people, places, and traditions that are most familiar to them.[45] Consequently, personal exploration of more diverse cultural experiences and identities that stem from individual initiative, creativity, and opportunity has become commonplace. Such behavior brings rewards but also risks—even possible rejection by the family and local community. Pull cultural activity is open-ended, fast-paced, and fragmented.

The cultural options made available by communications technology today also correspond with unprecedented levels of personal mobility rooted in immigration, tourism, student exchanges, international business travel, and overseas governmental and nongovernmental work. These interacting conditions of life experience—mediated and unmediated—promote the potential for vastly expanded cultural awareness. *Pull culture represents the individual person under constant reflection and self-formation in a globalized world.*[46]

The locus of much cultural activity today thus is shifting from structure and tradition to choices made by individual persons participating in extensive social networks and communities. Cultural freedom in modern societies unleashes creative and entrepreneurial talent and stimulates further development of the technological innovations that opened up new cultural spaces in the first place.[47]

Distinguishing between the push and pull of culture reflects the dynamic tension between collective behaviors rooted in tradition and individualized wants and needs satisfied through personalized cultural experiences. But like Culture and culture, push and pull do not occupy completely separate domains in behavior or the options available.

The dynamics of digital marketing can help explain how push and pull tendencies interact: Because social media track our searches, visits, likes, shares, and purchases, online advertisers directly push products they believe will likely appeal to us; we have already shown potential interest in what they are trying to sell. This kind of marketing represents a "soft push." We see the same kinds of personalized recommendations made by audio- and video-streaming platforms like Spotify and Netflix. So while the pull side of the cultural equation represents greater freedom in general, some of our pull options continue to be guided by our push history. We draw from both sides to assemble the dynamic totality of our cultural experiences and identities.

Major economic transformations from heavy to light industry and from the manufacture of durable goods to the creation and processing of information have produced extraordinary cultural changes at the global level. The terms most often used to describe the current era—the Digital Age, the Information Age, and the Communication Age—make clear where contemporary cultural life has been going for decades and where it's headed in the future.

Self-culture

We are creating **self-cultures**.[48] People personalize their cultural experiences and identities by drawing from nonlocal and nontraditional resources. Self-cultures inevitably include traditional influences too. Because we live in both worlds, creative interplay between varying levels of cultural

reality has become the hub of cultural activity. People select and mix resources made available by Culture and culture to construct multiple parallel lives.[49]

Cultural Programming

The process of creating a self-culture resembles what electronic media programmers do in their professional work. Directors of radio and television stations carefully select a mixture of program elements to create the right sound or look for the formats or programs they manage.

As cultural entrepreneurs armed with modern communications technology, we too have become programmers. But instead of programming radio or television stations, we are creating our cultural lives. We retrieve, invent, edit, and synthesize bits of culture into our personal profiles.

Trends that underlie self-culture formation have been shaping up for decades. Toward the end of last century, audiotape recorders, video recorders, video cameras, and remote control devices started to give consumers much greater control over how and when they listened to music and watched television. The flexibility inherent in those technological developments encouraged people to customize their media experiences according to their interests, tastes, and schedules. The marketplace success of personal computers beginning in the 1990s and later the explosion of cell phones and smartphones continued to prepare the ground for a radical transformation of cultural experience.

SELFIE CULTURE

Long before smartphones and smart televisions were invented, one of their essential components—glass—was fabricated as an industrial technology.[50] The first glass items were created in Egypt 5,000 years ago, and glass technology continued to evolve through the centuries, mainly in the Middle East. By the end of the 1500s, glass microscopes and telescopes invented in the Netherlands made it possible to observe everything from tiny biological cells to the vast expanses of the multiverse.

Industrial innovators later found that applying a thin veneer of metallic silver to one side of a pane of clear glass creates a reflection that gives people the ability to see themselves clearly.

Selfies emerged as a worldwide phenomenon when glass technology in the form of a camera lens was applied to the fascination we have for capturing and disseminating images of ourselves. The smartphone wasn't the first technology to create self-representational images. Today's selfie is a digital version of the oil-and-canvas self-portrait, which dates back to European artists in the 1600s and 1700s. The Dutch artist Rembrandt, for example, painted more than 40 selfies.

FIGURE 9.2 Selfies feed self-cultures by documenting and displaying our cultural experiences. Although selfies feature individuals by their very nature, they often represent the individual in social situations. Courtesy of Oleg Elkov/iStock.com

Today's selfies give individuals material they can package to present themselves on social media. The individual person has become the homepage on social media and functions like a personal brand. You are encouraged to tell "your story" visually. Newsfeeds amount to rolling exhibitions of other people's self-presentations and stories.

The selfie phenomenon is not without its perils. Taking selfies is considered passé or bad taste by many people. Taking selfies can disturb the real-time experience of other people trying to appreciate nature or a social situation. Selfie sticks only enhance the disturbances. A new type of carpal tunnel syndrome, the "selfie wrist," can be caused by constant flexing of the wrist to take a photo. And everyone's heard of people falling over cliffs or into bodies of water trying to get the perfect angle for snapping a selfie.

Cultural Spheres

Not unlike self-assembling technologies that are destined to be invented, people spontaneously seek the resources they need to put together their self-cultures. In addition to local Cultural influences, more remote sources of cultural inspiration include nations, civilizations, international materials, and universal values.

Nations

Nations function as "imagined communities" defined by complex and often romanticized cultural narratives that inscribe and reinforce idealized systems of values.[51] The nation gives people a unique shared sense of community that is reinforced through the routines and rituals of everyday life and by symbolic displays of values and traditions.

The nation's fundamental elements—its legal system, religion(s), dominant language(s), system of commerce, and social customs—are all backed up by unifying cultural materials and symbolic forms. These include constitutions, flags, national anthems, churches, temples, mosques, school curricula, military forces, mass media, national museums, and advertising.

Civilizations

Civilizations are made up of countries that group together according to common ancestry, history, values, religion, and customs. Some civilizations represent a shared worldview founded in religion (Islamic, Buddhist, Hindu, Orthodox, East Asian). Two other civilizations were created by colonial expansionism (Western Civilization and Latin America), and two more developed primarily because of unique geographic circumstances (Japan and Africa).[52]

Civilizations function not only as material entities (real people and material goods in real physical places) but also as ideological and cultural spaces that people draw on to establish and maintain their cultural identities, activities, and relationships. By reinforcing dominant cultural themes, international mass media and the Internet contribute much to keeping civilizations viable and accessible.

International Resources

Self-cultures increasingly reflect symbolic cultural resources that are circulated globally by international media and the culture industries. Foreign cultural material often differs from and sometimes conflicts with local, national, and civilizational life.

Some common media genres—action, romance, science fiction, sports, and music—appeal across cultural boundaries.[53] The Internet, satellite telecommunications, international film industry, tourism, theme parks, popular music, and professional sports now reach most of the world's population. International media transmit news and information that expand political and cultural awareness to global audiences.

Universal Values

Many people find inspiration in the cultural values endorsed by the United Nations and codified in the Universal Declaration of Human Rights.[54] Women, racial and sexual minorities, religious minorities, and atheists are especially likely to search beyond their borders for understanding and acceptance. Among the prescribed universal rights are the following:

- All human beings are born free and equal (Article 1)
- Everyone has the right to life, liberty, and security of the person (Article 3)
- No slavery (Article 4), torture, inhuman, or degrading treatment (Article 5)
- Everyone to be recognized as a person before the law (Article 6)
- No arbitrary interference with privacy, family, home, or correspondence (Article 12)
- Right to marry with free and full consent of intending spouses; family is natural and fundamental group unit of society (Article 16)
- Everyone has the right to own property alone (Article 17)
- Freedom of thought, conscience, religion, opinion, expression, peaceful assembly, and association (Articles 18–20)
- Everyone has the right to work, and to free choice of employment, and equal pay for equal work (Article 23)
- All people have the right to leisure and adequate standard of living (Article 25)
- Everyone has the right to basic, free education (Article 26)
- All the world's people have the right to participate in the cultural life of the community, including the arts and sciences (Article 27)

The Cultural Divides

Over the past several pages we have described how individuals creatively compose self-cultures by tapping into traditional and distant cultural resources. Clearly, not everyone has the same motives or opportunities to engage in this kind of cultural activity. Segments of the global population differ in key ways they live culturally. A brief discussion of three divisions of the global population follows—individualist vs. collectivist cultures, monocultural vs. bicultural realities, and differences in socioeconomic status.

Individualist vs. Collectivist Cultures

With its explicit emphasis on marriage, family, property ownership, individuality, freedom, rule of law, even the right to leisure, the Universal Declaration of Human Rights reads like a laundry list of basic Western, middle-class values and lifestyles. Individuals who have personal mobility, access to communications technology, and sufficient cultural freedom can turn their lives into do-it-yourself projects.

The idealized notion of a semi-autonomous individual who is highly motivated to create a self-culture draws originally from rhetorical traditions that took hold in ancient Greece.[55] The "law of the excluded middle" in Greek philosophy means that in a debate, *one person is right*

and the other is wrong. The ascending prominence of the place of the individual in society was confirmed and spread farther by Enlightenment thinking. Above all else, individual initiative is emphasized.

The Western way of thinking differs from Confucian philosophy, which shaped cultural realities in China and East Asia. In China, the "doctrine of the mean" posits that when two sides debate an issue, *both sides are right and wrong*; the truth of the matter lies in the middle. With no winner declared in a disagreement, compromise becomes the norm. The East Asian collectivist style was shaped for centuries by the need for social cooperation in ancient Chinese agriculture compared to Greece, where agriculture arrived later.[56]

Individualist cultures value independence, competition, and the needs and rights of the individual. Collectivist cultures emphasize harmony, interdependence, and conformity to group needs. Western cultures process information in a personalized and focused manner. East Asian cultures engage incoming information more communally and holistically.[57]

Although cultural differences influence behavior around the world, individualism is on the rise everywhere.[58] Socioeconomic development fuels the global increase in individualistic values and practices. The values that make up the United Nations Declaration of Human Rights reflect one idealized version of life in the modern world, yet those values represent a kind of cultural freedom that appeals to many people outside the West as well.

Biculturalism

The number of migrants flowing into and out of countries has been on the rise for the past decade, especially from Africa and the Greater Middle East into Europe.[59] Migration from Central America to the United States has increased dramatically. Some 11 million undocumented migrants live in the United States today, at least half of them from Mexico.[60]

Legal immigration greatly outpaces illegal border crossings. Nearly 14 percent of all people living in the United States were not born there, the highest percentage since 1910. At least 25 other countries have a higher percentage of recent immigrants.[61] Many immigrants flock to the Persian Gulf region as temporary workers. But large settlements of ethnically related peoples—**diasporas**—also emerge where opportunities are the greatest—the more economically advanced countries, especially Australia, New Zealand, Canada, the United States, Switzerland, Austria, and Sweden.

Communications media and global travel have made it easy for most immigrants to maintain strong ties with their Cultures of origin. Messaging apps, social media, email, the Internet, and international media make it possible for immigrants to live comfortably in their first languages. Global trade delivers familiar food, clothing, and other cultural resources to distant locations.

Nonetheless, to one degree or another, the prospect of economic viability means that most immigrants must adapt significantly to their new cultural environments. Young immigrants typically handle the adjustments more easily than older migrants and are counted on to help the older adults make the transition. Millions of people worldwide live in more than one cultural world, often by necessity. For a growing number of individuals, biculturalism and bilingualism have become normal.

Putting together a self-culture becomes natural for people who are already busy stitching together two primary Cultures just to navigate daily life.

The Social and Economic Divide

Having opportunities to incorporate new or alternative elements into cultural experience can ignite a spirit of self-discovery that leads to a more satisfying life. For the economically and culturally

privileged—the international middle class—convenient, relatively unregulated access to constantly multiplying sources of information provides an ample variety of cultural resources for shaping self-cultures.

Many other people also try to find new sources of cultural inspiration, free themselves from cultural limitations, and organize their lives in ways that promise to better fulfill their individual aspirations.[62] But doing so requires sufficient financial resources, literacy, access to technology, personal autonomy, and confidence. The availability of communications technology and distant symbolic resources does not distribute equally among nations or within social classes in any country.

Only about half the global population is online.[63] The technological advantages and cultural freedoms enjoyed by most people in Western societies do not exist in equal measure around the world. Economic, political, and cultural realities sort people into categories of difference—social class, race, age, gender, religion, and nation state. These conditions were established long ago and aren't likely to change soon. Even in the United States, more than 10 percent of American adults don't use the best cultural resource—the Internet. Elderly, poor, less educated, and rural people are least likely to be online.[64]

Greater personal independence has its rewards but also costs. The negative consequences of individualization are becoming apparent even for those who have all the advantages. Life today in modern Western nations and beyond is characterized by an increasing number of single person households, more mobility, more divorces, and the greater privatization of space and time.[65] Many Americans—widely known for their freedom to create individualistic lifestyles—have become particularly disconnected socially and disengaged from civic life.[66]

Meme

The transfer of useful information among anatomically modern humans dates back to when groups of Sapiens began to interact about 300,000 years ago in Africa. Learning how to copy each other's beneficial ideas and behaviors set the stage for all subsequent cultural development.

Any cultural idea that springs from one place and quickly becomes copied in multiple locations, even within a cultural group, is a **meme**. The linguistic origin of "meme" derives from the Greek word *mimema*, which means "that which is imitated." A meme is information copied from person to person. The *Oxford English Dictionary* defines a meme as "an element of culture that may be considered to be passed on by non-genetic means, especially imitation." Memes are units of cultural transmission. The concept was introduced in the 1970s by the British biologist Richard Dawkins. He was looking for a nonbiological counterpart to genetic inheritance that could explain how favorable ideas get passed on and integrated into daily life.[67]

Big ideas like "afterlife" or "money" have endured and helped shape cultural life in many parts of the world. Conceptual memes appeal to our emotional needs or pressing practical necessities. But more ephemeral cultural ideas like a popular children's toy, fashion trends, architectural styles, even popular songs you can't get out of your head also gain widespread interest, acceptance, and imitation.

In **Chapter 7** we discussed the evolutionary nature of communications technology. Each technological form starts out as an idea. Some technologies—televisions and smartphones, for example—were such compelling ideas that they were destined to be invented. But what about nontechnological ideas? Can they also take on a spontaneous life of their own beyond the point of origin? If they are appealing enough, the answer to the question is "yes." Like helpful technologies, nonmaterial ideas grow and thrive too. Once they start to circulate, they are difficult to stop.

Memetic Transmission

Memes drive cultural evolution because they draw attention to certain ideas, regardless of where they originate, and make those ideas available for reproduction.[68] **Memetic transmission** is the process whereby memes spread contagiously from place to place, are imitated, and, in some cases, produce cultural patterns. Complex contemporary cultures around the world represent the legacy of thousands of years of memetic evolution.[69]

Like genes that require a secure home from which to operate—the double helix of DNA nested within a biological carrier—memes need vehicles to carry them around and spread their influence. In memetic transmission, people acquire, embody, transport, communicate, and give credibility to the cultural ideas they host. Then they interact with other people and habitats where they spread the cultural ideas. Influential persons who facilitate memetic transmission by serving as a medium between the idea and the environment are **interactors**.[70]

Cultural ideas—memes—originate, enter, and become stored in human brains**.** But memes also exist independent of their human hosts, taking on lives of their own as free-floating cultural elements in other ways:

Memes Reside in Communications Technology. For instance, a cultural idea can exist in the content of a television program or on a website, where it is preserved and later picked up by many people in multiple locations.[71] The mass media, personal communications technology, and culture industries all serve as contemporary meme storage devices and transmitters.

Memes Reside in Social Institutions. Schools, religious organizations, governments, political parties, civic groups, and countless other social institutions harbor, endorse, and disseminate memes.

Memes Reside in All the Material Objects and Nonmaterial Ideas That Surround Us. That is, a cultural idea also exists in the very thing it refers to. For instance, the idea of an existing aluminum can is a meme. Memes inspire other memes, like recycling. The idea of a soccer ball is a meme, and so is the sport of soccer. Some ideas that roam around even subconsciously in our heads (cans, recycling, balls, sports) get copied so much that they come into high relief, become widely recognized, and persist over time as highly recognizable elements of culture.

Every cultural artifact—from everyday items like eating utensils, children's toys, and shopping carts to most imposing cathedrals, temples, and mosques—embodies and transmits multiple memes. Cultural meanings inhabit nonmaterial domains as well. For instance, gender roles, dietary restrictions, funeral rituals, folkloric traditions, and academic theories all originate as ideas that were copied—memes.

Propelling cultural ideas widely requires receptivity to the ideas being transmitted. Some cultural notions, big and small, catch on in new locations because people accept and copy the ideas.

Genes and Memes

How ideas travel from person to person and take hold culturally has been compared to the way biological characteristics are passed along genetically. Let's look at how genes and memes reproduce and assess their evolutionary consequences:

1. *Genes* are instructions for making proteins in the body that determine some of an individual's physical characteristics and traits. They are stored in the cells of the body. Genes propagate themselves directly by leaping from body to body by means of sexual reproduction. Genes are expressed in organ development. The effectiveness of the gene depends on its interaction with

the biological habitat and the external environment where it is expressed. Biological evolution takes place in the biosphere.

2. *Memes* are instructions for carrying out cultural behavior. They are stored in people's brains, in communications media, in social institutions, and in cultural artifacts.[72] Memes travel from brain to brain through enactment, observation, and imitation of behavior that represents the meme.[73] Memes are expressed in cultural development. The cultural potential of a meme depends on the nature of the cultural population and physical environment where it is introduced. Memetic transmission takes place in the ideosphere.

Biological and Cultural Evolution

Biological evolution can be understood scientifically by examining the DNA of organisms that has been passed from generation to generation over the millennia. Cultural evolution can be understood by analyzing how memes travel and produce the ways of thinking, artifacts, and behaviors that characterize a cultural group.

Some memes are represented explicitly by cultural behavior and can be copied through observational learning. For example, a new technique for building a fire or preparing food can be demonstrated and imitated physically. With repetition, an approximation of the copied behavior gradually becomes rooted in the habits of the follower. Other cultural memes exist as thoughts or values that are less directly demonstrable and observable. For instance, the meme "always be thrifty" requires that someone explain the idea to another person. Descriptive language becomes the medium through which the meme is transmitted.[74]

Unlike the relatively high fidelity of genetic transmission, the transfer of cultural information by means of language and behavior is less exact. But like a mutation that benefits a biological species, an imperfection in memetic transmission can lead to modification of the original meme in a way that may serve to make it fit better in a given environment. Imperfect copying of cultural behavior is often done on purpose in order to innovate.[75]

Memetic Selection

Like organisms, cultural ideas compete for life. Some memes appeal broadly enough to draw attention away from other cultural ideas. This is the process of **memetic selection**. Successful memes reproduce rapidly and endure over time in ways that define and sustain fundamental cultural realities.

As a process of cultural change, memetic selection embodies the principles of natural selection and sexual selection. The best originators, adopters, and imitators of helpful memes are more likely to survive while others fade away—natural selection. Throughout the history of our species, entrepreneurial ability—from making the first tools and cooking pots to expressing oneself through language, song, and dance—becomes a key criterion for choosing reproductive mates—sexual selection.

Outcomes

By circulating memes far and wide, contemporary media promote many positive outcomes. Among the big cultural ideas that have caught on in much of the world are gender equality, universal education, social justice, protecting children, protecting the environment, and transparency.

Memes don't always convey good ideas. Some memes prompt destructive tendencies. Once again, fear comes into play. For instance, in recent years we've been reminded of the cultural meaning of the Nazi salute—a powerful meme that elicits disgust and trepidation among most people, while it inspires a small number of others. We've been introduced to the fake news meme that

FIGURE 9.3 Handicap access is an example of the globalization of good ideas

undermines the credibility of a free press in a democracy. School shootings are imitated. Once established, bad ideas can be difficult to erase.

Some memes are purposefully manufactured for political, cultural, or economic reasons and targeted at receptive groups or subgroups. For example, disinformation memes are channeled to individuals who fit a demographic and political profile. Religious memes are exchanged within congregations and populate Internet sites like memesforjesus.com. Teenagers play with memes as jokes and insults. Advertisers try to generate memes with slogans and visuals targeted to likely consumers.

Internet Memes

Meme has a much narrower meaning when used to describe whimsical ideas, images, or videos that take off on the Internet. In popular usage, an **Internet meme** refers to a humorous or captivating image, video, or comment that is copied and spread rapidly by online users.

Bodies and bodily movement are often featured in Internet memes. Social media and YouTube sensations like "dabbing," South Korean "*gangnam* style" dancing, or the "dancing baby" are classic examples. Politics produces lots of Internet memes that are regularly updated on a dedicated website—PoliticalMemes.com. Dozens of websites and illustrated books collect and present popular memes, including Pokémon memes, Star Wars memes, mug shot memes, funny cat memes, and Trump memes.

Internet memes often contain a kernel of truth; that's one reason they can catch on. For instance, revealing the dishonest or contrived side of politics—even for a second or two—resonates with a general public belief. But most Internet memes do not amount to important cultural transmission.[76] Although an Internet meme might get a quick look and an emotional or physical reaction, more meaningful memes originate and migrate to influence culture in far more substantial and enduring ways.

Memeplex

Selection processes work together so that good genes and attractive memes get copied more often than their substandard competitors. The similarities don't stop there. Just as genes function in gene pools—where individual genes become viable and influential because of their association with other genes—memes act in concert too. These interacting, mutually reinforcing cultural associations represent a **memeplex**.

For example, an automobile represents a memeplex that contains many diverse cultural elements having to do with general concepts of machinery, transportation, freedom, responsibility, style, licensing, and regulation as well as specific brands, logos, advertising campaigns, and so on. Today's automobile descends from invention of the wheel, discovery of the axle, fusion of the drive train with the combustion engine or electric motor, and industrialization of the assembly line. On top of those big cultural ideas some brand name memes catch on—the Corvette, Mustang, Prius, and Tesla, for instance.

Another familiar example of a memeplex is the telephone. Originally designed to be an aid for the hearing impaired, the telephone also became a surveillance and information tool used during wartime. Today we recognize various kinds of phones as popular personal communications technologies. Still, each historical cultural moment remains in the actual telephone. Telephonic technology continues to serve as a hearing aid, an essential piece of military equipment, and an information-sharing medium facilitated by fiber optic and satellite technology and the global telecommunications industry. Like automobiles, some specific phone brands catch on. Apple is a powerful meme. Before that, Palm Pilot, Motorola Razr, and Blackberry were trending. Even the clever spinoff expression "Crackberry," signaling the addictive nature of smartphones, became a global meme because the idea resonated with what was becoming a universally recognized truth.

Cultural artifacts such as automobiles or telephones don't succeed solely on the basis of their functionality. They also embody powerful symbolic meanings. Any cultural idea is situated within a broad system of meanings—its **cultural ecology**. For example, the idea of personal freedom inheres as a cultural value in automobiles and telephones, but restrictions on cars and phones (especially laws, rules, and pricing) have also evolved as part of their memeplexes. Some memes become particularly good survivors in the presence of other elements of the memeplex, especially when complicated or controversial belief systems like religion or politics are involved.[77] The memeplex lives on through continuous social acceptance and repeated imitation.

Viral Memes

How memes and memeplexes spread their influence has been compared to the way an invasive virus can ruin a human body or a computer.[78] The familiar expression "going viral" reflects the speed and impact some memes deliver, but it also imbues memes with a negative connotation.

From the "meme-as-virus" point of view, memes infect our lives often without our awareness or consent. As building blocks of culture, memes socialize us with assumptions, routines, and rituals that go largely unquestioned. Memes become the DNA of society; in effect, we become the memes that surround us.

The very nature of memes makes them unpredictable and potentially dangerous. But in the end, the virus metaphor conveys a misleading impression. Viruses only bring misery. Cultural life, even under repressive conditions, is almost always far less determined or gloomy. Human beings have not evolved through the millennia only to become inert repositories of cultural

ideas that permanently fix their values and direct their behavior. New memes arrive all the time and modify the cultural elements that are already in place. That's why cultures change and evolve.

Chapter Summary

Although other animal species engage in coordinated behavior that helps them live collectively, and some have developed simple cultures, human cultures are uniquely complex. Cultural development has been facilitated by the ability to transfer ideas and behaviors from one individual to another through communication and social learning. Once useful ideas began to take hold, particular ways of thinking and behaving became characteristic of each cultural group. Accumulating values and behaviors were transmitted from generation to generation, leading to ever-greater complexities.

Cultures matured over tens of thousands of years as communities of descent. Selection pressure and the biological requirements of reproduction forced the various cultural groups to create tight patterns of interdependency wherever they went. Our ancestors' interactions with local environments produced cultural traits that reflect the areas where they settled. Cultural production increased notably during the Great Leap Forward after many of our ancestors migrated to Europe.

Traditional cultural elements include geographic locations, languages, shared values, social rules, behavioral patterns, religion, material artifacts, discourses, stories and narratives, symbols, and rituals. But pervasive communications technology and the sweep of globalization are changing the nature and meaning of culture today. Cultural experiences and identities are being formed in new ways, signaling a fundamental transformation in how we live.

The push and pull of culture describes a dynamic tension between Culture—which depends on tradition—and culture—which represents individualizing tendencies. Push culture is absorbed by people inside their various social networks and through socializing institutions, like schools, religious organizations, and local media. But much of the vitality and creativity that inspire us today stems from voluntary personal engagements with the pull side of the cultural equation. Pull culture represents exposure to more distant cultural resources facilitated by communications technology and human mobility.

Cultural activity today is shifting toward formation of self-cultures. Creating a robust self-culture requires access to diverse ideas, regardless of their place of origin. The process of mixing disparate cultural elements into the self-culture—cultural programming—has become commonplace in today's technologically driven, globalized environment. People around the world do not have equal access to the range of contemporary cultural resources available. A global cultural divide still exists, even within modern Western countries.

The transfer of cultural information from person to person and from group to group has been compared to the way genes reproduce. The unit of cultural reproduction and inheritance is the meme. Memes are cultural ideas that reside in human minds, communications media, and material artifacts. Memetic transmission bears some resemblance to genetic transmission but materializes with less fidelity. This lack of precision provides space for cultural innovation. Like gene pools, individual memes exist in mutually reinforcing networks—memeplexes.

Memes represent cultural ideas that have been spread from group to group throughout the history of our species. Today cultural ideas travel with much greater range, velocity, and impact than ever before. Some Internet memes gain instant global attention but fail to meet the standard of significant cultural transmission.

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10

INFORMATION

Like all apes, humans crave novelty and exhibit great curiosity.[1] We want to comprehend the true nature of what's happening around us, because not knowing some things can cause great harm or death. We want to get information fast, especially in threatening situations. That's why we depend on hurricane, tornado, and wildfire alerts, for example. But as digital technology has dramatically increased the amount of information that is made available, it has also accelerated the spread of false information. That's become an enormous problem. We depend on the accuracy and integrity of information to make rational decisions.

We begin this chapter by explaining how information is understood and used in communication systems. We get to the key idea of the chapter right away: How do we determine what information is true and respond to it given the enormous amount of information we encounter each day? In this chapter, we also look closely at how information becomes corrupted and influences political decision making. We explore trust, credibility, and the literacies that are needed to use information wisely. And finally, we reflect on how erosion of the integrity of information will influence the future course of human evolution.

What Is Information?

To be useful, information should be valid and reliable. But that's not always the case. **Information** refers to asserted facts that may or may not be accurate. For example, if someone tells you that next Monday is a school holiday when it isn't, you have information but it isn't factual.

Think of information as data; there is good data and bad data. Good data is factually sound; bad data is not, even though it may appear to be factual. Unethically manipulating statistical data for political and business purposes is commonplace. A popular book is titled *Damn Lies and Statistics*. Another is *How to Lie with Statistics*.

The Information Age?

Although the current period in world history is often referred to as the Information Age, we've always lived in an information age. And not just us. Beginning with the first form of organic life—single cell bacteria—every species that has ever lived has needed to process information accurately to survive and reproduce. Information flows through each atom, molecule, and cell of every plant

and animal on the Earth. One theory of quantum physics asserts that information, not physical matter, may be the force that drives activity throughout the entire universe.[2]

Evolution centers on two principles of information: *(1) Credible information is a life-sustaining resource*, and *(2) information transfer from one organism to another represents nature's most basic communication process*.

What You Don't Know

The classic **information theory** model of communication was developed by mathematicians Claude Shannon and Warren Weaver last century.[3] Their model describes the properties and dynamics of information flow. Shannon and Weaver worked in an experimental laboratory for Bell Telephone. They were trying to figure out how to electronically transmit information in the form of voices across space in the most efficient and clear way possible. The insights they generated led to the development of modern telecommunications systems (**Chapter 8**).

We normally think of information as something we already know, as in "I have that information." But according to information theory, information is what you *don't* know. So, the less likely something is to happen or exist, the more information it affords.[4] This perspective on information is consistent with evolutionary thinking. *We instinctively want to reduce uncertainty whenever and wherever we encounter it*.

Entropy means the absence of order—chaos—a world of utter confusion. Negative entropy, or **negentropy**, refers to the process of reducing entropy—making a situation or an environment more orderly, structured, and functional. Reducing uncertainty increases the chances for positive outcomes. This goal has become more and more challenging because the amount of information that flows from us and to us each day continues to increase exponentially.[5] Nearly four billion Google searches take place every day. More than four million YouTube videos are viewed every *minute* of every day. Sixteen million text messages are sent every minute. The number of tweets and social media posts made every 60 seconds is likewise off the charts. Furthermore, most of the information to which we are exposed is processed; it is expanded, compressed, and framed to meet the self-interested motives of message senders.

We want to extract order out of the environment by determining which information is factual and timely and requires the least inconvenience to retrieve. For example, think of how you might use the Information Desk at an airport where you've arrived the first time. You might go to the desk if you are uncertain about something you need to know—like, "Where do I go to catch a ride share downtown?" You might try to find the answer by using your phone too, of course. It's the same task; you need factual information.

Some factors reduce the usefulness of information. First, *predictability* lessens the value. So, for example, at most airports the ride share drivers pick up passengers near the baggage claim area. Knowing this, you might simply head out in the predictable direction. Doing so, you run the risk of being wrong about the pickup location, wasting your time. But you take the chance after (even subconsciously) assessing the probability of being right (high) against the cost of being wrong (wasting time, becoming anxious). *Redundancy* also reduces information value. Let's say the person at the Information Desk tells you where to go for ride share. Another person overhears your conversation and confirms that information. The confirmation may be comforting but contains no information.

Now imagine another situation: You suddenly realize you are completely lost as you walk around an unfamiliar part of a big city (high uncertainty). The area is known to be dangerous (consequences extreme), but someone tells you clearly how to exit the area safely (effective message). You have reduced uncertainty in a dangerous situation by taking action that was prompted by factual

information. *The value of information increases when uncertainty is great, the consequences of not knowing are extreme, and the message sent reduces the uncertainty.*

Information Processing

The information theory model created by Shannon and Weaver describes communication as a system. Their research gave rise to the familiar **S-M-C-R model** as a way to describe how information flows from one place to another. A *source*, either a person or an institution, sends a *message* through a *channel* to a *receiver.* The message can be unmediated, like a voice, or mediated, like a social media post. Channels range from gestures and speech expressed by an individual to government and business communication transmitted by satellite. The receiver represents the intended destination of the message.

Communications systems invariably contain *noise*, which is anything that interferes with the ability of the receiver to get and accurately interpret the message—a loud room, for instance, or a bad phone connection. In most unmediated interactions, the source receives *feedback* from the receiver(s). Communication takes place in particular *contexts*—the time, setting, and circumstances of a communications event, like a classroom lecture or an online chat with a friend. Communication events take place within *broader environments* too. For instance, the current state of the economy influences how people talk about job prospects.

Message Efficiency

In the world of digital media, content is created to conform to the principles of information theory. Message efficiency is the goal. Improving the speed and clarity of digital communications drives the computer hardware and software industries just as speed and clarity were the main objectives in the development of the first modern analog communication technologies—the telegraph and telephone.

Speed of transmission and message clarity depend primarily on how much uncertainty is removed when a message is created and sent. For instance, when software engineers write code for an app, the smallest unit of information that is used—a **bit**—is coded as a 0 or 1, absent or present. The coder writes the bits in sequences to create patterns—**bytes**. Bytes accumulate into symbolic elements that represent information in a form that can be accessed by users of the software. For example, one byte (composed of eight bits) produces enough information to make a single written alphabetical letter. Three bytes (24 bits) make up a single pixel in a typical JPEG photograph. *Each bit and byte reduce uncertainty by a known amount in the progressive stages of information production.*

Transmitting information is inherently open to error. Glitches appear in programs when software engineers make mistakes in coding computer language, for example. A fix is then needed. The same kind of problem occurs when we hit the wrong key on a smartphone keyboard or get bad driving directions from someone. That's why autocorrect and Global Positioning Satellite (GPS) systems became so popular. When they operate properly, technologies like autocorrect and GPS function as information purifiers.

Each unit of valid information contained in a message serves as a node in ever-expanding networks of information.[6] Letters make up words, words make up sentences, and sentences make up increasingly complex forms of spoken and written language. Interpreted correctly, patterns emerge from the messages enabled by the various units of language. The patterns serve as informational building blocks, with the potential to increase complexity of thought that can be turned into knowledge.

But information today floats around in an increasingly noisy and chaotic communications environment where it can be very difficult to know what's true and what isn't.

Determining What's True

We seek to know the truth about our surroundings by relying on factual evidence and using our ability to draw logical conclusions and make sound judgments. Free societies embed the same process into their institutions. The American legal system, for example, requires that individuals who speak before a judge or jury tell the "truth, the whole truth, and nothing but the truth." Fair and impartial judgments can be rendered only when truthful testimony is presented. Even in everyday discourse, we use idiomatic expressions like "the honest truth," "the naked truth," "a moment of truth," even "true love," to assert an honest and accurate representation of an idea or a feeling.

Truth(s)

The meaning of **truth**—information supported by facts that accurately represents empirical reality—shouldn't waver in a secular society. But for some people, truth can mean what *feels* true regardless of facts.

The meaning of truth has always been subject to interpretation in the popular mind. Descriptions of events and beliefs taken from the Bible and other religious texts have long served as one standard against which the truthfulness of a claim can be evaluated. In the West, the expression "It's the gospel truth" dates back to when the Bible existed only in parchment form. But because of common usage since the late 1800s, the meaning of "the gospel truth" has broadened to describe truth generally, even when the expression is used casually.[7] Biblical literalism was the most commonly accepted authoritative source before science offered an alternative.

"Truth" has become a subjective and flexible resource that serves differing constituencies. Truth in the scientific, empirically provable sense benefits a diverse population because it presents a baseline of facts from which individuals and societies can make rational decisions. But truth as perceived by followers of a dedicated belief system can also serve individuals and groups in some ways, regardless of factual evidence. Truth is judged by its practical consequences: An idea is true if its implementation achieves the intended result, such as a desirable political or cultural outcome.[8]

The belief-driven way of understanding truth as a relative idea contradicts a fundamental principle that runs throughout evolutionary history: We do better as individuals and communities when we are able to rationally assess the nature of our surroundings and act accordingly. For a democratic society to succeed, some passions need to be controlled by logic and reason. But logical reasoning has an evolutionary competitor. Loyalty to a mythological belief system even in the face of verifiable evidence can also help communities survive, at least over the short term. The community remains strong so long as a critical mass of individuals maintains confidence in their shared beliefs—their truths.

The English language vocabulary has been expanded in response to the ways people understand truth. In 2006 a new word was coined: **Truthiness**, which is the quality of *seeming to be true* according to one's intuition, opinion, or perception without regard to factual evidence and logic.[9] The word "truthiness" was invented by American comedian and talk-show host Stephen Colbert. Ten years later **post-truth** became *Oxford Dictionary*'s Word of the Year. Post-truth means relating or referring to circumstances in which objective facts are less influential in shaping public opinion than are appeals to emotion and personal belief.[10]

CRITICAL THINKING

Advanced computing power makes it possible for anyone with access to the Internet to get information and analyze things with a level of expertise that no person or group could ever muster before. But information, like truth, has become an ambiguous idea. To guard against error and abuse in our daily decision making, we must distinguish facts from false claims.

Critical thinking evolved to help us evaluate information and judge the reasonableness of claims. The key ideas that make up critical thinking are presented in the following paragraphs.

A **fact** is something that is known to have happened or to exist for which valid and reliable evidence can be summoned.[11] For example, geological dating techniques show that volcanic eruptions occurred above and below the location of dinosaur fossils. This fact verifies the scientific claim that the dinosaurs went extinct about 65 million years ago.

Claims refer to assertions that are made about something. Not all claims are factual, although they are often stated as if they are. For instance, Donald Trump repeatedly claimed he won the popular vote in the 2016 presidential election. He also said thousands of immigrants voted illegally for his opponent. No evidence supports either of these claims; they are false. Trump also claimed to have won the Electoral College vote. Evidence supports that claim; it is true. The first two claims are not based on facts. The third claim is factual.

Evidence provides the objective support needed to determine if a claim is factual. Evidence includes observable examples, valid and reliable scientific measurements, verifiable statistics, credible historical narratives, and personal testimony that is corroborated by multiple sources.[12]

Reasoning is the cognitive process we use to evaluate evidence and draw conclusions, helping individuals and groups decide what to believe. We turn factual information into knowledge through logic and reasoning.

Inferences are conclusions or interpretations drawn from facts. If you see a flash of lightning, hear a crack of thunder, and watch people quickly enter the room soaking wet, you can reasonably infer that it is raining. All the evidence points in the same direction.

Using logic to draw inferences from facts is a cognitive skill that was shaped by human experience over thousands of generations. Our ancestors had to solve complicated social problems that were created just by living in groups.[13] They developed the ability to work together, which made them collectively responsible for and subject to the consequences of their joint decision making.

Maximizing access to factual information, reasoning logically, and developing knowledge help people make good decisions as individuals and community members. That was true for our hominin ancestors as they formed cultures, was demanded by the Greeks when they invented the first political democracy, and remains true for self-governing societies today.

Scientific Theory and Research

Populated by imperfect human beings, the discipline of science self-consciously works to get errors and personal bias out of the systems of evidence collection, reasoning, and reporting that give science its legitimacy. Personal opinions don't count. The standards used for evaluating evidence, producing knowledge, and developing theory conform to strict rules that have been established for conducting scientific research. Careful observation and cautious reasoning must be employed before claims can be said to be true.

Scientific claims take the form of hypotheses that are tested against valid and reliable evidence. The hypothesis must be objectively proven to be true before any conclusions can be drawn. For example, a botanist might put forward the following hypothesis: tomato plants watered with Liquid Vitamin B grow faster than tomato plants watered with Liquid Vitamin E. In order to test the hypothesis, the botanist measures comparative growth in a controlled environment. If the botanist is right, the hypothesis (the scientific claim) is confirmed.

Scientific findings are always subject to revision. The findings of an experiment like the one described above are subject to additional testing. If other scientists conduct the same test and get the same result, the original hypothesis will be strengthened. But if further tests fail to confirm the hypothesis, then it is held in question. Or if other researchers vary any of the factors in plant growth (for example, amount of sun exposure, temperature, time of year) and find that one or any combination of these factors changes the result, then the original claim must be refined to account for the variations.

CARL SAGAN AND THE DEMON-HAUNTED MIND

Carl Sagan was the first great science communicator in the age of electronic media. He was a Cornell University astronomy professor, author of more than a dozen books, journal editor, and played a leading role developing NASA spacecraft expeditions to other planets. But Sagan may be best remembered as the creator and host of the legendary public television series *Cosmos*.

With contagious enthusiasm about the sheer thrill of being alive, Sagan saw rays of hope for the uncertain future of humanity if we keep an open mind and pursue scientific research with logic and reason. But Sagan worried that human beings may never be able to overcome our worst instincts and ancient hatreds.[14]

FIGURE 10.1 Carl Sagan. Courtesy of Joseph Sohm/shutterstock.com

A book of Carl Sagan's essays, *The Demon-Haunted World,* was published after his death more than 20 years ago. His words seem more prescient now than ever before:

> Science is more than a body of knowledge; it is a way of thinking. I have a foreboding of an America in my children's or grandchildren's time—when the United States is a service and information economy; when nearly all the key manufacturing industries have slipped away into other countries; when awesome technological powers are in the hands of a very few, and no one representing the public interest can even grasp the issues; when the people have lost the ability to set their own agendas or knowledgeably question those in authority; when, clutching our crystals and nervously consulting our horoscope, our critical faculties in decline, unable to distinguish between what feels good and what's true, we slide, almost without noticing, back into superstition and darkness.[15]

Fear

In many ways, the explicit rules and controlled conditions of scientific research formalize and regularize commonsense reasoning. They help us figure out what can or cannot be proved to be true. But emotions also influence our behavior. Emotions evolved by natural selection the same way our physical anatomy, reasoning ability, and language skill evolved.[16]

Fear is the most commonly expressed negative human emotion.[17] Fear evolved as a psychological and biological response to real and imagined threats. Fear helps keep us alive. Our body warns us of possible danger by creating an emotional and chemical reaction induced by stress, especially when we feel helpless. Many fears developed as instinctual reactions to the dangers our ancestors encountered in nature: snakes, spiders, germs, wolves, and lightning storms among them. Many people fear physical conditions we come across in daily life: heights and enclosed spaces, for example.

Fear and other emotions evolved as warning signs that can help us evaluate situations, identify problems, and make rational decisions that work to our advantage.[18] For example, not getting too close to some snakes, insects, germs, wolves, dogs, or high places is a good idea. But fearful reactions also can be irrational and create counterproductive anxieties, even crippling phobias. For instance, some people fear flying even though air travel is by far the safest form of transportation. Other people fear meeting new people, using a public restroom, or that a shark is going to attack them in safe waters. Overreacting to perceived threats creates openings for those who want to exploit our emotional vulnerabilities.

Exploiting Fear

Exploiting fear for selfish reasons takes place in the non-human animal world too, especially by males for purposes of sexual reproduction or food. Above all else, animals fear predators—a constant anxiety that can be manipulated. For example, when male antelopes in Kenya sense that a sexually receptive female is starting to leave their shared territory, the male often will strike a frozen stance and snort a warning that predators are nearby, even when they aren't. The female then typically retreats, and the male will attempt to mate with her before she tries to leave again. Females repeat this submissive behavior because the consequences of predation are so great.[19]

Males of various species of moth make a clicking noise that imitates a sound made by predator bats. That sound inhibits female moths from flying away, keeping them available for mating.[20] Low-ranking tufted capuchin monkeys in South America try to distract high-ranking monkeys by sounding a false warning that a predator is near. If they can frighten the high-ranking monkeys long enough, they can grab some of the banana pieces those monkeys are hoarding.[21]

Because both reason and emotion influence behavior, we often struggle to determine just how much to trust our "head" or "gut" in various situations. Fearfulness cautions us to be careful when we encounter something that might be dangerous or wrong.[22] But fear can also be created, overstated, and exploited. That's why some news media can profit by marketing fear and anxiety.

Managing Information

People in modern democratic nation states rely on media that are relatively independent of government control to give them factual information. But the same technology that evolved to report news accurately and move information at lightning speed also creates serious complications.

Information Overload

Explosive growth in the number of electronic and digital media operating worldwide took place toward the end of last century. Cable television spread into urban areas, and satellite television began to canvass the globe in the 1970s. The first 24/7 cable television news channel, CNN, went live in 1980. The Internet developed rapidly as a popular information medium beginning in the 1990s.

Opportunities for exposure to information of all kinds grew quickly as the number of media channels and Internet sites increased. The abundance of information was welcomed by most people.[23] But concerns also arose that many individuals would feel overwhelmed by the flood of information.[24] With so much information available and so many choices for people to make, some experts predicted that lots of people would simply tune everything out.

Niche Media

The media landscape was expanding toward the end of last century. Cable television operators rushed to create information and entertainment channels that featured specialized programming. Program content was tailored to attract and reinforce potential audiences large enough to produce ratings and revenues. As a result, most people increased their overall media consumption, especially the amount of television viewing they did.[25]

Niche media appeal to audiences that have a special interest in everything from sports, music, and travel to crime, shopping, and pornography. Business channels track news that financial investors want to know. Religious media preach to their viewers and listeners. Foreign language television channels attract viewers for the language and for the political and cultural perspective these channels provide. The Internet, with its unlimited variety of information, developed on the heels of niche media, giving people many more opportunities to find specialized information.

Time Shift

Another key technological development in the evolving relationship between audience members and electronic sources of information took place around the time niche media first appeared. **Time-shift technology**—videocassette recorders and digital video recorders—gave audience members another measure of control over their experiences with television. The ability to manage time conveniently is a compelling feature of the Internet too, of course. Specialized television programming, time-shift technology, and the ubiquitous Internet all converged around the same time. People expect to use these resources on their own terms.

Changing Audience

Traditional media environments—where a large number of people consume the same news and entertainment programs at the same time—no longer exist in most parts of the developed world. For instance, the three main commercial television networks in the United States captured 90 percent of the audience before cable television, time-shift technology, and the Internet arrived. That percentage was cut in half by the end of last century and amounts to less than 30 percent now.[26] News consumers have steadily migrated away from newspapers, network television, radio, and news magazines toward cable television and online sources.[27] Even relatively homogenous democratic societies like Sweden have witnessed their state-sponsored nightly TV news viewing—long considered an informal cultural duty for citizens—become less common as satellite TV and the Internet enticed people away.[28]

Commercial mass media and social media contribute to and profit from the audience fragmentation that has taken place. Most cable news channels and Internet sources present information with a point of view. Audiences typically become loyal to their preferred sources while avoiding other media content. Social media added to the polarization by circulating information from like-thinking "friends" and "followers." These converging developments encourage people to enter into informational echo chambers that reinforce their biases.

Echo Chamber

People are susceptible to information that arouses their emotions regardless of the facts. For some individuals and groups, the "truth" must fit with their political leanings, religious teachings, or cultural traditions. They make decisions and take action on the basis of their preexisting beliefs and the opinions of others who think like them, including media personalities and proclaimed experts.

Strong personal opinions about important issues don't always arise from careful consideration of proven and relevant facts. For instance, Americans who couldn't find Ukraine on a map were most likely to favor military intervention there.[29] Nonmedical authorities are most enthusiastic about homeopathic remedies. People who know the least about the science of evolution are most likely to oppose it.[30] These individuals live in an echo chamber of misleading but personally comforting information that contradicts the facts.[31] Opinions that align with personal beliefs often defeat factual information. Challenges to core beliefs can be quickly dismissed as fake news or elitist.

The Fox News audience is the best example of this tendency in the United States.[32] With the national demographic picture becoming more diverse, Fox News—whose viewers are almost all white Christians—blatantly exploits their audience's anxiety about losing political and cultural power. In their efforts to build large and loyal communities of followers, Fox News, some Internet sites, and many contributors to social media purposefully disregard the integrity of factual information.

Inducing Fear

The first true mass medium—the penny press newspapers of the 1800s—was a real-world experiment in the large-scale manipulation of human behavior (**Chapter 8**). By observing which news stories attracted the most interest, tabloid publishers quickly learned how to exploit emotion for profit. Stories that provoked negative emotions quickly became a high priority. Accounts that evoke fear, suspicion, hatred, revenge, jealousy, and anger regularly found their way onto the pages of the first popular newspapers. The amount of negative news coverage on all media has increased steadily since then.[33]

Naturally people stay alert for real threats to their security. That's why dramatic and unsettling news stories grab people's attention. And some unusual events do put people in peril. But many news stories and themes that are featured on entertainment programs only contribute to an already existing climate of fear. For instance, people who watch a lot of television overestimate the dangers they are likely to confront in their daily lives.[34] Highlighting stories about crime, drugs, undocumented immigrants, plane crashes, and runaway viruses heightens anxiety.[35] Saturation coverage of stories like these across media platforms further increases the trepidation, especially when the event is threatening and visual.

Terrorist attacks shown on television and the Internet also stimulate a fearful reaction. Terrorists themselves say that's what they're trying to do. But only a tiny number of people in the United States have been killed or wounded by terrorists. Tornados are visually captivating too, but kill fewer than 100 people annually, only 10 in a recent year.

Asthma—which kills more than 4,000 Americans every year—is a much more serious threat than terrorism or tornados but gets very little national news coverage. The appeal of most medical news isn't visual, and, for most people, the threat isn't immediate. In another domain, nearly 200,000 people are lifted out of poverty worldwide every year—a dramatic global turnaround in the fortunes of the poor. But that's not the kind of story that attracts viewers. Small audiences don't help news organizations turn a profit.

The information that is made most available, especially if it taps into our fears, creates an impression that it is true. Shocking short-term threats, especially when presented in dramatic story form, create the impression that things are worse than they actually are.[36] This is the phenomenon of the **availability heuristic**, a mental shortcut that undercuts rational analysis.[37]

Fake News

Besides the sheer amount of information that reaches us every day, another concern was expressed by critical observers as mass media, the Internet, and social media became popular. The worry was that the surge of information would make people vulnerable to manipulation. That has happened. And it's not just the amount of information or the types of news and entertainment that creates problems. The Internet is a predatory environment. Information has been weaponized for political and cultural influence.

Defining Fake News

"Fake news" is an ambiguous catch-all term that needs clarification. The original meaning of **fake news** is false, often sensational information that is disseminated mainly on the Internet under the guise of news. Many fake news stories are created by partisan interests to influence political opinions, voting, and cultural behavior. Fake news stories of this variety confuse people about the credibility of news reports and sources. Legitimate journalism gets discredited.

A second kind of fake news originates with powerful individuals who have the ability to attract media attention and use their public platform to intentionally make false statements. These individuals rely on the loyalty of their followers to believe them and on the impossibility of news consumers to check the factual details for accuracy. Before describing these two kinds of fake news in more detail, it's helpful to define the terms commonly associated with fake news (**Table 10.1**).

TABLE 10.1 Defining Fake News Terms

Types	*Description*
Misinformation	Incorrect or misleading information that may or may not be passed along with purpose to deceive
Disinformation	False information that is created and disseminated with the purpose to deceive
Alternative facts	Evidence or claims that are posited as alternatives to more widely accepted evidence or claims. Intended to contradict verifiable facts
Falsehood	Polite reference to an untrue statement
Lie	Untrue statement. As a verb, to make an untrue statement with intent to deceive; to create a false or misleading impression
Fake news	(1) Fictitious news stories circulated mainly on the Internet with the intention to create confusion and sway public opinion; (2) untrue claims made by power holders in a society to create a false impression
Deep fake	Technologically manipulated video or audio that creates a misleading, often harmful representation of the original source

Fake news circulates widely because the Internet allows almost anyone to enter and attempt to influence the global information system. That has not always been the case. Before cable television and the Internet were available, only a small number of broadcasters were able to obtain government licenses to transmit news and entertainment programs. The system was closed to outsiders. For the most part, mainstream news was assumed by the majority of the public to be true.

Cable television and the Internet changed that. The creation and spread of disinformation in the form of fake news reports became a primary strategy for waging global information warfare in the 2016 American and 2017 French presidential elections. Russian government-backed information operations groups targeted psychologically vulnerable populations—especially older, politically conservative individuals who are far more likely than younger people to share fake news links.[38] Americans were exposed to stories like Hillary Clinton running a child sex trafficking ring out of a pizza parlor in New Jersey. Or Pope Francis endorsing Trump for president. None were true.

Fake news creators attempt to influence the behavior of friendship networks. Bogus friendship requests are sent to unsuspecting social media users. Then **click bait**—attractive made-up Internet content—encourages the targeted receivers to click on a link that sends them to a fake news page. Some of the targeted users then share the fake news link with their social media contacts. Those friends pass the link on to more friends. That's how "atoms" of false information rocket through the information ecosystem at high speed powered by trusted peer-to-peer networks.[39]

Although the vast majority of fake news stories are directed to conservatives, both sides are subjected to attack in order to create maximum conflict and chaos. Digitally manipulated photos and graphics support made-up stories. Inflammatory memes circulate.

More than two-thirds of all Americans say fake news has an impact—especially as it affects public confidence in government institutions—and needs to be fixed.[40] Nearly a quarter of them believe they have knowingly or unknowingly shared a fake news story. The top fake political news stories during the 2016 presidential campaign produced more clicks and re-tweets than the top real news stories.[41] Facebook users were more responsive to fake news stories than they were to reports from legitimate news sources.[42]

Twitter Effect

Most people who use Twitter tweet infrequently. But because of his excessive and provocative use of Twitter, Donald Trump turned the unique social medium into an influential form of political messaging. By tweeting multiple times a day, Trump got around mainstream news media to communicate directly to his followers, much like sports stars and celebrities do. But the main effect of his tweets was not on his Twitter followers. The Twitter impact was amplified by the mass media that routinely covered and repeated the tweets, including the networks' own Twitter platforms.[43]

Gaslighting

Donald Trump kicked off his presidential bid by claiming Barack Obama was not born in the United States. He later claimed President Obama wire-trapped Trump's office building in New York, that three million undocumented persons voted for Hillary Clinton (denying Trump the popular vote), that "thousands and thousands" of Muslims in New Jersey publicly celebrated the destruction of the Twin Towers, and that the crowd that had assembled for his inauguration was the largest in history.

Journalists, fact checkers, and news commentators rushed to analyze these and many other false claims made by Trump. Their investigations exposed a complete lack of evidence supporting many of his assertions. Still, extensive press coverage of the fake stories gave great visibility to multiple untrue claims, which worked in Trump's favor. Like the availability heuristic, simple repetition of fake news over time—the **mere exposure effect**—increases the perception that it may be true.[44]

Making up completely unsubstantiated and untrue stories represents the psychological strategy of **gaslighting**—manipulating people to make them question their own knowledge, memory, perception, or sanity. Dictators, abusers, narcissists, and cult leaders tell blatant lies, deny what can easily be proved, repeat the lies to wear their opponents down, accuse others of misdeeds they themselves do, compliment their opponents to confuse them, create a fanatical following, and then claim that everyone but them is lying.[45]

Donald Trump appropriated the term "fake news" to mean any news story he disagrees with or makes him look bad. The term was already being used mainly by right-wing political websites and radio talk-show commentators when they wanted to discredit information that challenged their views or supported their political opponents.[46] Trump made claims of fake news extremely popular with his backers. He tweeted and shouted "Fake News!" whenever he didn't like a news story. He yelled "Fake News!" pointing at journalists reporting from his rallies and called the mainstream press the "enemy of the people."

Fake news became a meme exploited by authoritarian leaders around the world when they don't want unfavorable information contained in legitimate news reports to circulate. Tyrants govern by creating uncertainty and confusion.[47] Strong man leaders in Turkey, the Philippines, Cambodia, Bangladesh, Myanmar, and other countries allege "fake news" as a pretense to arrest journalists, commentators, and bloggers who disagree with their actions and policies. A record number of journalists have been jailed in recent years in China, Egypt, and Turkey as "terrorists" and purveyors of fake news.[48]

FIGURE 10.2 Facts not Fox News. Courtesy of J. Bicking/shutterstock.com

Confirmation Bias

Political partisanship plays a decisive role in how people respond to new information, including fake news. But lack of critical thinking also contributes to the one-sidedness. Only about a quarter of adult Americans can tell the difference between facts supported by objective evidence and the expression of personal opinion.[49] For example, Americans have trouble recognizing how a statement like "Spending on Social Security, Medicare, and Medicaid make up the largest portion of the U.S. federal budget" differs from "Democracy is the greatest form of government."

Scientific facts relevant to controversial issues are often interpreted more in accord with political and cultural identities than as logical conclusions reasoned from reliable evidence.[50] Republicans and Democrats are both more likely to identify factual and opinion statements as factual when the statement supports their political views. For example, when political conservatives hear discussions about gun control or climate change, many of them fear the government is plotting to change the Constitution or intrude on the free market. At the same time, debates about genetically modified foods and genetic engineering cause some liberals to unhesitatingly blame corporate greed or Nazi-style eugenics. People of all educational levels tend to believe incoming information that corresponds with their views, even when the information is false.[51]

The tendency to interpret new information in ways that align with preexisting beliefs is **confirmation bias**, sometimes called "myside bias." Information that supports one's beliefs is likely to be accepted, while information that contradicts those beliefs is rejected or ignored. Bias is anticipatory too. People generally consult information sources they believe are most likely to agree with them and avoid those that don't.[52] They want to reduce **cognitive dissonance**—the uncomfortable feeling of holding contradictory ideas together in the brain.[53] The brain is hardwired to receive confirming information that harmonizes with a person's existing view and beliefs and reject or misinterpret information that clashes with those views.[54]

Scientific research on confirmation bias began with a study conducted in the middle of last century of how college students at two rival American universities "saw" a football game played between their schools.[55] Princeton students reported that the rival Dartmouth team committed many more fouls than their team did during the game. Dartmouth fans said the same about the Princeton squad. The authors concluded the game was "many different games" and that conflicting perceptions of what happened felt equally real for both sides.

Motivated Reasoning

Although evolution has shaped human cognition to detect falsity, our brains also work to direct incoming information toward favorable conclusions rather than follow where the evidence and logic leads. People are predisposed to defend their core beliefs even when confronted with valid information that conflicts with their personal opinions or the prevalent views of the communities with which they identify. They can do so even unconsciously. This psychological process is called **motivated reasoning**.[56]

Passive ignorance can result when a person has not been exposed to or is unable to consider factual information—because of an inability to read, for example. But **willful ignorance** reflects conscious avoidance and rejection of information because it threatens a belief system. In any case, we tend to resist new information that challenges us to change our minds. **Belief perseverance** is the tendency to continue to believe something even after learning the foundation of the belief is false. Part of the reward is chemical: Vigorously reaffirming a personal belief, especially when evidence does *not* support it, sends a shot of dopamine through the brain.[57]

The Utility of Fake News

Ignoring credible evidence can be extremely dangerous. Our evolved ability to reason a course of action from factual information helps us respond to the challenges we face. But irrational, fact-denying, confirmation bias must have been useful in some respects for our ancestors too, or it wouldn't have evolved.

Attempts by some of our hunter-gatherer ancestors to gain social status in their groups may help explain it. The ability to simplify complex problems and propose solutions by expressing opinions with confidence and authority—even when the information deployed in the argument isn't completely true—can be highly persuasive. By using strong emotional appeals and personal charisma to win arguments about possible courses of action, some individuals would have ascended to leadership roles in primitive societies.[58] The passionate rhetoric of self-assured leaders can make their followers feel safe.

For many people, the ground for this kind of thinking has long been prepared. The worlds' major religious belief systems are all founded on emotionally powerful but empirically unproven claims. Adding to the appeal, mainstream religious belief formalizes and ritualizes fear; to fear God is virtuous. The stakes for not holding on to the core beliefs of a religious community become extremely high.

Conspiracy Theories

Information circulating on social media can turn into **conspiracy theories**—the belief that some extraordinary event or circumstance was brought about by a secret plot undertaken by powerful conspirators. Most conspiracy theories amount to nothing more than pure speculation.

Fake news stories that play on people's apprehensions often are designed to develop into conspiracy theories by reinforcing the idea that the government or other powerful institutions are hiding the truth from the public. Persuading people to believe in conspiracies, especially when the conspiracy conforms to their political, ethnic, or cultural biases, has become a profitable industry. Anxious people, and those who feel disenfranchised by society, are especially likely to be drawn to conspiratorial thinking.[59]

In other cases, believing in the conspiracy is purely delusional. For instance, settled science and common sense are ignored by believers in a scandalous, age-old claim that has new legs: the Earth is flat. After an American rap artist tweeted that a conspiracy is keeping the world from finding out that the world is flat, the number of Google searches for "flat earth" immediately shot way up. Another big spike in flat earth searches took place a year later when some famous American professional basketball players repeated the claim. Google trends data for "flat earth" tripled.[60] A Flat Earth International Conference was held.

Popular delusions like this have circulated throughout human history, especially before modern science inoculated most people against extreme self-deception. Today most delusional behavior is considered to be a mental illness. Yet some people still believe in outrageous false conspiracies, even though those same individuals act rationally in other aspects of their lives.

Barack Obama is a secret Muslim. The Holocaust didn't happen. The Moon landing was faked. George Bush allowed the 9/11 attacks to occur. Combining real-world people with imaginary events can turn a far-fetched conspiracy into a seemingly plausible story that satisfies the conspiracy believers emotionally.[61]

Conspiracy theories have real-world consequences. For example, individuals who promote the discredited idea that vaccines cause autism have brought about a decline in immunization rates and outbreaks of disease. Anti-government and anti-vaccination groups are among those whose

FIGURE 10.3 The flat earth. Courtesy of David Roberts/iStock.com

members are targeted for misinformation campaigns. People who believe in government conspiracies become alienated from the societies in which they live and are less likely to vote.[62]

Pointing out that no credible evidence supports a conspiracy just makes some people more confident that the conspiracy is true; the science must be wrong or the truth is being covered up. Some conspiracy theories cannot be disproved. The government cannot show, for example, that it is not keeping dead aliens somewhere in a secret laboratory.[63]

Trust

We lessen our vulnerability to potential danger by identifying bad information. Especially when the potential usefulness of information is high, it's important to be able to trust the message source. Evolution has prepared us to be naturally suspicious of each other. Our cognitive immune system protects us by working to detect falsity.[64]

People have different motives for communicating interpersonally. Those differences influence the way messages are formed and how they are interpreted.[65] The initiators of interpersonal communication expect some kind of positive outcome. But message receivers also wonder, "What's in this for me?" The Greek philosopher Aristotle wrote long ago that people want to know if the sender of a message has the "good will" of the receivers in mind.[66]

We study people closely because they represent a main source of information.[67] We focus on eye contact and body movement. We look for ambiguous motives, factual errors, inconsistencies, and alternative explanations for what's being said or written. We rely on that same ingrained habit to scrutinize politicians, actors, sports stars, and other celebrities when they appear on the media. The success of novels, reality television, soap operas, and movies also depends on the need and ability of audience members to assess human intentions and detect deceit.

Armed with the same instinct, people also question the trustworthiness of the institutions that are supposed to serve them. Primary among those social institutions are the news media. The ideal of journalistic fairness and objectivity was forged during a time when relatively few media options were available to the public. The degree of people's trust in the media to report the news fully, accurately, and fairly in the United States was nearly 75 percent when media credibility data was first collected in the 1970s.[68] Media credibility has declined steadily since then.[69] Political conservatives and younger and older adults are particularly untrusting of the news media.

Although an increasing number of people get some of their news from social media, they rank the Internet very low as a trustworthy source.[70] Teens and young adults are least likely to follow news routinely and are ambivalent about television and social media in general as reliable information sources.[71]

News reporting by credible sources has never been more accurate than it is today. Yet the overall credibility of news media in today's acrimonious political and cultural environment has fallen to the lowest point in history, and not just in the United States.[72] Globally, the media rank as the least trusted social institution.[73] Just one-third of the global public trusts the news media.

Press Freedom

Despite the big drop in media credibility, democratic societies still depend on their populations to reason logically from factual information in order to make wise decisions. Journalism in a democracy should serve as a check on government and other powerful institutions. That's why freedom of the press continues to be guarded so passionately by most people in democratic societies.

By contrast, societies ruled by state authority—China may be the clearest example—exercise great control over their national news media and the practice of journalism. Russia, North Korea, and Laos don't allow objective reporting. In state-run countries, news events are selected, edited, and created in ways the leaders believe will maintain social stability and educate the population about government policy. Access to the Internet is much more tightly controlled.[74]

A Global Problem

Press freedom does not exist in many parts of the world, and conditions are getting worse.[75] Many journalists, commentators, and bloggers face constant danger. The fake news trope and other forms of politically motivated anti-media discourse have heightened the risk for information workers everywhere. More than a thousand journalists around the world have been killed in the line of duty over the past 30 years.[76] The Greater Middle East and North Africa have become the most repressive regions overall. In one recent year at least 65 media workers in Syria, Mexico, Afghanistan, Iraq, Myanmar, the Philippines, and elsewhere were murdered while doing their work.[77] Journalists in the United States have been threatened physically by right-wing extremists. Authoritarian leaders have corrupted the integrity of much public information worldwide and pose an unprecedented challenge to professional journalism.

Fighting Back

Data journalists, fact checkers, critical media commentators, and whistleblowers in Western democracies have responded to the challenge.

Although trust in media has sunk low, the credibility of professional journalists is on the rise.[78] In the United States, a resurgence of investigative reporting by the mainstream press challenged the veracity of exaggerations and lies made by authoritarian leaders like Donald Trump. Nearly 10,000 false or misleading claims made by Trump in tweets, speeches, and offhand remarks were

documented by the *Washington Post* during the first two years of his presidency, with the rate of lies increasing as time went on.[79]

Fact-checking organizations like Snopes, Politifax, and the Poynter International Fact Checking Network are culling out hoaxes, opinion, and satire from straight news reporting at the global level. The European Union helps its member nations identify fake news and disinformation. In Germany, strict laws prohibit hate speech and spreading false information on the Internet. The British Broadcasting Corporation and other media organizations have stopped giving equal time to individuals who represent disproven sides to made-up controversies like climate change.

Social Media Response

Because the U.S. government and the general public applied pressure, social media executives also finally confronted the massive disinformation problem. At first, they were defensive. After admitting that fake news posts from Russian operatives may have reached more than 100 million Americans, Facebook's CEO said that because news is so complex, social media shouldn't have to play the role of arbiter of truth.

The original idea of the Internet was to allow people to freely share information that others can use. But the amount of information that flows through social media alone today is staggering and still growing. A delicate balance has to be struck between freedom of expression and the potential for abuse, between verifiable and false information, fake news and sarcasm, fact and opinion.

Facebook finally conceded that too much sensationalism, disinformation, and polarizing commentary circulates online and that social media are a big part of the problem. Facebook claimed to accept a degree of moral responsibility for their role and vowed to make content on the social media giant more civil and trustworthy. The company hired additional content moderators and fact checkers, deleted the most problematic accounts, and increased sensitivity to spam and clickbait tactics. They promised to be alert to cyberattacks using false information. Content sent to users' newsfeeds was re-prioritized to feature more trustworthy, informative, and relevant local news sources. Facebook also asked government to play a more active role in controlling harmful content and protect elections, privacy, and data.

Other social media companies and more traditional news sources, including online newspapers, also acted. Attempting to separate free speech from hate speech, Twitter suspended accounts held by extremist political groups and banned some groups outright. Google deployed artificial intelligence programs to search for and expel the most offensive YouTube videos. Online news sources added **trust indicators** similar to nutrition labeling in order to distinguish among news, background article, analysis, and opinion.

Evolving Literacies

Just 200 years ago nearly 90 percent of the world's population could not read or write.[80] As recently as 1950 about two-thirds of the global population remained illiterate. Literacy levels have improved greatly since then because basic education became a priority in most parts of the world. Today global literacy is approaching 90 percent, but substantial gaps exist between geographic regions and between genders in parts of the developing world.

Media Literacy

The flow of information sparked by the arrival of electronic media last century brought about new forms of literacy. Parents and educators became concerned about children and families when they

realized television was dominating their leisure time. They worried about physical effects (damaging the eyes, interfering with sleep, irritability, passivity), social effects (reducing family interaction, disrupting meal times, limiting outside activity), and cultural effects (learning unwanted values, antisocial behavior, children's advertising, racial and gender stereotyping).

These concerns prompted many families to impose rules for watching television and in some cases to keep television out of the home. A social movement emerged with a call for **media literacy**—teaching people how to regulate their media consumption and think critically about the messages they get from the mass media, especially television.

Computer Literacy

Life in the modern world changed again when computers became common domestic technologies during the 1980s. New skills were needed to perform tasks such as data entry, word processing, and filling out spreadsheets. Some basic understanding of hardware and software was required, but **computer literacy** focused mainly on the competencies needed to operate a desktop computer efficiently, like how to use the various functions of a QWERTY keyboard.

Digital Literacy

Things got more complicated a decade later when the Internet became part of everyday life. *Unlike earlier consumer media technologies, computers and the Internet allow people to produce as well as receive content*. This revolutionary development represents an historic change in the relationship between ordinary human beings and communications technology. Consequently, the focus in literacy shifted from the technical ability to use computers to participating meaningfully and safely in the flow of information generated online.

Digital literacy refers to the ability to use communications technology to locate, assess, use, and create information in a digital environment. The educational emphasis in digital literacy centers on helping people learn how to properly evaluate and use information found online.

Although everyone is vulnerable to the hazards of cyberspace, teenagers and young adults have been the focus of most digital literacy campaigns. These populations are adept at using communications technology but not good at differentiating between credible and unreliable sources of text and images.[81] Many young people fail to understand the motives of the sources behind information that appears online. For example, they often can't distinguish between fake news and real news or between advertisements and news stories. Realistic looking photos and graphics can trick anyone into thinking a source is legitimate when it isn't.

What Do We Really Know?

We evolved to be rational actors. People actively seek, evaluate, and use factual information to make sensible decisions in their everyday lives in order to stay safe and productively connected. Other animals—elephants, chimpanzees, lions, and ravens are among the best examples—also think and behave rationally beyond what their basic instincts tell them to do.[82]

Depending on reliable evidence and possessing superior reasoning ability allowed Sapiens to form productive cultures. The role of the rational individual became important in the process. Western democracies were founded on the idea that the voter knows best, the free market customer is always right, and modern education should encourage students to think for themselves.[83]

But people can be persuaded more by emotional appeals than by verifiable, accurate information.[84] Emotional reactions to everyday situations and heuristic thinking—using mental shortcuts

such as trusting intuition, making educated guesses, and dutifully following cultural norms—greatly influence behavior. Trusting the emotions and heuristic thinking must have been evolutionarily advantageous in some ways for our ancestors too.

Complexity and Information

With mounting success, generations of our ancestors relied not only on the good intentions and work habits of other people in their communities but also on their expertise. In modern complex societies we need doctors, lawyers, math teachers, and mechanics in our communities.

But today's communications technologies have expanded access to expert authority way beyond the local. As people's lives become more complicated, they increasingly depend on remote authorities and anonymous social institutions to provide the information they want and need. Good information retrieved from distant sources can be vital to well-being. But reliance on technologically mediated sources of information also creates unique problems. Distinctions typically made between factual and false information become less clear as reliance on non-local sources increases.

The Illusion of Knowledge

Consulting websites like Huffington Post or Wikipedia can give people exaggerated confidence about the depth of their knowledge about all kinds of issues.[85] Clicking on The Food Babe, Answers in Genesis, InfoWars, or Age of Autism makes the problem worse.

Depending on sources like these can create an illusion of knowledge.[86] Information and advice issued by authorities who lack proper credentials are taken by some people with the same degree of seriousness that is afforded to actual experts. Alternative universes of information have been created by commentators on talk radio, cable television, and the Internet. False claims, politicized opinions, and conspiracy theories flow through television, computers, and personal communications devices.

FIGURE 10.4 Stand up for Science rally in Boston. Courtesy of Heidi Besen/iStock.com

Anti-Scientific Thinking

Scientific discovery ranks very high among the greatest of human achievements. Yet even the most extraordinary scientific work has been met with resistance throughout history. Galileo was tried and condemned by the Vatican. The Bishop of Oxford wanted to know which side of Darwin's family descended from an ape.

Sharing useful factual information is normal. But brazenly ignoring science, legitimate expertise, and rational argument in the name of individual freedom has gained traction in today's political and cultural environment.[87] A crisis of credible information has taken place despite the fact the global population today is better educated and has access to better technology and greater sources of knowledge than ever before. Disregarding factual evidence because "everyone has the right to their own opinion" and substituting opinions for facts nurtures anti-intellectual behavior and diminishes the power of reason.

Science has never won the day simply by providing a litany of evidence, no matter how convincing.[88] But as Stephen Hawking lamented in his last book, we are experiencing something new and truly alarming today—a global revolt against experts, especially scientists.[89] Science and legitimate expertise have become casualties of trends evident in the early twenty-first century.

Evolutionary Paradox

The crisis of information represents an evolutionary paradox. Acting rationally on the basis of reliable information has been crucial to human evolution and is not likely to disappear.[90] But facts and the fundamental integrity of information and authority don't concern some people now, including individuals who occupy positions of enormous power. Respect for well-sourced information and the quality of reasoning that underlies logical decision making have been compromised. Distrust and disdain are being cast at the most reliable sources of information that produce true knowledge about the world—professional journalism and academic research.

Simultaneous wars on science, fact-based journalism, and scholarly thinking in general are being waged mainly by ultra-conservative politicians and right-wing media. Rational debate over points of government policy has faded. **Techno-populism**—where respect for factual information and honest reporting are replaced by technology-driven political discourses—threatens the viability of democratic governance.[91]

The technological dimension of what's happening is clear: Mass media, the Internet, social media, and smartphones have become dominant forces in modern life. The sheer amount of information that passes through these channels and its impact are unprecedented. But the populist dimension of the movement is also clear: A reactionary sentiment is being fueled by authoritarian leaders and partisan media commentators who have little regard for truth.

Disregarding and discrediting the advice of esteemed scientists and other legitimate authorities together with the loss of trust in institutions, including credible news media, creates great uncertainty. The roles to be played by factual information and rational decision making in the future are not irretrievable but certainly have been placed in doubt.

Chapter Summary

Accurate information has always been a powerful evolutionary resource. The transfer of information from one person to another represents the most fundamental form of communication

undertaken by all forms of organic life. Utilizing factual information wisely allows us to reduce uncertainty and communicate efficiently. But information is proving to be more and more difficult to define and control.

Truth is best understood as information supported by facts. But truth is subjective, and for some people, it need not have a factual basis. Separating what is demonstrably true from ambiguous or false information requires critical thinking where facts, claims, evidence, reasoning, and inferences are carefully considered. These factors form the basis for scientific thinking. But emotional, belief-driven truth, often motivated by fear, has great influence too.

The technological landscape has changed in ways that make it difficult to manage information. As the number of information sources options expands, people drift toward niche media that appeal to their political and cultural biases. Echo chambers develop wherein individuals become exposed mainly to what they already agree with.

Fake news represents a significant global challenge to the integrity of information. Disinformation campaigns have influenced global politics and democratic elections. Some authoritarian leaders call anything they disagree with fake news and make up their own fake news to confuse constituencies. Conspiracies abound. The nature of cognition and the nature of news as a business explain some of the appeal of anxiety-producing information.

Trustworthy news sources are experiencing unprecedented threats to their freedom. As their credibility is disputed and their lives put at risk, professional journalists and other information specialists are fighting back to gain public trust.

Information has always played a role both in uniting and in dividing people. Advances in communications technology have intensified the polarizing effects. Information becomes the marker around which political and cultural differences are revealed. With science and other fact-based sources of information under attack, an evolutionary paradox puts the future of information in question.

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11

IDEOLOGY AND RELIGION

What many people think of when they hear the word "evolution" is the biosphere—a natural world teeming with billions of biological organisms that undergo constant change. But ideas evolve too. Doing so, they shape and continually reshape the ever-changing world of ideas in which we live—the ideosphere.

Biological organisms don't survive on their own. Neither do ideas. In the first part of this chapter, we explore how ideas are linked together as ideologies. Because religion has become the world's most powerful ideological force, it merits careful analysis for that reason alone. But for many people around the world, religious belief contradicts the very fact of evolution, especially human evolution. In the second part of this chapter, we explain how belief in the supernatural and communities of religious faith developed through wide-ranging communication processes, especially the force of ritual and cultural stories that have been told through the centuries.

Ideology

We begin the first part of the chapter by defining ideology. Then we trace the origins of this important concept and explain how dominant ideologies influence societies ranging from democratic capitalist countries, like the United States, to communist nations, like China. Next, we examine how ideology spreads, affects consciousness, and maintains its impact. We make the transition to the second main part of the chapter by introducing the connection between ideology and religion—theology.

What Is Ideology?

For purposes of our discussion here, **idea** refers to a way of thinking about something—a belief. But important ideas rarely stand alone. Over time, beliefs become organized into systems of ideas—ideologies. Ideologies are never innocent. They represent the values and aspirations of the individuals who support them. The *Oxford Dictionary* combines these characteristics into a clear and succinct definition: **Ideology** is a system of ideas and ideals.

For any system of ideas and ideals to be maximally effective, it must be internally consistent and communicated successfully. For example, feminist ideology asserts that women should have the same political, economic, and social rights as men. All those rights are ideas that fit together into an

overarching ideology—feminism. Feminist ideology can then be broken down into specific beliefs having to do with voting rights, reproductive rights, equal pay for equal work, and protection from sexual abuse in the workplace, for example.

The core ideas of feminism are widely known. But like all ideologies, the actual meaning of feminism differs from place to place. For instance, the core belief of feminists who live in Norway and India is similar if not identical—gender equality. But specific concerns about the nature of gender equality between the two countries reflect cultural differences. For example, the battle for gender-based educational equity largely has been won in Norway but not in many parts of India.

Ideology can refer to a system of ideas that makes up global sociopolitical movements like feminism, environmentalism, or civil rights. But ideology can also take a more particular form of interrelated ideas that define nation states, business organizations, schools, labor unions, even professional sporting teams, urban gangs, and rock bands. Usually, however, ideology refers to large-scale, often competing systems of ideas like the differences between capitalism and socialism as economic systems, contrasts in the governing philosophies of the Democrat and Republican political parties in the United States, or differences between religious faith and secular (nonreligious) thinking—an issue that will be discussed later in this chapter.

Origins of Ideology

The linguistic root of the word "ideology" derives from the early Greek language. In that language, *ideo-logy* means a discourse about ideas—a way of talking about things. But modern critical usage of the term originated with French philosophers writing in the late 1700s. For them, the emerging concept of ideology represented something truly important in human history—a science of ideas.[1] The French philosophers believed that physical force and coercion aren't the only ways to influence thinking and behavior. Systems of ideas—ideologies—have great persuasive power too.

Feudal societies in Europe had previously prepared people to think of their place in the world ideologically without realizing it. Ordinary people were told that the aristocracy rules over them by divine providence. Peasants suffer because it's God's will. Poor people will be rewarded in the afterlife if they obey religious authority on earth. Cultural traditions and rituals that originated during the Middle Ages reinforced the idea that the prevalent ideologies of the time should not be questioned.[2]

Writing during the Industrial Revolution of the early 1800s, the German philosopher Karl Marx advanced a theory of ideology to explain how the upper classes in capitalist societies gain and maintain power over working people.[3] Marx argued that differences between the social classes established in agrarian societies were being reproduced by the way workers were treated in the harsh realities of industrial production. He referred to the economic foundation of society—where industrial production takes place—as its **base** (**Figure 11.1**).

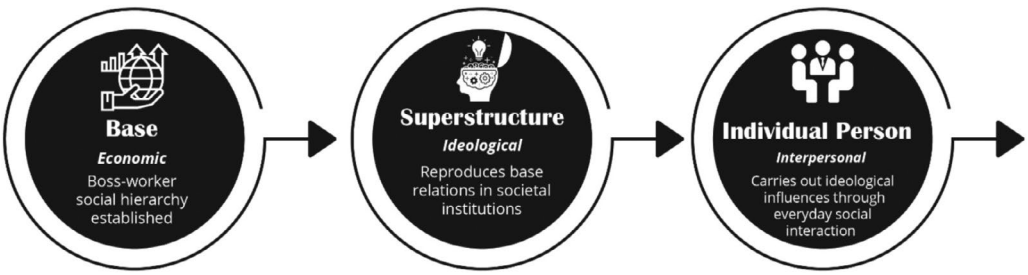

FIGURE 11.1 Critical theory of ideology

Domination of workers by bosses in the industrial workplace solidified and extended a sharp contrast between the social classes. The gap was maintained not only in the workplace but in a mentality of subordination that was being imposed on the working class. Social class domination was economic but also ideological.

The proposition that ideology functions as a potent social force representing the economic and political interests of the upper classes spread rapidly among critical thinkers throughout Europe in the middle1800s. Ideology was thought to be crucial to maintaining the influence exercised by the elites in society, what Marx called the "ruling class." Marx wrote that *the ideas of the ruling class (their ideologies) become the ruling ideas of entire societies.*[4] Ruling class ideas emerged from and continued to reinforce the divided social structure of feudal cultures.

Social inequality inhabits the entire range of social institutions in capitalist societies, including family, education, law, religion, and media, according to Marx. The totality of those institutions makes up society's **superstructure.** The superstructure reproduces the same kind of authority that bosses have over workers in the workplace in other settings. Interpersonal communication becomes the primary medium of control. For example, in families, fathers oversee their wives and children. In schools, teachers instruct their students. In communities, police regulate behavior. In religion, priests, preachers, rabbis, and imams command their congregations. Mass media reproduce relations of social domination through information and entertainment programming (**Figure 11.1**).

Dominant Ideology

Individuals and groups that occupy positions of power in every political-economic system—capitalist, socialist, authoritarian, or communist—apply pressure on their society's major institutions—especially the law-making bodies, military, courts, media, education system, technology sector, and science—to act in ways that benefit them. Constantly manipulating information to uphold the economic, political, and cultural interests of society's power holders produces a **dominant ideology**.[5]

Democratic Capitalism

In capitalist countries, especially the United States, the dominant ideology stems from a cultural history of rugged individualism and an economy that operates with minimal regulation. The melding of print, electronic, and interactive digital media campaigns sells consumer products and the political-economic-cultural infrastructure that goes along with them. Because media content in capitalist countries is not financed directly by government, its ideological tones and trajectories often go unrecognized by the public.

Democratic Socialism

Whereas individual rights and self-responsibility are stressed in capitalist societies, the responsibility of individuals to help maintain the community as a healthy whole is emphasized in socialist countries. Social guarantees like health care and public education are prioritized by the political system and national media. Canada, Finland, Norway, Sweden, and Denmark are prime examples of countries with strong socialist components. These democracies are among the most economically and culturally successful countries in the world. Cuba, Algeria, Bangladesh, and Sri Lanka are examples of less democratic and less successful socialist nations.

Authoritarianism

Dictators in highly authoritarian countries, like Russia, Syria, North Korea, Sudan, and Egypt, restrict access to information and communications technology in order to maintain political and economic control. They rule by ideological decree. State-sponsored ideology can reflect the whims of an hereditary dictator; the historical policies of a longstanding monarchy; or in the case of Iran, Saudi Arabia, Yemen, and the Vatican City among others nations, the dictates of religious dogma. Theocracies have become some of the most repressive authoritarian regimes in the world.[6]

Communism

Communism is an undemocratic blend of socialism and authoritarianism. In communist nations, including China, Vietnam, and North Korea, party officials develop explicit ideological objectives and lessons, which are sent to the people through media programming. For example, Chinese television, websites, radio, and print media present biased news reports, politically correct dramas, documentaries that praise the Communist Party, and didactic editorials. Communist ideology is straightforwardly prescriptive. The Communist Party claims to act in the best interests of the people, who, the government says, need and want ideological supervision.

How Does Ideology Work?

Just as language is learned, practiced, and reinforced in normal conversation, ideology becomes familiar in routine social interaction. Language gives people a tool for expressing themselves and exchanging information; ideology directs their thought processes toward particular ways of thinking and behaving. Language generates vocabularies and grammatical structures that shape communicative interaction; ideology creates frameworks for discussing topics that reinforce the interests of those who stand to benefit from the ideas.

Any belief system becomes influential when it is communicated persuasively to an intended population. Dominant ideologies can only become effective when they are circulated by communications technology and reinforced in conversation among families, friends, coworkers, teachers, students, neighbors, and social media contacts. When people refer to media messages and images in unmediated, everyday conversation or share them online, the ideological themes they contain are articulated and validated once again.[7]

Consciousness

Consciousness represents our first-person subjective experience of the world—including the ideologies we come into contact with and all the knowledge, beliefs, attitudes, opinions, and feelings we hold. Consciousness influences how we act. But how does consciousness develop?

Brain researchers today are investigating the processes by which our cell-based biological system produces consciousness, or what is commonly referred to as the **mind**.[8]

In biological terms, individual consciousness is created by a distributed system of nearly 100 billion neuronal cells, which incessantly fire electrochemical charges across different layers of the brain's architecture (**Chapter 5**). The network of neuronal cells processes incoming information in ways that transform the experience of perceiving the world into a retrievable store of conceptual resources.

Think of consciousness as a reservoir of bubbles racing around in a pot of boiling water. Each bubble represents an element of consciousness that has been formed by prior sensory input. Particular bubbles rise to the surface when they are triggered by new experiences. The bubbles interact

with what is happening around us as our minds flick from one thought to another. The way our minds interpret incoming information and activate a response in any situation is shaped by prior experience in the never-ending process of consciousness formation.

Consciousness does not presuppose complete or current awareness of everything we know or why we know it. Like fish that don't contemplate the existence or effect of the water in which they swim, people don't always reflect on how the material and symbolic environments in which they live shape their thinking. And consciousness does not always work in our favor. Some thoughts bubble up we'd rather forget about. Other thoughts get stuck in consciousness from mere exposure to information. For instance, even when people flatly reject ideas they get from mass media or social media, or think those ideas are not relevant to them, they do so only after being introduced to and, at some level, absorbing the subject matter to which they are exposed.

Ideological Influence

Ideologies do not act as perfect unities or closed systems. Three essential characteristics of human communication make absolute ideological control impossible.[9]

First, major ideological sources, such as governments, schools, or mass media, can never be completely consistent in their messaging. Social institutions all play different roles and are composed of people with diverse opinions that inevitably emerge to one degree or another. Second, communications technology is extremely difficult to manage by authority. For example, smartphones with photographic and video capacity are linked to the Internet, creating a level of transparency that makes power holders more vulnerable than ever before. Third, the intended meaning of any message cannot be imposed directly on people. Symbolic forms, including languages, are inherently open to multiple, diverse, and contradictory interpretations that reflect the needs, interests, and ambitions of those who decode them.

Nonetheless, resisting the force of dominant ideologies is hard work, even if we are motivated to do so. It's easier for people to keep believing what they already think is true or useful rather than challenge their values and beliefs, especially if those feelings are deeply held. The brain rewards conformity. We get a rush of dopamine when processing information that supports our beliefs, even if those beliefs are provably wrong: Guns make families safe, vaccines are harmful, and homeopathic remedies work.[10]

The ideas and images that enter our minds don't arrive randomly. Powerful social forces repeatedly inject ideas into our collective consciousness, while other systems of ideas get less exposure. We need another key concept to further explain how the currents of dominant ideology flow throughout the larger society with impact.

Hegemony

Ideology is a system of ideas and ideals represented in communication. Dominant ideologies make up the systems of ideas and ideals that are advocated by the economic, political, and cultural power holders in a society. Consciousness refers to the mental processes that store and reflect the totality of subjective human experience, including the ideological representations to which we are routinely exposed.

But what allows dominant ideology to permeate consciousness? **Hegemony** is an institutionalized and self-perpetuating method for gaining and maintaining social power by continuously planting and reinforcing dominant ideology in the collective consciousness of a population (**Figure 11.2**).

Ideology → Hegemony → Consciousness

FIGURE 11.2 Flow of dominant ideology

Mass media and communications technology are crucial to hegemony because they disseminate ideology widely, repetitively, and persuasively. Audiences are incessantly subjected to content that mainstreams them into stereotypical social roles they are prone to tacitly accept.[11] Ideological hegemony is accomplished in part by the widespread circulation of explicit messages that tell people in capitalist countries, for example, what to buy or who to vote for. But hegemony also works by the way media content frames social reality more abstractly. For instance, especially in consumer-driven societies like the United States, television commercials encourage audiences to think of themselves more as customers than citizens.[12] Americans are told they live in a "free society" and "deserve" to have nice things just by virtue of being alive.

In essence, society's most deeply entrenched and powerful institutions—schools, political parties, government agencies, trade unions, religious groups, and other social organizations—all depend on many of the same sources of political and economic support. Although they manifest surface disagreements, they are fundamentally aligned with each other. *This inter-articulating, mutually-reinforcing process of ideological influence is the essence of hegemony.*

Consent serves as a far more effective long-term means of maintaining privilege and control than does coercion or force.[13] Hegemony depends on the widespread acceptance of dominant ideology by the public as good and natural. Ideological assertions become taken-for-granted cultural assumptions. But the vast majority of people in a given population have to willingly accept the legitimacy of their social institutions for ideological hegemony to work. The ultimate test of hegemony's impact over a society is whether or not young men and women are willing to march off to war in order to defend the system in which they live.

Theology

So far in this chapter we have focused on how ideology shapes thinking in the political-economic systems of contemporary societies. But the evolutionary history of ideology extends back much farther to the conceptual origins of culture.

Gods and ways of worshipping them are ideological and dependent on hegemonic influence too. In the original Greek, theology means the study of, or discourses about, a god or gods. We'll take that definition a bit further for purposes of this chapter. Here, **theology** is defined as a system of ideas and ideals about a god or gods that is expressed in communication. Theology is the oldest and most extensive form of ideology. The primary social institution that puts theological hegemony into practice is religion.

Religion

Religion amounts to much more than discourses about gods. For many people, religion is intensely personal. It's a compelling way to think about the meaning of life and death, feel part of a close-knit community, and adopt a prescriptive moral code. Religion allows people to communicate comfortably with an imagined supernatural being and with other believers through language and ritual. Because of its widespread presence and unmatched influence around the world, religion may represent the most complex, influential, and controversial of all ideologies and social institutions.

In the following pages, we briefly outline the nature and scope of religion, explain its cognitive and cultural origins, and describe how complex forms of early human communication—cave

art, rituals, and narratives—shaped and continue to influence the evolution of religious belief and behavior. We identify the evolutionary functions of religion, explain the history and importance of religious narratives, and show how religious hegemony develops through communication. Finally, we reflect on the future of religion in the globalizing world.

What Is Religion?

Although religion is a uniquely human invention, we may not be the only species to demonstrate some form of spirituality. Research on chimpanzee troops living in various places along the West African savanna reveals that creating rituals related to the supernatural may not be exclusive to us.[14]

Using motion-activated video technology, scientists have watched chimpanzees repeatedly engage in behavior that has no apparent practical explanation—collecting and throwing rocks with purpose at trees. The chimpanzees first gather and place large- and medium-sized rocks on top of each other in hollowed-out tree trunks. Rocks piled up like this form **cairns** (pronounced "kerns" (**Figure 11.3**). Later the chimpanzees take some the rocks out of the crevices and throw them against the trees, leaving distinct marks on the trunks.

Most of the chimpanzees that do this are males. One possible evolutionary explanation for the behavior is that throwing rocks at trees represents a male sexual or dominance display. Striking the trees with rocks produces loud and low sounds that carry a long distance—consistent with traits of male sexual signaling.

This behavior represents the first time chimpanzees have been observed using tools (rocks in this case) to do something other than forage for food, make obvious sexual displays, clean their bodies, fight, or inspect their near environment (**Chapter 7**). If not for one of these reasons, then why do the chimpanzees engage in this behavior? Living organisms don't waste energy for no reason.

The researchers believe the chimpanzees may be marking "sacred trees." They note that the piles of rocks, the pattern of throwing the rocks, and the trees that are repeatedly struck correspond with two factors that characterize human rituals: (1) a strong association of a particular site with the collection of artifacts over time, and (2) patterns of ritualized behavior that have no other plausible evolutionary explanation. Moreover, the chimpanzees' actions resemble similar behavior by humans. Certain indigenous populations in the same part of West Africa also accumulate stones

FIGURE 11.3 Cairn made by West African chimpanzees

at the base of trees they consider sacred. Some indigenous Latin American groups make cairns to represent religious shrines and burial sites.[15] Originally, our hominin ancestors made cairns to mark boundaries and pathways.[16]

Religions have unifying ideological components and corresponding behavioral elements, including rituals, prayers, and other forms of social communication, that are related to religious practice. The beliefs and behavioral components of religion combine to represent reverence for and obedience to a god, gods, spirits, or other form of superhuman power.

Religion is pervasive. Based on census data, surveys, and population registers representing more than 230 countries and territories, about 84 percent of the world population claims some religious affiliation.[17] Christianity has the most followers, with 2.2 billion (32 percent); followed by Islam, with 1.6 billion (23 percent); and Hinduism, with 1 billion (15 percent). Buddhism and other religions, including Judaism, Sikhism, folk, and indigenous faiths, combine to make up another billion people (14 percent). About 1.1 billion people worldwide (16 percent) say they have no religious affiliation.

Because of their various cultural origins, religious populations tend to be concentrated geographically. Most Hindus and Buddhists live in the Asian-Pacific region. Islam is concentrated in the Asian-Pacific area, South Asia, the Middle East, and Africa. Christianity originated near Jerusalem but rapidly spread throughout the Roman Empire and has become the most widely dispersed religion.

Religion's Origins

How did a diverse mixture of ideas and ideals about gods, a commitment to sacred cultural values, and the presence of powerful symbolic iconography develop into belief systems that are held by the vast majority of the world's population? How do we explain the creation, ubiquity, and influence of the world's religions in evolutionary terms?

Religion emerged very late in human history. The main driver of evolution—natural selection—shaped the way religions flourished. Religions mutate like biological organisms. Variants arise. Some religious ideas catch on. But natural selection was not the starting point for the development of religious belief. Our instinctual thought processes played that role.

The Cognitive Component

The nature of complex cognition likely created the opening for religious beliefs to emerge among human populations.[18] **Cognition** refers to the mental processing of information—what we sense, perceive, and come to understand through sensory experience. We are innately driven to make sense of the complexities we encounter in our physical and social environments. This sense-making behavior likely predates the evolution of our species and became instinctual over time.

By five months old children recognize the difference between animate and inanimate things. Soon thereafter they look for causes of the actions they observe and attempt to discern any intentionality that lies behind those actions. Even young children develop theory of mind; they come to realize that other people and animals have mental orientations that may differ from their own.

If no person or other physical source can be identified as the cause of an action, children instinctually invent make-believe causal agents, especially when they try to understand threatening or mysterious events that impinge directly on them. The nature of human cognition makes children vulnerable to **magical thinking**—subjective, often irrational or wishful explanations of what causes certain things to happen in the physical world. The direction the fantasy takes for children

can be guided by adults. For instance, many children in Western cultures are told that Santa Claus or the tooth fairy exist and will bring them gifts or money.

Adults leave Santa Claus and the tooth fairy behind, but many continue to practice other forms of superstition that grow out of magical thinking. For example, they might blow on dice to muster special advantage when gambling in Las Vegas, hang a protective dream catcher over their bed, or ask a god to cure the cancer that has just stricken a family member. Magical thinking also prompts many adults to look for undetectable causal agents when they ask the most perplexing existential questions: How did I get here? What's the meaning of life? Where do I go after I die?

The close connection that develops between earth-bound humans and the supernatural agents they imagine is facilitated by communication. For example, many parents encourage their children to make a written list (in any language) of presents they would like Santa to bring them on Christmas. Santa responds overnight to at least some of their requests and may even leave visible evidence of his visit—thereby validating an unusual but immensely rewarding two-way relationship young children believe they are developing.

Adults communicate with ethereal agents in many ways. Normal thought processes intermix with fantasies about supernatural intervention. For instance, religious adults might ask a god to give them a sign indicating what to do when pondering possible courses of action in response to a challenging situation. After praying and thinking about the problem, and talking about it with other people, the adult decides to do one thing or another. The person then credits their god for sending them sanctified advice. The "magic" of magical realism lies not just in the fantasized potency of supernatural beings but in the way humans believe they communicate personally with those beings.

God can easily become the default cause of unexplainable events and a limitless resource to be called on, especially in times of need. Thousands of gods representing a wide range of physical appearances, personalities, and characteristic behaviors have been imagined and consulted mentally throughout history. For example, Zeus (the supreme god of the ancient Greeks), Marduk (the Babylonian god of creation), Jupiter (the supreme god of the Romans), and Huehueteotl (the god of the Aztecs) were worshipped with even greater intensity than today's deities are idolized.[19] All the original gods and most of their descendants were discarded long ago or have been transformed repeatedly into newer versions as cultural conditions changed.

The predisposition to believe that a powerful, unseen, but somehow tangible force exists did not have to lead to the invention of religion.[20] Our brains don't automatically name the gods we dream up, create elaborate belief systems around those deities, or build complex religious institutions. The roots of **monotheism**, the exclusionary idea of "one true God" who oversees morality, arrived very late in religious development. So did Buddhism and Confucianism, which claim no supreme being. Other recent faiths, Hinduism and Daoism, for example, worship multiple gods. The emergence of religion resulted from the way human cognition and emotion interacted with Sapiens' long-term social and cultural development in particular cultural contexts.

Religion and Culture

To understand how religion became the extraordinary cultural phenomenon it is today, we must revisit our hunter-gatherer roots.[21] Our immediate ancestral predecessor, Erectus, developed hunting and gathering as a cooperative survival strategy two million years ago. Anatomically modern Sapiens followed as hunters and gatherers beginning about 300,000 years ago (**Chapter 2**). The social and ecological contexts that Sapiens groups have inhabited since then shaped today's diverse cultures.

Shamans

The social structure of early cultural groups changed when Sapiens developed more stable populations, especially over the past 50,000 years. An increasingly diversified division of roles emerged within the groups. The **shaman**—a tribal member who pretended to summon good and evil spirits and give them symbolic presence—emerged as the witch doctors and medicine men of early human cultures.

Shamans became uniquely influential in their groups by exploiting people's primeval fears and fantasies—fertile psychological ground for the invention of belief systems based on superstition. *The pathway to religious belief then and now began with magical thinking that is given direction by human agency.* Shamans would become the rabbis, priests, mullahs, ministers, monks, and gurus of contemporary

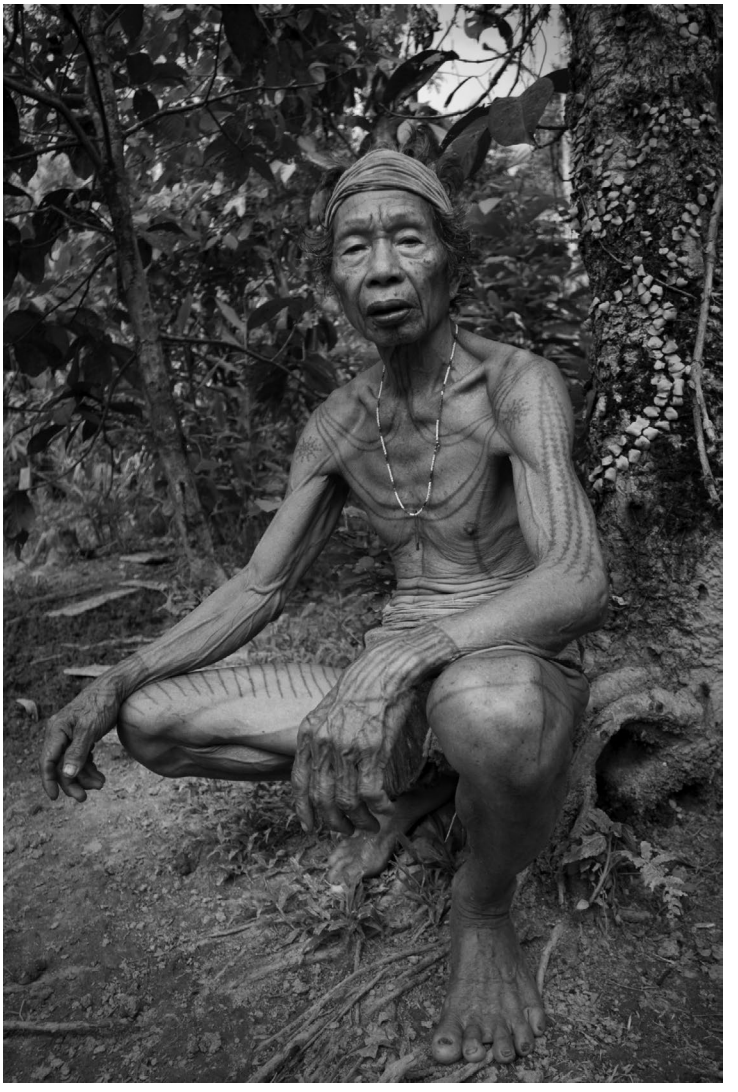

FIGURE 11.4 Modern-day shaman of the Mentaway Islands, Indonesia

religions. Shamans put the idea in tribal members' heads, or exaggerated an illusion they already held, that a knowable, powerful, and potentially charitable force acts with knowledge and intention outside the range of normal human perception.

Our Sapiens ancestors could identify the cause of most things that happened in their lives and respond in ways that advanced their individual and group interests. But they had no explanation for what causes natural phenomena, like lightning and thunder, or human tragedies, such as the sudden death of a child.[22] Major events—including birth, death, disasters, and tragedies—apparently take place outside human control.

Shamans presented themselves as intermediaries who could communicate with and influence the invisible spirits responsible for threatening events like these. The shamans played with probabilities and coincidences. For instance, imagine a scenario where the sky darkens ominously, birds and other animals become restless, and a strong wind suddenly dies down. Apparently a powerful thunderstorm is approaching. The shaman implores the spirits to send the storm away. By happenstance, the skies lighten and the storm abates.

The propensity for magical thinking isn't the only way the human brain prepared our ancestors for religion. Chemical reward also plays a role. Uncertainty about what causes uncontrollable things to happen can be psychologically troubling but emotionally exciting at the same time. A present-day example from casino gambling reveals why the greatest sense of exhilaration stems from moments of doubt and uncertainty: It is during the few seconds when the symbols on a slot machine are spinning, *not* the moment when the cherries line up on the same row, that dopamine shoots its narcotizing effects through the brain.[23]

In part because of this chemical reward, peak moments of uncertainty could have coaxed our ancestral tribal members into belief. Some unseen *something* must willfully bring about lightning, thunder, and torrential rain. The shaman apparently could influence that actor.

The mystifying and seductive appeal of magical thinking and exploitation of that appeal by shamans served as the foundation upon which religious belief and behavior would evolve. But the occult roots of religion had to broaden for our ancestral cultural groups to maintain internal solidarity. As part of their overall cultural development, Sapiens created extraordinary new forms of symbolic communication—cave art, religious rituals, and religious narratives.

Cave Art

Spiritual invocations issued by shamans were greatly embellished by some of the first forms of visual communication produced in human history—simple drawings and paintings that adorn the walls of deep caves located in southern France and northern Spain.

Among the images appearing in three of the Spanish caves are patterned red dots, ladder-like shapes, hand prints, hand stencils, and various simple animal depictions. The images were created from red-and-black ochre pigment, the same kind of material that was used to make the crude paintings found in the Blombos cave of South Africa and other parts of the world.

Some of the paintings in Spain date back 65,000 years. Research confirms that it may have been Neanderthals, not Sapiens, that made the oldest cave art in Europe.[24] Neanderthal tribes had occupied European caves for 20,000 years before Sapiens migrated to the continent. The fact that cave art perhaps did not originate with Sapiens is not surprising. Cave drawings have also been found in Indonesia that are as old as those in Spain.[25] Painting as symbolic communication likely developed in Africa before some of our ancestors left.

Because of their unrefined physical characteristics and the common belief that they lacked intelligence and creativity, Neanderthal has often been reduced to a comedic caveman stereotype. Their demise was said to be inevitable. As the story goes, Sapiens arrived in parts of Europe that were

occupied by Neanderthal, outsmarted the brutish species, and drove them to extinction. Sapiens' superior communication ability was widely thought to be a major reason they outcompeted Neanderthal in their home territory.

The Spanish cave paintings suggest a different possible conclusion: Neanderthal may have had the brainpower to conceptualize and create symbolic forms. They certainly had some form of spoken language. Furthermore, Neanderthal and Sapiens interbred significantly. In key respects, Neanderthal and Sapiens are more similar and closely related than previously thought. The two human species coexisted for thousands of years. Although conflict between the groups was likely, they apparently were not engaged in any winner-takes-all ethnic warfare. Neanderthal more likely was unable to adapt to the changing climate.

Sapiens added many images to caves previously occupied by Neanderthal. Sapiens also discovered many new caves they used for artistic and spiritual expression. Geometric shapes—dots, hooks, crosses, rectangles, stars, and straight lines—were among the first images Sapiens created.[26] Later, images of nature were added. Bison, mammoth, bear, deer, and horses—each symbolizing a distinct kind of power—were common subjects. The images were organized into patterns that express the artists' thoughts and feelings but do not reveal any narrative qualities.

Sapiens made tools specifically designed to produce cave art. Flint tools (**Chapter 7**) with a blunt edge were used as chisels to engrave the walls. Concentrated deposits of colored pigment were stored on the floors. Crayon-like sticks made from mineral deposits were used to sketch outlines and fill in colors. A drinking straw made of natural materials was used to blow a solution of ochre and water over stencils or the artist's hand to make images on the walls.

These specialized artists' tools represent a significant investment made by Sapiens to develop expressive media. The social and cultural benefits that symbolic forms like cave art brought to the tribal groups must have outweighed the cost of time and energy required to produce them. Symbolic expression was becoming an integral part of life. Cave art was the precursor to development of increasingly elaborate symbolic systems, including rituals, that would emerge during the cultural Great Leap Forward starting 40,000–35,000 years ago (**Chapter 9**).

FIGURE 11.5 Cave art, Lascaux, France. Courtesy of thipjang/shutterstock.com

Ritualized Communication

Long before the Great Leap Forward, cave art had been integrated into cultural practices that led to religion. Locations in the caves where the cave paintings appear reflect distinct ceremonial and ritualistic qualities.[27] **Rituals**—solemn ceremonies where a series of actions are performed repeatedly in a prescribed order—function today as one of the most unique and significant forms of human communication. Rituals mark important events in every culture and have been part of daily life for Sapiens for tens of thousands of years. But rituals did not originate with Sapiens, Neanderthal, or any other human ancestor.

Non-human apes and other animals also perform rituals. All the great apes and many other animal species perform distinctive courtship rituals before mating. Chimpanzees, dolphins, and elephants carry out death rituals. After chimpanzees fight, the loser makes distinct submissive noises and despondently offers a hand to the victor. The dominant chimp then either rejects the offer of reconciliation, sometimes by biting the hand, or accepts it, by embracing and kissing the defeated individual.[28] Elephants, dogs, dolphins, and pre-school-age children (who provide excellent insight into animal behavior) also reconcile. As we've seen, chimpanzees ritualistically build cairns and throw rocks at "sacred" trees.

Ritualistic behavior must have been adaptive for the pre-human primate ancestors we have in common with these other animals. Endless repetition of particular behaviors over the millennia fused ritualistic behavior into our genes. With the psychological bent for ritual in place, human cultures later determined how that impulse would be channeled—what the rituals would represent and what they would look like.

Whether performed for spiritual, sexual, or patriotic reasons, rituals excite the emotions. An increased level of excitement can alter consciousness. Think of the thrill extreme athletes feel when they push their bodies to the limit, for example, or what military families experience the moment they reunite after a long absence. Some American Indian tribes dance to exhaustion to develop a deep spiritual commitment. Moving for hours to electronic dance music can create the same effect. Those feelings only approximate the euphoria many religious people experience when they close their eyes, raise their hands skyward, and sway back and forth in song or prayer. Rhythmic body movements—especially when performed collectively in rituals—release the happiness chemicals—dopamine and endorphins—in the brain.

Many religious rituals entail great physical punishment that elicits strong emotional and chemical rewards. Crawling on the knees, walking in long processions, and self-flagellation stimulate rapturous feelings. Other religious rituals exact great cost or bring about significant personal inconvenience—orthodox Jewish clothing requirements, Amish denial of technology, or the undertaking of the expensive pilgrimage to Mecca by Muslims, for instance.[29] Extreme rituals allow participants to send clear signals of devotion to a god. At the same time, they bring religious communities together and help sort out authentic believers from pretenders.

More subdued and commonplace ceremonial rituals also signal obedience to a god and help build community. Religious congregations bow their heads or lower their bodies in unison to pray, sometimes utter prayers in shared vocal cadence, stand up to sing hymns together, place money in the collection plate as it passes by, count prayer beads, and make many other displays of personal and communal deference and devotion. Repetition validates the rituals, intensifies their emotional and cultural effects, and commits them to memory.

Acoustical elements heighten the impact. Many of the cave paintings in France and Spain were created in the deep recesses of the labyrinthine caverns—locations that lend themselves acoustically to drumming and chanting.[30] Some of the caves were likely used for various initiation ceremonies.[31] The combined effect of a shaman's incantations, schematic paintings on the walls, group

chanting, and drumming accompanied by flickering torch light in the pitch darkness surely would have been captivating and intimidating.

Just as chanting and drumming led by shamans surely impressed their followers, religious music produced in later stages of cultural development has had a similar effect. Awe-inspiring cathedral organ music was the loudest human-made sound that medieval peasants had ever heard, helping to demonstrate the apparent validity and importance of a god and religion.[32] The majestic sound of religious music in recent Western religious traditions—George Frideric Handel's "Hallelujah Chorus" may be the best example—provokes thrilling emotional reactions.

Some religious experiences activate the same areas of the brain that stimulate other deeply pleasurable feelings brought on by love, sex, and drugs.[33] Adding music to religious rituals produces nearly the same neural and biochemical reaction—a strong dopamine rush that intensifies the theological effect.[34]

Religious belief is deeply connected to ritual and amplified by sound—inside and outside places of worship. Calls to worship broadcast by loudspeaker five times a day from minarets in the Islamic world reach everyone in the community. Church bells toll on Sundays and holidays in Christian-dominated communities.

Social Status

Another way to analyze why religion became so pervasive and potent is to ask: Who benefits from the spread of religious belief and in what ways do they profit? To answer these questions, it helps to distinguish between the *producers* and the *consumers* of religious belief and behavior.[35]

Complex social hierarchies form when cultural groups become larger and more developed. Some individuals ascend to the top of their social structure, while others occupy more common positions. By virtue of their apparent special powers, shamans held a special place in the social hierarchies of ancestral groups, much like religious leaders do in many societies today. In part because no scientific explanations were available at the time to provide perspective on the proclaimed powers of magical thinking, shamans benefitted from their unique status as the apparent possessors of great knowledge and wisdom. For this reason, shamans likely had privileged access to group resources and sexual partners.[36]

Shamans laid the groundwork for the powerful social role of clergy as religious belief took a more central place in culture over the millennia. From this platform, a worldview orchestrated by religious authority emerged. Various forms of social control—ancestor worship, food taboos, rites of passage, initiation rituals, and sacrifices—were installed as cultural customs. These and many other injunctions and rituals—all subject to oversight by observant and exacting gods and their earthly representatives—became increasingly elaborate, emotionally charged, and persuasive.

In addition to spiritual guidance, tribal members depended on shamans for access to herbal medicines and folk remedies that may have helped relieve some of their physical maladies. Mixing beneficial treatments with occult knowledge, trance-inducing drugs, magical incantations, and ceremonial staging enhanced the shamans' credibility.

The real and imagined benefits provided by shamans set the stage for the development of religion as a principal domain, often *the* principal domain, of cultures around the world. But what about the consumers of religion? What motivates so many people to invest so much time, emotion, physical energy, and money into a system that demands unquestioning belief in an empirically implausible essence and steadfast willingness to obey strict religious requirements? Why did religion evolve to become such an enormously influential ideological and cultural force?

Religion's Functions

Most people correctly believe they can better face the unknown and overcome threats to safety with others they trust. Collective religious belief embedded in cultural norms solidifies and extends that trust.[37] Religion continued to grow over the millennia as an unparalleled source of inspiration and utility for many reasons:

Inspiration

- Encourages people to believe a sympathetic supernatural power watches over them personally, listens to their prayers, and is capable of answering prayers to their benefit
- Gives hope for life after physical death
- Provides answers to seemingly incomprehensible questions about life's meaning
- Presents captivating narratives, architecture, art, and music
- Delivers pleasurable biochemical rewards, especially during rituals

Utility

- Offers community support and consolation
- Provides a roadmap for life
- Provides a focal point for developing a strong personal and cultural identity
- Prescribes moral codes and attempts to enforce them, creating a sense of moral uprightness
- Makes appropriate potential mates available
- Supplies a shared language for communicating in a comforting way
- Regulates the flow of life experience with regular calls to prayer, services, meetings, and other social gatherings

The appealing idea that a powerful and helpful supernatural force that cares deeply about people in exchange for submission, worship, and responsibility to the religious community became part of consciousness. The religious imagination and growth of religious institutions were further galvanized by telling sacred stories.

Religious Narratives

Narratives describe sequences of events, supply emotionally engaging characters, and dramatize what happens in ordinary life. Stories can make imaginary events seem coherent and real, even if the main elements of the narrative are demonstrably untrue. Many narratives have a point of view—"the moral of the story." In the case of religious narratives, stories provide inspiration, rules, and requirements for living.

Stories and storytellers help keep cultures together. Sapiens were telling stories before some of our ancestral groups left Africa (**Chapter 5**). Later, shamans and priests created stories to enhance their messages and solidify their place as spiritual leaders. As cultures developed into civilizations, some of those ancient tales mutated into the mythologies and folklore that would become the narratives religious groups embrace today. *Contemporary religions are the products of creative storytelling that has been refined, repeated, and circulated over the centuries.*[38]

Myths are traditional stories composed of real or fictional events or a mixture of the two. Myths endure because they articulate important principles that resonate with cultural values. **Creation myths** are foremost among these kinds of stories. Creation myths poetically describe how a god

initiated a series of miraculous events that gave birth to the Earth, sun, stars, and all the elements of nature. Everything that became part of religious teaching follows from the creation myths.

Creationist or "birth of humanity" stories expressed in religious and cultural mythology are deeply ethnocentric. For example, the Garden of Eden resembles what people in an agricultural society in the Middle East might have imagined more than 2,000 years ago. In Asia, a Chinese cultural legend contends that God Pan Gu floated for 18,000 years through a cosmic black egg until he smashed it open, created the universe, and separated heaven from earth. Even today members of North America's Havasupai tribe learn from their elders that Arizona's Grand Canyon is the birthplace of all humanity, despite their knowledge of scientific evidence that invalidates the story.

Religious narratives all have an inspirational protagonist. Much like what happens in superhero movies and many video games, the protagonist fights to overcome tremendous adversity. For Christians, the central character is Jesus—a humble carpenter, born of a virgin, sent by God to save the world, who performed miracles, died on the cross for the sins of humanity, rose again, and ascended triumphantly to heaven. For Muslims, a story is told about the prophet Muhammad—an illiterate, ordinary, oft-married man, a military hero who was chosen by God to receive the final and true revelation and establish, by physical force if necessary, the rightful place on earth for obedient followers of the morally superior faith.

Religious stories enchant and persuade because they tap into a wide spectrum of human emotion and invite the listener or reader to participate in the fantasy. Religious stories first enter consciousness when young children are socialized. Our brains have gradually adapted to perceive, organize, store, and employ information that increases our chances to survive and reproduce, even if the origin of that information is only the imagination.[39]

The original sources of primary religious texts have not been reliably traced. Over the centuries religious narratives have been interpreted in various ways and translated into many languages. Nonetheless, the stories are routinely told as if they accurately represent past events. Young children and scriptural literalists are the individuals most likely to hear religious narratives as factual. But most religious authorities today continue to base their claims of doctrinal knowledge and high moral standing on various versions of the same ancient stories.

Control over the circulation of cultural myths has been crucial to religion's development throughout history. Managing the stories in ways that promote the interests of religious leaders was less problematic when spoken language was the only communications medium. After written language was invented, elites in traditional societies had to struggle to maintain control over the production and consumption of all kinds of information (**Chapter 6**).

Writing eventually led to the invention of print media technology (**Chapter 8**). The printing press radically altered the realm of religious storytelling and chiseled away at the structure of religious authority in Europe. Books began to be published in all major European languages. Literacy rates increased dramatically.

Scientific Influence

Religious authority faced another strong challenge around the same time the printing press was invented. Up until about 500 years ago, Christianity, Islam, Buddhism, and Confucianism all preached that answers to the major existential questions were already known.[40] Religious institutions had been well established as unassailable sources of knowledge and wisdom. But new discoveries in astronomy, physics, chemistry, medicine, and other emerging sciences began to contradict religious explanations about the physical world. For example, stories of miracles—indispensable components of mainstream religious belief—were refuted one by one as scientific inquiry advanced.[41]

The credibility gap between factual claims made in religious narratives and the findings produced by scientific research begins with the conspicuous discrepancy in explanations about the age of the Earth. Orthodox Jews, Evangelical Christians, and some Muslim groups still overwhelmingly favor the idea of young earth creationism—an idea taken from the Torah and Old Testament that God created the Earth in six days about 6,000 years ago. Scientific data places the actual origin of our planet at about 4.5 billion years ago. The biblical claim thus amounts to only .0001 percent of the actual age of the planet. Moreover, no evidence of godly intervention has been found or is needed to understand the origin of the universe.[42] When the Bible was written, people also thought the Earth was flat and the sun revolves around the Earth.[43]

Many religious individuals no longer take the biblical narratives literally. Most modern religious leaders have converted claims about the creation myths and other traditional stories from factual accounts into metaphorical allegories that symbolize what the literal truths were meant to mean.[44] An increasing amount of scientific data today is being imaginatively inserted into creationist arguments.[45]

Some areas of scientific inquiry—especially anything concerning evolution—continue to be denied by many people on doctrinal grounds. Even in the face of overwhelming evidence, religious belief can still inoculate people against challenges coming from science. Claims made by other religions hold no weight. For evolution deniers, the truthfulness of religious belief remains nonnegotiable. Born-again Christians are implored to surrender to God without reservation. Islam means "to submit." In extreme cases, some people willingly give up their lives or kill their own family members—honor killings—because they believe their religion requires them to do so.[46]

CAN RELIGION AND SCIENCE COEXIST?

Religion was recognized as a respected social institution long before science reached that status. But even our ancient ancestors had to think in a scientific manner. Survival requires the ability to examine factual evidence and draw logical conclusions.

Primitive religions originated in part from crude attempts at scientific reasoning. The various creation myths were early efforts to explain how everything got here. But pre-scientific speculations about the complexities of cosmology and the material world were pure conjecture. To make measurements about observed phenomena and carry out experiments, scientists need technologies. The printing press was crucial to advancing these ambitions. Manuals that helped researchers make mathematical calculations started to be circulated widely. Optical technologies that extend the human ability to examine objects closely—the microscope and telescope—were invented during the same period.

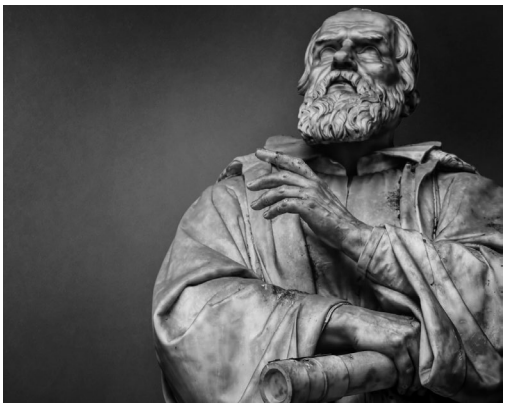

FIGURE 11.6 Galileo Galilei. Courtesy of ArTono/shutterstock.com

Grinding glass for his own long-distance telescope, the Italian astronomer Galileo Galilei was able to observe the

surface of the moon, the satellites of Jupiter, and the Milky Way. Galileo's observations and interpretations validated the Copernican hypothesis: The Earth revolves around the sun, not the other way around. The universe is infinite; the cosmos was not made for humans alone.[47] Because of those discoveries, Galileo was condemned as a heretic by the Catholic Church. His scientific breakthroughs contradicted the Church's narrative about the origin and meaning of life. Galileo was forced to recant the truth of his scientific work and live out his last years under house arrest.

Ever since Galileo's unwelcome discovery, religion and science have been at odds philosophically. Some people of good will have tried to resolve the rift in a way that credits both sides. One essay, written by an important scientific authority, stands out. American evolutionary biologist Stephen Jay Gould, who himself was not religious, attempted to find a satisfactory accommodation between religion and science in his article, "Nonoverlapping magisteria," or NOMA.[48] The plural form of magisterium, **magisteria**, refers to well-defined areas of teaching authority.

Gould argued that no conflict exists between science and religion because they occupy separate domains of scholarship—nonoverlapping magisteria. According to him, science is about the empirical constitution of the universe. Religion is about values, morals, and the spiritual meaning of human life.

Because of its challenge to religious authority, the science of human evolution became emblematic of the territorial dispute. It's also the ground on which compromise between the two sides has been sought. Except for fundamentalists of all faiths, most religious authorities no longer deny the fact of evolution. They admit the human body evolves. More than a third of the American population believes in theistic evolution—that evolution is real but a god guides the process.[49] Nonetheless, most religious authorities continue to insist on an idea that was introduced by our primitive ancestors—that an immaterial and immortal soul has been divinely infused into each human being. Science hasn't been able to locate the soul because it's said to be part of the spiritual side of nature, not the physical side.

Gould wrote that he personally could not accept the idea of a scientifically undetectable soul. But he was willing to grant religious authorities the right to make that argument, even if only metaphorically, because he believed their claim doesn't contradict the magisterium of science. Above all else, Gould was trying to help create a reasonable and respectful discourse about what he thought was an unsolvable debate.

Other scientists are less interested in creating harmony between the two sides because they feel no genuine debate exists.[50] They argue that the magisteria represented by scientific and religious authorities, particularly on questions of evolution, *do* overlap. No credence can be given therefore to the existence of a soul, the reality of miracles, or the power of prayer. Most important, to allow religion to reign over questions of morality implies that morality and other human values cannot be studied and understood scientifically, which, as we shall see in the next chapter, is not the case.

Science and religion have different methods for producing claims about reality and arriving at conclusions about the nature of the universe. For religion, the basis for claims is faith that springs from emotion and speaks to personal beliefs. For science, the basis for claims is empirical evidence subjected to rigorous interpretation to test the validity of ideas and establish facts.[51]

Religious Hegemony

The realm of the spirits was not ideological at first. The precursors to modern religion filled that gap. Loosely related beliefs concerning plants and animals, the sun, the night sky, myths, and rituals administered by shamans were performed in tribal communities with great creativity and communication skill.

But as cultures progressed, existential questions turned increasingly complex. People became more and more enamored with the supernatural. Social forces organized to develop and promote religious belief. Still, even the most primal belief in the existence of a "universal creator" and "all seeing deity" was not formed by human populations until relatively late in our cultural development.[52]

Spiritual beliefs based on an omnipotent god eventually grew into systems of ideas and ideals—religious ideologies. In turn, those ideologies influenced the development of culture. In the process, religion ascended to become a primary axis of cultural transmission in most societies.

Religious belief systems served as focal points around which many cultural groups organized themselves socially, clarified their values, and created emotionally reassuring anchors of personal and group identity. *Ideology and identity fuse through religion.* The experiential self submits to the narrative self—religious fictions and the authorities that oversee them.[53]

The word "religion" derives from the Latin verb *religare*, which means "to tie or bind." The appeal of religion ultimately rests in the functional advantages the religious community provides for its members. Today's charismatic leaders personalize the sources and mandates of religious authority by unifying their faith-based communities and encouraging the groups' members to cooperate more fully with each other.[54] Purifying the ethos of religious culture and transmitting the belief system from generation to generation help groups work together with common purpose toward shared goals.

The hegemonic effect of religion depends on the converging influence of communications forms. As the centuries went by, sacred symbols were created to serve as sources of identity and solidarity for religious sects, especially when differing groups came into contact and competed for resources. Religious iconography and architecture continue to serve as extraordinary communications media today. The most recognizable contemporary symbols—the Star of David, Christian Cross, and Islamic Crescent moon—were created to identify religions based on the patriarch Abraham and his descendants. Today's impressive synagogues, magnificent churches, and beautiful mosques reproduce and magnify the spine-chilling ambiance of places of worship that originated in the caves where tribal shamans mesmerized their followers.

Religious hegemony is ideological but also geographical. The concept of a personal god with moral concerns began when nomadic groups formed agrarian societies. Their origins clustered remarkably close together. The same parts of the Holy Land are claimed by Jews, Christians, and Muslims, for example. Mecca and Medina in Saudi Arabia define the vectors of Islamic history. Varanasi, a city in north central India, is sacred for Hindus. Buddhists make pilgrimages to Bihar, India. Religious absolutism was later used by the political and religious elite to hold the Roman Empire together. Regional Islamic caliphates dominated thought during the Middle Ages.

The political and cultural order that was shaped by religion over many centuries remains hegemonic today. Political and religious power holders in many nations work together to maintain stability in their governing activity so that potentially disruptive forces can be kept at bay.[55] Officials who rule over Islamic theocracies, like Saudi Arabia, Iran, and Sudan, prescribe acceptable social behavior based on religious teachings and punish wrongdoers severely. About half the population

of Pakistan, Jordan, Malaysia, Senegal, and the Palestinian Territories agree that their legal system should strictly follow commands from the Quran.[56]

To endure as a dominant political and cultural force in a democracy like the United States, religious ideology has to become an assumed part of everyday life in more subtle ways. Interpersonal communication cements the ideological elements together in everyday life. That process starts when young children are socialized by their parents, schools, and government agencies with a worldview that is consistent with what the religious institutions preach.

Fundamentalism

Religion evolved because it was adaptive for individuals and the cultural groups to which they belong. Religion can give people a feeling they occupy a relatively safe, familiar, and trusted physical and psychological space. But religious groups lean increasingly inward as they become more confident in the bonds they think they develop with their deities and more certain of their moral positions and commitments. Extremist elements emerge from this mindset, especially when some in the religious community feel physically threatened or believe their core beliefs are under siege.

The term "fundamentalist" first arose in the early 1900s in the United States as a reference to Protestant groups whose faith was based on a literal interpretation of the Bible. Evangelicals are by far today's most prevalent influential Christian fundamentalists, and not only in the United States. Evangelical Christianity has become very popular in Latin America and parts of Asia, for instance. But Evangelicals are not alone in the intensity of their convictions. Religious fundamentalists of all faiths become convinced of the absolute authority of their sacred texts and teachings. Believing they have exclusive access to a god justifies fundamentalists' confidence in their sense of moral superiority and the right to deny the claims of competing ideologies.[57] Because fundamentalists' core religious beliefs cannot be challenged within their groups, each new generation inherits the ideology and animosities of its predecessors.[58]

To "evangelize" means to try to convert others to a particular version of Christianity. In Western countries, religious fundamentalists inside and outside government try to create alternative institutions like faith-based schools to compete with and in some cases to overtake secular institutions, like public education.[59] They support political candidates who are favorable to their causes.

Islamic theocracies act with a fundamentalist mentality at the government level and set control over communication as a main priority. They operate state-run communications media as religious agencies, enforce cultural conformity, and censor outside influence, especially international television and social media. Blasphemy laws prohibit any criticism of Allah or the Prophet Muhammad. Jihadist terrorism emerged from this mindset.

The foundational principle of biological and cultural evolution is adaptability—including the capacity and willingness to learn and apply new things. Like useful tools, good ideas get copied. But people tend not to learn from others when their belief system shuts out innovation and external influence.

Scholars in the Greater Middle East invented algebra, geometry, and medicine during the Golden Age of Arabic Science from 1,100 to 800 years ago. Today 46 Muslim countries contribute less than 1 percent to scientific literature, and what little is offered is of lower quality.[60] Two historical Muslim clerics have been blamed for the decline of Islamic civilization because they could not accept knowledge that didn't originate in Islam. Logic, mathematics, and physics were ruled incompatible with the religion. Religious madrassas began to take the place of public education in many countries centuries ago.

The Islamic world never experienced a cultural moment that approximates the Reformation or Enlightenment. No vocabulary in Arabic expresses the idea of new ways of living. Some cultures become progress prone over time; others become progress resistant.[61]

The inability of strict religionists of any faith to critically scrutinize their belief systems has cultural and neurological causes. Because they base their worldviews on religious doctrine, fundamentalists' religious beliefs automatically defeat facts and theories produced by scientific research. That's the cultural part. But lack of openness to new or alternative ideas has also been traced to diminished functionality in different parts of the brain, especially two regions of the prefrontal cortex, making it difficult for fundamentalists to change their beliefs when confronted with new factual information.[62] Those parts of the brain reinforce religious ideological hegemony by maintaining social harmony for the group and cognitive consistency for the individual.

Willful ignorance of verifiable truth represents confirmation bias in the extreme (**Chapter 10**). It's no coincidence that the fake news trope and strident denial of climate change became hallmarks of a political movement supported by religious fundamentalists. Science is inherently threatening and humbling. Fundamentalism requires that individuals should not think openly or critically and be proud of that unyielding stance.

American Christian Hegemony

Most American religious fundamentalists support a ban on abortion, oppose same-sex marriage, hold exclusionary views on immigration, are skeptical about climate change, resist multiculturalism, and want their faith groups to be protected by the government. They depend on political office holders to implement and sustain their agenda.

The close alliance that was struck between white Evangelical Christians and Donald Trump is a particularly clear example of how a religion-politics partnership can advance the interests of both groups in a democratic system. Evangelicals voted as a bloc for Trump, helping him win the presidential election. Their post-election reward included appointment of conservative judges thought to be likely to overturn abortion rights, attempts to ban Muslim immigrants to the United States, and the loosening of regulations that give businesses more freedom, often at the expense of the environment.

Ongoing efforts by some groups to create a Christian hegemony in the United States are based on the myth that the country was founded as a Christian nation. The idea that the United States should be governed by Christian ideology is still advocated by the majority of white Evangelical Christians and about half of all residents in America's southern states.[63]

Justification for establishment of American Christian hegemony was expressed by some of the very first immigrants to the New World. Colonial state governments granted the Pilgrims, among the original immigrants, the freedom to practice their various Christian religions in America. Even though many Pilgrims were escaping religious persecution in Europe, many of their leaders attempted to impose their faith on colonial populations.

An intertwined dual identity—religious and national—was being formed in the minds of some early Americans.[64] But the founders of the federal government took steps to insure that the young country would not affiliate with any religion. The United States became the first federal government in world history to formally separate church from state. The U.S. Constitution was written as a secular document.

Although the Constitution contains no mention of a god or Christianity, many Americans conflate Christian religious commitment with patriotism. In some crucial respects, they've been successful. Religious ideology was used to justify both sides in the American Civil War. Christianity

was promoted as the antidote to the evils of communism in the realignment of global political and military power after World War II.

Key symbolic acts took place in the aftermath of that war. Congress voted to insert the words "under God" into the national Pledge of Allegiance in the 1950s. Around the same time, the phrase "In God We Trust" was added to all American currency and was recognized as the national motto, replacing the original motto of *E Pluribus Unum* (Of Many, One), celebrating plurality, not theism. The presidential oath of office does not contain the phrase "so help me God" nor does it require the president or any other government official to be sworn into office on a Bible, but most of them do. They fear their constituents would be offended if they didn't.

Last century brought a variety of sources of Christian religious influence into American culture and politics. Fox News, which promotes itself as the defender of "God, country, and family," became America's most watched cable news channel. The Creation Museum in Kentucky draws hundreds of thousands of visitors each year with its story of young earth creationism, including a display of Adam, Eve, and various dinosaurs sharing space in the Garden of Eden. The Texas Board of Education requires that social studies textbooks play up the idea that the nation's federal government was founded on Christian articles of faith and play down separation of church and state. Public school science teachers in many states feel obligated to treat evolution skeptically and balance it with "creation science." Private religious schools teach creationism any way they choose.

Communicating Religion Today

Religion occupies a central place in most cultures, even to the point in some places where faith and culture are inseparable. People can immerse themselves so thoroughly in their religious cultures they rarely see or hear anything disagreeable.

Disparate sources of information and channels of communication function in complementary ways to spread religious ideology. Religious rituals include weekly sermons, lectures, group prayers, group singing, holiday celebrations, pilgrimages, public calls to worship, even a National Day of Prayer. Artifacts include the various holy books and other sacred documents, portable logos (Star of David, Christian cross, Islamic crescent moon, Buddhist dharma wheel, Hindu om), special clothing, prayer beads, prayer rugs, special food and drink, home decorations, and religious jewelry among many other things. Religious messages circulate constantly through mass media (including literature, radio stations, television programs), popular culture (like rock and rap groups, films, theme parks), architecture (especially cathedrals, megachurches, synagogues, mosques), and online sources (including websites, social media, video games).

To be effective, religious hegemony requires more than the presence of an ideology supported by rituals, artifacts, media, popular culture, and online sources. The faithful must also continually affirm their belief through routine interpersonal communication. Most religious communication takes place outside places of worship. Religious affiliation gives community members an opportunity to converse in a shared code. Expressions like "Praise the Lord," "Peace be upon the prophet," "Jesus loves you," "Pray for me," "God willing," or "It's God's will" permeate everyday discourse among many religious faithful.

Other sanctioned behavior takes place in the formal contexts of religious observance. Executing obligatory religious practices—especially the proper ways to pray and perform other rituals—reinforces the belief system for the individual and signals commitment and reverence to others. Designated days of worship and religious holidays reinforce the naturalness of religion's dominating presence. Politicians and media personalities send "thoughts and prayers" to victims of mass murders and disasters. Journalists refer to scenes of devastation and destruction in the aftermath of hurricanes,

FIGURE 11.7 Evangelical Christians tend to be white and older. Courtesy of PixelCatchers/iStock.com

floods, and wildfires as looking like "Hell on Earth," "The Apocalypse," or "Armageddon"—the prophesized battle of "End Times" when God does away with all who have not converted to Christianity. Even nonbelievers unreflectively utter expressions like "God dammit!" "Bless you!" or "What the Hell?"

Is Religious Hegemony Fading?

Monotheistic religion remains strong in most parts of the world today. Nearly two-thirds of the global population say they are religious.[65] The Greater Middle East and northern Africa, where Islam dominates, are the world's most religious areas.[66] If current trends continue, by 2050 Islam and Christianity will have an equal number of adherents, and by 2070, Islam will become the world's dominant religion. Muslim populations grow fast because the overall population is young, poor, and has high fertility rates.[67]

Religion remains strong throughout Latin America, but with a significant change. The Catholic Church is losing popularity there because many people want a more personally rewarding experience with their Christian God and enjoy the emotionally engaging style of the Evangelical, Pentecostal, and other alternative faiths.[68] In Brazil, the creative mixing of religions is the norm. Catholicism, Evangelicalism, and a variety of religions brought to South America by African slaves are practiced separately and together.

Some other parts of the world have steadily disengaged from religious belief and behavior in recent decades. Church attendance and religious affiliation have declined significantly across Western Europe.[69] The Nordic and Baltic countries are particularly nonreligious. Great Britain, France, the Czech Republic, and the Netherlands have become far less religious than before. Religiosity in these countries ranges between 7 and 20 percent. Furthermore, most Western Europeans want to keep religion and government separate. Majorities in those countries also support same-sex marriage and abortion rights.

Although most Western Europeans don't read the Bible, pray, or attend church often, the connection between their loosely held Christian identities and national loyalties remains strong. Fluid

human movement taking place within the framework of the European Union and the arrival of refugees from Africa and the Middle East have tested Europeans' cultural tolerance. European Christians' national identity is associated with negative feelings toward immigrants and religious minorities, especially Jews and Muslims.[70]

The Communist system in China permits Buddhism, Taoism, Catholicism, and Protestantism to operate in limited ways but is by far the world's least religious country.[71] The Chinese government promotes strict nationalism and considers religious ideologies and communities—especially Islam—to be competitors for people's innermost loyalties. Japan's population is about one-third atheist.

Religion in the United States

The United States has a unique religious history and profile. More than 70 percent of the population identifies with some branch of Christianity.[72] Americans exceed all other developed nations in the number of times people pray each day, attend church services, and believe the Bible is the literal word of a god.[73] Although the numbers are declining, significant majorities still believe in a personal god, heaven, hell, angels, the devil, miracles, the virgin birth, resurrection, life after death, and that Jesus was a god or the son of a god.[74]

Even though the percentage of religious believers in the United States remains high compared to other Western nations, the number of religious adherents has been steadily declining, especially over the past decade. The percentage of Americans who say they do not embrace any religion is nearing one-fourth of the population, about the same number of individuals who identify as Evangelical Christian.[75]

Attitudes toward evolution have been changing too. For the first time, the percentage of Americans who believe humans evolved but that a god directed their development is the same as the strict creationist view that a god created humans in their present form. Evangelical Christians are most likely to believe humans have always existed in their present form.[76] Nineteen percent of the overall American population says humans evolved, but a god played no part in the process.[77]

Decline in religious affiliation in the United States reflects an erosion of people who formerly considered themselves to be at least somewhat religious as well as individuals who never formed a religious identity. The main reasons people give for leaving the ranks of the religiously affiliated are the following:[78]

- Question the authenticity and wisdom of many religious teachings
- Don't like the positions churches take on social issues (homosexuality, abortion, birth control, environmental protection, immigration)
- No longer have confidence in organized religion
- Believe religion operates too much like a business
- Lost faith in God
- Consider religion to be irrelevant to my life
- Don't like religious leaders
- Science
- Lack of evidence to support religion
- Prefer to study and think for myself

Still, religion and politics in the United States remain closely intertwined. More than half of American adults would not likely vote for a presidential candidate who doesn't believe in a god (the same god the voters believe in).[79] Americans rank atheists behind people of all religious affiliations as

being well qualified to be president of the country.[80] White "born again" or Evangelicals, white Catholics, and Mormons voted overwhelmingly for Donald Trump as they had for all previous conservative candidates.[81] The most politically liberal groups in America are religiously unaffiliated persons, Jews, Buddhists, Hindus, and Muslims.[82]

The change in attitude toward religion is demographic and cultural. White Christians, once the dominant religious group in the United States, now comprise less than half of all adults in the country.[83] Strong religious believers in all demographic groups continue their unwavering commitment to faith but are disproportionately older and make up smaller numbers.[84]

At the other end of the spectrum, most religiously unaffiliated people in America are young.[85] Religious attrition in the West can be explained in large measure by intergenerational replacement; as older people die, younger ones take their place.[86] However, young Americans are not losing religion simply because of their age. They have different attitudes toward life. Compared to previous generations, millennials overall are more individualistic, tolerant, confident, open minded, and ambitious.[87]

People who don't identify with any organized religion often have been referred to as "nones," as in no affiliation. But myriad alternatives to traditional forms of religious faith and the organizations that support them have cropped up.[88] More and more people piece together do-it-yourself spiritual experiences and identities. They integrate reincarnation, yoga, and other Eastern teachings with mystical musings like astrology and numerology into their worldviews. Some bring natural forms of spiritualism—reverence for mountains, oceans, trees, and crystals, for instance—into the mix. Others use intense physical fitness programs, like CrossFit and SoulCycle, as substitutes for the church experience.[89]

Many websites provide space for the nones to form communities and devise new forms of spirituality. The Internet also gives atheists a convenient place to find and support each other. For instance, well-known atheist author and podcaster Sam Harris has written a meditational guide for finding spirituality without religion.[90] Some online fandom groups for popular culture figures function as religions.[91] Other websites are dedicated to helping religious defectors recover from their experience.

Secularization Thesis

The decrease in religious identity and participation in Europe and America, especially among young people, can lead to the impression that the world is becoming a more secular, less religious place. Logic would suggest that cultural modernity, greater rates of education, relative economic prosperity, and the impressive achievements of science would make religion increasingly irrelevant everywhere. That is *not* what's happening.[92] A belief system cannot be destroyed by facts or scientific evidence. Religion is too personal and emotional for that. It's difficult to reason a person out of a belief system that they weren't reasoned into in the first place.[93]

Religiosity is declining among populations in high-income countries due mainly to intergenerational replacement, but it has remained strong in most low-income and middle-income countries.[94] Religious commitment has also increased in post-communist countries as people seek new sources of belonging and identity.

Most nonreligious people live in China, Japan, the United States, and Europe—parts of the world where population size will remain stable or decrease in the future. The number of people who identify as atheists, agnostics, or unaffiliated in these countries will continue to increase but decrease as a percentage of the overall global population.[95] Although Islam will eventually overtake Christianity in total number of followers worldwide, Christianity will also grow in size for the foreseeable future. The world is on track to become more religious, not less.

The Long View

People around the world today practice thousands of different religions. In the past they've practiced thousands more. The prevalence of religion, its gods, core beliefs, and similarities in the way people worship have prompted some scholars to argue that the propensity to create and carry out religious behavior is instinctual. They say an underlying organizing principle of religion may exist, much like the presumed universal grammar of language. According to this view, becoming religious is natural and normal.[96]

Does this mean we are born to be religious the same way we are cognitively prepared to acquire spoken language? Could it be that differing theologies arose the same way languages emerged?

Not likely. Although we are cognitively disposed to learn language, no underlying mental orientation directs us toward religion. Acquiring language and becoming religious have very different evolutionary trajectories. All ancient cultures had language. Over time favorable genetic mutations endowed our species with increasingly sophisticated communication abilities. But many cultures of the ancient world did not believe in gods or invent religions. Other groups were polytheistic and tolerant of diverse beliefs, including atheism.[97]

We are *not* hardwired into religious belief. But religion must be evolutionarily advantageous in some ways, or it wouldn't exist, certainly not at such an extensive level. How do we explain that?

Two instincts explain the emergence of supernatural entities and the subsequent rise of religion. First, as we saw earlier in this chapter, beginning as infants, we instinctually look for the cause of occurrences taking place in our environments, especially threatening events. When we can't identify the cause of an action, we try to imagine what the source might be. In the absence of observable real-world sources, our ancestors nominated an array of supernatural spirits as the likely instigators.

The second instinct interacts with the first. Vulnerable from the moment of birth, we desperately seek protection and support. We need communities to survive. By becoming a participating member of a religious community, individuals tend to live longer, express higher levels of personal happiness, vote, and engage in other civic activities.[98] The religious socialization of children is a high priority in many communities. The community is what is important.

Despite the passion with which they are held, religious ideologies—like biological species, languages, cultures, and technologies—mutate and change over time. Rudimentary belief systems grew out of primitive spiritualities. Folklore and rituals were formed. As Sapiens migrated from place to place, their beliefs and practices slowly developed into sectarian religious behavior. Conflict within and between cultural groups, climate change, and broader cultural transformations provoked modifications in religious ideologies and the ways they were practiced over the millennia.

What we call religious traditions today draw from these long histories. Religious ideologies and practices have been transformed many times in the past and will continue to mutate in the future. The Hindu religion originated between 4,300 and 3,500 years ago. But the mixture of beliefs that make up Hinduism reflect spiritual traditions that date back to cultural groups that occupied the mountainous regions of what is now northern India, Pakistan, and Afghanistan. Influenced by migrations and invasions from territory that is now Russia, Eastern Europe, Iran, and Saudi Arabia, Hinduism has continued to evolve since it was established.

The founder of Buddhism, Siddhartha, was born a Hindu. Over time, Buddhism developed its own diverse traditions, beliefs, and practices that set it apart from Hinduism. Sikhism emerged in the same region a thousand years later with the same effect.

The major monotheistic religions today—Judaism, Christianity, and Islam—are just a few thousand years old, a tiny increment of evolutionary time. The theological antecedents of Judaism stem from polytheistic Semitic religions mixed with elements of the Babylonian folklore, which drew from Sumerian mythology, some which had been inscribed onto the early clay tablets (**Chapter 6**).

Key ideological tenets of Judaism were then incorporated into Christianity. The selected histories and teachings of Judaism and Christianity later influenced the ideological underpinnings of the most recent major monotheistic belief system—Islam. Judaism, Christianity, and Islam have mutated into multiple forms since then.

Evolutionary Modernization

Originally, religion may have been adaptive, serving as a bulwark against existential anxiety and the fear of annihilation.[99] Early religion could have helped strengthen cultural communities by encouraging loyalty and cooperation within groups. But the primary factions that mutated and spread out from the major monotheistic religions—Orthodox and Reform Judaism, Catholic and Protestant Christianity, and Sunni and Shia Islam—compete, sometimes violently, within and between their domains.

Most people today who live where survival is uncertain—think of the conditions that drive refugees to Europe and North America, for instance, and in other economically and culturally underdeveloped countries—remain religious. They depend on religion to feel safe and cared for. But in more secure places, the conveniences and comforts of modernity have made daily life far less stressful than before. As people enjoy greater existential security, they depend less on a god to feel protected and happy.[100] Secularism grew rapidly under these conditions. Non-religious people living in conditions of existential security say they are happier than deeply religious people in religion-dominant "survival value" countries say.[101]

Modern life certainly does not unfold free of stress. The complexity of life in advanced societies is challenging. The recent crisis in the credibility of information has elevated stress levels for people everywhere. Political and cultural forces continue to stoke fear and create anxiety.

Not thinking openly or critically would seem to be a maladapted evolutionary posture. But under pressure of existential insecurity, the mind processes information in defensive and irrational ways. Religion affirms the place of the faithful in their communities. Their compliance assures that religious ideology remains hegemonic but always subject to change.

Chapter Summary

Ideology is a system of ideas and ideals expressed in communication. Ideologies represent ways of thinking that support particular interests. To be effective, an ideology like feminism, environmentalism, or civil rights must have internal consistency; the ideas that make up the ideology have to hang together in patterns. Ideologies can represent high visibility institutions, like nations or political parties, but also cultural phenomena, like sporting teams or musical groups.

The term "ideology" originated with a critical edge. Public intellectuals in northern Europe in the 1800s described how the economically elite sectors of society use a dominant ideology that is favorable to their interests to maintain control over the rest of the population. Social inequality lies at the heart of the critique of ideology. Fundamental themes that make up dominant ideologies stem from discriminatory traditions that were established among feudalist populations.

To be influential, ideologies must repeatedly direct people's attention to ways of thinking that support that system of ideas. Infusing dominant ideologies into human consciousness is accomplished by hegemonic processes that rely on mediated and unmediated communication. Theologies represent various systems of religious ideas and ideals that influence, and sometimes dominate, cultures.

Religious belief and behavior began as a product of brain architecture that was shaped over time by the power of cognition and magical thinking. The cognitive disposition toward magical thinking

prompted our ancestors to assign causality for unexplainable events to a supernatural actor. Magical thinking was exploited culturally by tribal shaman, who served as the first intermediaries between humans and gods. Summoning otherworldly spirits became tribal rituals.

Cave art and religious narratives, especially the creation myths, evolved as communications media that transformed spirituality into religious faith. Over the millennia, religion became the dominant cultural institution in most parts of the world. Islamic and Christian fundamentalists greatly impact politics and culture today. American Christian hegemony combines with ultra conservative political forces in the United States.

Despite its hegemonic influence, the number of people who identify with any religion is decreasing in Europe and the United States. But the vast majority of the world's population remains religiously affiliated. Christianity and Islam are growing in numbers worldwide. Any idea that the world overall is becoming more secular overall is false. Those who continue to promulgate religion assure the persistence of religious ideologies, although current belief systems will continue to mutate.

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12

MORALITY, IDENTITY, COMMUNITY

Communication plays determining roles in the way we apply our moral sensibilities, create our various identities, and go about forming communities. This chapter explores how evolution guides the ways these vital realms of social interaction unfold.

Altruism and empathy comprise the core of universal codes of morality. But moral behavior is influenced by culture and has become aligned with tribal interests. The way tribal allegiances have led to "Us" and "Them" distinctions between human groups is taken up in the first part of the chapter.

People everywhere assume identities that reflect their gender/sex, ethnic/racial, and cultural worlds in order to create and nurture a personal sense of belonging and well-being. The connections between these vectors of identity are described in the second major part of the chapter.

The last major section of the chapter addresses the challenges of living together in our hyper-globalized world. Inequality, complex migration, and the meaning of "group" and "community" in a divided world are explained. We offer a realistic assessment of the prospects in a world divided and comment on the role of communication and the lessons of evolution to give us insight into our shared future.

Morality

In his speech "The Birth of a New Nation" given in Montgomery, Alabama, in 1957, Martin Luther King said, "Every person must decide at some point whether they will walk in the light of creative altruism or in the darkness of destructive selfishness."[1] The civil rights leader had identified a fundamental evolutionary quandary. At one level, sheer survival motivates us to be selfish, even deceptively so. But at the same time, we have the capacity to control our selfishness for the good of the group (and ourselves), which provides another kind of evolutionary advantage.

Individuals communicate their moral positions through their actions, and all animals act to protect their self-interests. Greed and cheating are natural temptations for individuals in all advanced species. But outright selfishness never rules the day in nature. Living in groups requires the ability to control one's selfish impulses, resist temptations, and exercise will power. Restraints on selfish behavior are required for social living and favored by natural and sexual selection for their survival value.

Morality refers to a shared sense of what most members of a group consider to be right and wrong. Human morality constitutes a system of expressed interests where the entire community is taken into account.[2] The principle of other-directedness in cultural groups takes the form of rule-governed moral behavior that includes the expression of sympathy, empathy, and a general appreciation for other people's goals.

Global Morality

Like Sapiens, other advanced animals have a sense of right and wrong. Their moral probity shows up in the ways they interact with other members of their communities.[3] For instance, chimpanzees communicate empathy, compassion, and consolation through vocalizations and body movement. Alpha male chimps don't dominate their troops solely by physical prowess or bullying behavior but by communicating leadership qualities that reflect empathy and fairness. They act to keep the peace, console individuals in distress, show impartiality in disputes, and provide security for the lowest members of their group. In matriarchal bonobo societies, females carry out the same type of supervision.[4] Bonobo matriarchs are particularly supportive of their kin and female friends.

Restraints on selfishness hinge on individual members of a community believing they are being treated fairly. Primates are particularly sensitive to matters of social justice. An amusing YouTube video demonstrates how social harmony for them depends on equal treatment.[5] In the video, monkeys in captivity behave calmly when fed the same food after completing a task directed by a researcher. But if one monkey gets a better snack—a grape instead of a cucumber—the monkeys who only get cucumber react defiantly, throwing the cucumber slices at the researcher and rattling their cages. The monkeys that get cucumbers can't blame other monkeys for the discrimination in an artificial setting. But hoarding food or other resources has severe consequences for animals in the wild too. The research experiment reveals that primates are ready to react when they are not treated fairly.

Primates are not the only animals that behave with moral sensitivity. Bottleneck dolphins swim back and forth rapidly to herd fish into vulnerable areas so other dolphins in the pod can eat. Elephants help each other in distress. Orangutans, dogs, and mice exhibit empathy. Human infants also have a strong sense of moral reasoning and social justice. They naturally share resources and help others achieve their goals.[6] Small children will help others with or without their parents telling them what to do. They prefer "helpers" over "hinderers" and favor "good guys" over "bad guys."[7]

Moral decision making happens fast. Deciding what to do morally does not require conscious awareness, reflection, or logical analysis of a situation.[8] For example, imagine your neighbor's child is drowning in her backyard swimming pool. You can't swim, but you jump in the water, trying to save the child. We typically explain moral behavior after the fact.[9] Acts of heroism are often followed by comments like, "I didn't think about it. Anybody would have done the same thing." The conscious mind develops a plausible rationalization for a decision that had been made reflexively by moral intuition. Doing the right thing brings on a dopamine rush—one of evolution's rewards for sacrificing for the good of the community.[10]

The core fundamentals of morality evolved universally, yet morality is not a "one-size-fits-all" phenomenon. Cultures provide context and give direction to right and wrong on many moral issues. But for any social system, morality means assuring the system's perpetuation. Individuals are expected to transmit a culture's values and beliefs to each other in the present and to subsequent generations in the future.

Altruism

Most definitions of altruism refer to it as something like "selfless concern for the well-being of others." A better way to understand **altruism** is to think of it as the communication of other-directed personal qualities through personal behavior. Altruistic gestures represent virtuous behaviors that are nested within a complex of values and actions that make up culturally based moral standards overall.

Recognizing Kin

Altruism is an inherited characteristic that derives from morality. But living organisms do not apply their moral intuition and reasoning equally, not even within their own communities. They favor individuals that are connected to them genetically—**nepotism**. That bond increases as the genetic relationship gets closer.

By actively helping close relatives survive and reproduce, altruists accomplish something almost as good as propagating their own genes. This is the case for other animals too. For example, female bonobos act with the intention to provide a reproductive advantage for their male offspring. The mothers of male bonobos create opportunities for their sons to copulate, even to the point of chasing away other males from females. Giving their sons multiple opportunities for sex increases the chances the mother's DNA will go forward as her "grandchildren."[11]

Genes aren't directly visible. But *information about genetic relations can be extracted from communicated messages read by the senses*. Organisms must first have the ability to recognize other members of the same species. Then they have to recognize members of their particular community. Finally, the organism must be able to recognize individuals with whom it is genetically related.

Recognizing individuals that are genetically related boosts the organism's potential to send their DNA forward to subsequent generations. But the ability to recognize relatives also helps organisms work together, avoid confrontations, promote alliances, detect outsiders, and avoid inbreeding.

Apes use their highly developed visual ability to recognize each other. Visual recognition focuses on morphology (physical contours and features of the body, especially faces) and behavior (typical movement). Visual perception interacts neurologically with files stored in our memory system to correctly identify others (**Chapter 5**).

Visual cues help many other organisms recognize family members too. For example, some birds recognize relatives by their patterns or gradations of coloring, distinctive markings, or feathering. Giant pandas focus on facial fur to tell each other apart. Sheep and wasps identify other individuals by their faces. Dogs make eye contact and use other visual cues to recognize individuals within their kinship groups, in their species, and across species—especially their human "family members."

The typical pattern of kin recognition begins with one sensory mode, often visual, and then switches to others—smell, sound, or touch. For example, bank swallows rely on their visual ability to locate their nests as they zip through the air. But after returning to the nest, they only feed individual chicks with whom they are genetically related. They identify those chicks by the sound of their signature chirps.

In general, birds recognize each other mainly by their vocal calls, especially during mating season. For instance, emperor penguins identify each other by a distinctive stereophonic call—sound produced by the vocal mechanisms that splits into two frequencies. Dolphins recognize each other's signature whistles, especially when family members or friends are separated by long distance.

Kinship in the natural world is often sorted out by family smell. The chemical-material basis of scent functions as sensory communication for virtually all living organisms, even many lower-order forms. Odors emitted by sweat glands, other specialized glands, urine, and feces are recognized by

family members. Elephants, for example, recognize each other by sound but also by the smell of urine. The scent of various butterfly species identifies family members while attracting mates and excluding predators. Among other species of fish, North American bluegill live in nests of mixed paternity, where they sort out and protect kin by scent. Many plants recognize and favor their relatives by processing information about chemicals released underground and through the air (**Chapter 2)**.[12]

Insects recognize kin by the specific scent of their colonies. For instance, a queen bee maintains her rule over the hive by producing pungent pheromones—a chemical that triggers a behavioral reaction. Bees that enter hives where no relatives live are killed. Wasps and ants behave similarly. The hives, mounds, and nests of these insects function as integrated systems held together by communication activity among kin.

What bees, wasps, and ants do with their kin is perfectly consistent with what humans do within family relations. Genetic proportion greatly influences the volume and nature of communication that takes place among individuals that make up families. Humans tend to display more kindness and generosity to their own offspring than to the children of their siblings.[13]

Reciprocal Altruism

When genetically unrelated organisms perform services for each other, they typically expect to get something back. This principle is reflected in the familiar saying "I'll scratch your back if you'll scratch my back." The mutual benefit that emerges among organisms regardless of the kinship connection is **reciprocal altruism**.[14] Doing something for another person makes you feel good. You have done something for the good of the community, which means you have also done something good for you. The chemical reward is strong.

Humans excel at cooperating with nonrelatives; the collaborative process of building cultures and civilizations emblazoned reciprocal behavior into our DNA. Other mammals behave according to the principle of reciprocal altruism too. For instance, chimpanzees are more likely to share food with others who contribute to the group. The case of vampire bats is particularly illustrative. Bats forage every night and return to the cave. Some bats succeed in the hunt; some do not. The bats that are not able to nourish themselves begin to weaken significantly in a few days. Whether related or not, bats that roost together donate blood to those who need it. The favor is commonly returned. The governing rule of reciprocity is clear throughout the animal kingdom: Deadbeats and cheaters are recognized and expelled from the community.[15]

For Sapiens, sharing information also sets up an expectation that the favor will be returned. By observing communication behavior, our ancestors could identify those individuals who fail to share valuable information or other resources.

Moral integrity expressed within the community underlies human cooperative communication (**Chapter 3**). As we learn to live together, the first stage of cooperation is *requesting* (I want you to do something for me). The second stage is *informing* (I want you to know something because I think it will help or interest you). The third stage progresses to the group level, *sharing* (I want you to feel something so that we can share feelings and act together).[16] The last two stages mark a crucial difference between humans and other primates. Advancing to the third stage established the common ground on which cultures developed their moral values and ethics.

Deceptive Communication

We've all heard the expression "Cheaters never prosper." But is that true? "*Never* prosper?" The answer depends first on whether an individual's goal is short-term gain or long-term survival.

Life for species in the same ecological niche over the long term favors the production of honest, true, and reliable signals. Honest communication expresses altruistic intent and community centeredness among related and unrelated individuals. But deceptive communication—lies, tricks, exploitation—is also common, even within kinship groups. Being deceived means the loss of invested time and effort on the part of those who fall for the deception—an exorbitant cost in evolutionary terms. So deceivers will be punished by other members of their communities for two main reasons: (1) Deceivers fail to hold up their responsibility to the community, and (2) deception produces a loss of time and effort for individuals who were misled.

Cultural Influence

The motivation to act with moral uprightness arrives with us at birth. But the specific vectors of applied morality in human communities are shaped by everyday experience, especially the influence of Culture (**Chapter 9**). All societies embrace the same core moral principles: Do unto others, don't kill, don't steal, avoid adultery and incest, and take care of children and the weak.[17] But other issues related to sexual behavior—extramarital affairs, homosexuality, abortion, premarital sex, divorce, and the use of contraceptives—differ widely across cultures.[18] Western Europe, Japan, and North America are generally more accepting or don't consider these to be moral issues. African and predominantly Muslim countries consider them to be moral issues and find violation unacceptable.

Cultural groups channel their moral imperatives into particular modes, codes, and rules. From that platform, a culturally guided moral sense then tells people in the community what's right and wrong; the conscience reprimands those who disobey.

Guilt and Shame

Moral violations can provoke the emotional reactions of guilt and shame.[19] We may be judged guilty and feel guilty ourselves for doing something illegal—even something relatively minor that could be considered an uncharacteristic lapse in judgment. The guilty person is punished appropriately.

Shame is a stronger sentiment. Shame exposes hidden traits that reflect a contemptible character flaw—like cheating to get into a prestigious university or, much worse, sexually abusing children. Shameful behavior undermines the deeply held norms of morality. The shamed person may be deemed socially undesirable and risks being kicked out of the community. Internet shaming has extended the exposure of a moral violation beyond community to a wide audience and turned it into entertainment.

Empathy

In general, **empathy** is the ability to understand and share feelings that others are experiencing, especially troubling feelings like sadness or loss. Fully functioning members of human societies recognize their own emotions and are able to empathize with the emotional state of others.[20] They have immediate awareness of another person's inner state, grasp their feelings and thoughts, and understand the emotional subtleties of complicated situations.[21]

Empathy takes two basic forms. **Emotional empathy**—is the biologically driven sensation that something that is happening to someone else is happening to you as well.[22] Other animals also

FIGURE 12.1 Focusing on an individual to evoke an emotional response. Courtesy of greenaperture/iStock.com

exhibit emotional empathy too.[23] Species that depend on close parental care and tight group living are most likely to feel emotional empathy.

For humans, empathy also has a cognitive dimension. **Cognitive empathy** refers to the ability of someone to consciously analyze, understand, and take the perspective of another person who is experiencing an emotionally upsetting situation.

Empathy is generally a good thing that comes naturally to most people. But empathy can also be counterproductive, even harmful.[24] Empathy can undermine rational thinking and behavior. For instance, if we simply observe and empathize with someone who is suffering, what good does that do? Emotional empathy might just magnify the problem, extend the negative sentiment, and do nothing to alleviate the person's suffering. Even if we care for a distressed individual at the moment, that does not solve an enduring problem.

Communicating Empathy

We are likely to feel more emotional empathy for a wounded animal that is close to us, like the family dog, than for a malnourished child living in brutal poverty in a distant place shown on television. That reality poses a challenge to our common humanity.

To solicit financial donations for starving children, television producers try to close the empathy gap by making the children relatable—starting with a face and a name. Close-up shots of individuals stimulate emotional reactions more effectively than images of large groups of suffering people or alarming statistics about their condition. With close-up imagery, the viewer looks directly into the eyes of individuals and establishes a fleeting personal connection with them. This strategy represents the "identifiable victim approach" for stirring empathy and encouraging genetically and culturally unrelated individuals to respond.[25]

LEARNING TO EMPATHIZE

Empathy helps people build and maintain communities. We look out for others in our communities, and they look out for us. Phrases like "We're all in this together" reflect the fact that our moral obligations rest first of all with how well we understand and treat people we already know.

Evolution has made the emotional mechanism of empathy local and personal. But daily life in the modern world takes most people out of their homes and communities. Being able to empathize with others, or at least appear to empathize with them, helps people get along with others outside their social circles.

The differences among us can be great. That fact poses a challenge for people to respond to unfamiliar others empathetically when doing so is part of their job. For example, police officers encounter individuals who are in difficult, sometimes threatening situations. Being able to understand what's going on from the point of view of everyone involved is crucial. That's why police departments try to match the race and ethnicity of officers on the street with the residents who live there. Getting police officers out of cars, on foot, and chatting with people can create friendly interactions that defuse real and potential animosities. Similarly, public school teachers frequently have students with whom they have little in common. Home visits and meetings with parents can help those teachers appreciate their students' social and emotional worlds.

FIGURE 12.2 Alan Alda. Courtesy of Alda Communication Training Co.

Based on many years of experience as a professional actor and public speaker, Alan Alda, founder of the Alan Alda Center for Communicating Science, believes good communicators in any situation should self-consciously combine emotional and cognitive empathy to reach their audiences effectively.[26] The goal is to create **affective resonance**—a feeling of emotional connectedness where brain activity reflecting the emotional state of message senders and receivers matches up.[27]

Professional communicators must appear to be empathetic to get and sustain their audience's attention. That's how speakers demonstrate that what they have to say has value for the listeners. But empathy is a two-way street. In an ideal situation, listeners also become motivated to care about the speaker. For example, not only do political candidates have to show empathy with the plight of voters, they need to show they are one of them. Telling emotionally evocative personal stories is one strategy political candidates use to humanize themselves and create affective resonance.

Showing empathy can improve relationships among people who are not professional communicators or politicians too. Many helpful resources appear online. One web page brings together diverse research dedicated to teaching people how to show empathy.[28] Two skills are emphasized: (1) *connecting with others* (listening attentively, opening up, offering physical affection, focusing attention outward, withholding judgment, and offering help), and (2) *building up your empathy* (practice curiosity about strangers, volunteer, challenge your prejudices, use your imagination, practice understanding how someone else might be feeling, treat people as important, practice loving-kindness meditation).

Empathy-creating techniques like these can open channels of communication in everyday interaction and broaden social awareness. Making commonalities clear builds trust. But try as we may, we cannot simply install empathy in ourselves or others.

Empathy is given direction and force by biology and culture. Empathetic feelings are tribal. They are biased to favor those individuals who are closest to us—families and close-knit group members.[29] Brain chemistry plays a role too. Oxytocin—a powerful hormone that bonds individuals together—is released when we observe someone suffering. The hormone stimulates feelings of emotional empathy—but only for people in the observer's in-group.[30]

"Us" vs. "Them"

We may be born with a universal core of moral values, but we do not apply these values easily to people from other tribes.[31] Neurological research shows that the default position in human social relations is "Us" versus "Them."[32] Sapiens automatically tend to favor their in-groups over out-groups in matters of applied morality like altruism and empathy. The human brain quickly sorts people into categories. In less than a tenth of a second, the brain recognizes and classifies individuals according to race, gender, and apparent social status.

These biases start early in life.[33] We automatically integrate the "Me" into the cultural or societal Us. Those same impulses cause Us to reject Them. We believe We are superior to Them. We consider Them to be homogenous, simple, and unable to change or improve. Our cultural stuff (for example, music, art, language, and literature) is better than Their stuff. When one of Them does something wrong, it's because of Their essential nature—Their race or culture is to blame. When one of Us does something wrong, extenuating circumstances or good excuses explain the lapse in judgment.

The tribal instinct also gives Us permission to exact revenge when one of Them does something against one or all of Us. When We are violated, We are compelled to get back at Them. Despite the time and energy that have to be invested, Our tribal members can help us by hurting Them when They have wronged Us. To do so is good for Our society. This is **altruistic punishment**.[34]

Other species have Us/Them fights too. Fights to the death between chimpanzee troops are not uncommon. Even some insect groups make an Us/Them distinction. As they compete for food and nest-building territory, ants will defend their colonies from outsiders to the point of all-out war. But most intra-species killing is done by individuals against other individuals, not groups. Even adult females among some species will commit infanticide to protect their offspring in struggles over limited resources. But humans are by far the animal most likely to kill other adults within the species.[35] And we are the only species that kills each other over ideas (**Chapter 11**).

Religious Morality

Genes, biology, and environment shaped moral behavior that was passed down from our Sapiens ancestors to us. Behaving with an implicit or informal understanding of right and wrong greatly benefitted the early groups.

Religion eventually became the primary cultural framework through which moral behavior was codified and institutionalized in most human societies (**Chapter 11**). Moral principles were weaved into the beliefs, myths, and rituals that make up religious ideology and culture. Setting a moral standard helped religious cultures to live together well.[36] But claiming moral high ground meant that leaving or renouncing the religious group—**apostasy**—was made difficult if not impossible, especially for women. In some cases, apostasy is still punishable by death—the most extreme form of altruistic retribution.

Many people today continue to believe that religious status, traditions, and iconography signal high moral character. Majorities of individuals in populations around the world, especially in poor countries, think it is necessary to believe in a god to be a moral person.[37] This conviction is nearly universal in Africa, the Middle East, and South Asia. The majority of people in the United States think this way too. By contrast, the vast majority of Europeans, Canadians, Japanese, and Australians do not regard belief in a god as necessary to be a morally upright person. Many of the same moral principles claimed by religion were also encoded in secular legal systems.

A profound sense of moral and religious superiority legitimized by claims of divine revelation has become the hallmark of all the major religious groups. Some version of the Golden Rule—which lies at the heart of communal living throughout the animal kingdom—exists in all religions. Upon closer inspection, however, the moral imperatives inferred from the Torah, Bible, Quran, and Islamic hadiths were never meant to apply to everybody. The sanctity and obligations of moral behavior pertain only to insiders—members of the various faiths. Belief that Our Group acts morally inevitably comes into conflict with Other Groups who feel the same way about their beliefs and behavior.

Identity

People want to be recognized for who they are.[38] **Identity** refers to the emotional affiliations people have with their body, history, values, and ways of living. In the following paragraphs we focus on the three primary categories of personal identity—gender and sexual orientation, racial and ethnic heritage, and cultural alliances and loyalties. The anchors of personal identity form the framework for how and what we communicate to others.

Individuals take on complex, multiple, sometimes overlapping identities. Some identities seem to contradict other identities. For example, a person might identify ethnically as Filipino and Catholic—nearly 90 percent of Filipinos are. That same person may also be gay, rich, vegetarian, come from a particular province of the Philippines, be a fan of England's Tottenham football club, and speak a regional dialect. Diverse characteristics like these contribute to the individual's self-culture (**Chapter 9**) and to his or her **composite personal identity** (**Figure 12.3**).

Gender Identity

Even subconsciously, everyone has a **gender identity**. Because we form our racial, ethnic, and cultural identities through gender, that's where any discussion of composite personal identity should start.

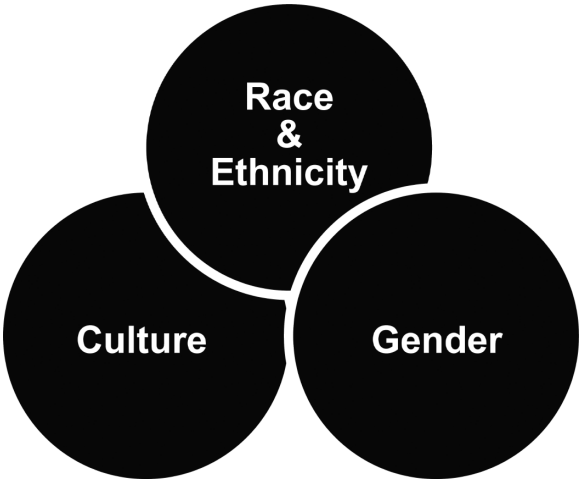

FIGURE 12.3 Composite personal identity

Gender identity reflects where a person believes they belong along the spectrum of female to male. That identity usually corresponds with biological sex assigned at birth but not always. Indicators of gender begin with the physical body, including genitalia, the reproductive system, chromosomes, and characteristics like facial hair and breasts. These physical characteristics determine gender identity for most heterosexual, bisexual, and homosexual individuals.

Gender markers are also psychological—the inner feelings a person has about who they are sexually. When the physical body and the mental state don't match up, the person experiences **gender dysphoria**. Most common among this population are transgendered persons.

The biological bases of gender formation and gender identity are not clear. The conventional belief is that social and cultural influences weigh most heavily on gender identity as a person matures. From this view, gender identity emerges with time and is subject to change. A second explanation centers on the role of sex hormones in early childhood. Gender identity emerges from the way hormones and the social environment interact to influence psychological development.[39] A third theory applies especially to transgendered individuals. It postulates that sexual differentiation of the genitals separates from sexual differentiation in the brain while the fetus is in the womb. This condition creates dual developmental paths—the body in one direction, the mind in another.[40]

Sexual Expression

With gender identity in place, individuals can act on their true sexual orientations. But the proliferation of sexual orientation categories over recent years—straight, lesbian, gay, bisexual, queer, transgender, plus—reveals the complexity of gender identity and its relation to sexual expression.

In the past, most people whose gender identity did not match their biological sex and individuals with a non-heterosexual orientation have felt the need to hide their identities, orientations, and behaviors from mainstream society, even from family members. Now gay pride events take place in much of the world—but not everywhere. In some countries people still can be sentenced to die for expressing nontraditional gender identities and sexual orientations.

Same-sex marriage became accepted by the majority of the population in the United States and many other countries during the past decade. That monumental change was prompted by

increasing numbers of individuals coming "out of the closet." Mass media—which have historically been dominant sources of traditional sex role stereotyping—played a big role in the change. Television writers wrote sympathetic gay and lesbian characters into their scripts. Popular media personalities and celebrities announced their homosexuality publicly.[41]

Individuals of both sexes in most species engage in homosexual behavior, in some cases more frequently than heterosexual interactions.[42] They do so for sexual pleasure but also to form strong social bonds of various kinds, providing a clear evolutionary advantage. While homosexual behavior is common among many species in the animal kingdom, most individuals ultimately produce offspring.

Racial and Ethnic Identity

For many people, racial identity and ethnic identity are central to the self-concept. An individual's **ethnic identity** refers to the state of belonging to a group whose members share common ancestry and core aspects of culture, especially language and religion. For example, Native Americans often identify as groups in terms of heritage, language, tribal customs, and family ties. Ethnic identities are displayed and defended because they represent deeply rooted, essential aspects of a person's and a group's imagined place in the world. The meaning and expression of ethnic identity typically increases when individuals or groups feel threatened or otherwise under duress.

To say the least, discussions about ethnicity are complicated. "Ethnicity" becomes a catch-all term used to make imprecise distinctions about personal and group identity. A case in point is China. A strong majority of Chinese people who live in China today say their traditional "way of life" is getting lost and needs to be protected.[43] But to what do the Chinese refer when they mention their way of life? China as a national population? Chinese people as an ethnic group? A race?

Chinese ethnic identity is rooted in a combination of ancestry, geography, and cultural traditions. But the People's Republic of China is composed of more than fifty ethnic groups, distinct geographical regions, different languages, and varying cultural traditions. Many individuals living outside China also claim Chinese heritage and consider themselves to be ethnically, if not racially, Chinese.

Referring to Chinese people in ethnic or racial terms can mislead because some nationally Chinese people living in various parts of the country have less genetic overlap with the dominant Chinese ethnic group, the Han, than they do with Japanese, Koreans, or Mongols, for example. The Chinese government has faced strong international criticism for forcing the ethnic Uighurs, a Muslim minority who live in a remote region of the country, to become assimilated into a Han Chinese ethnic and national identity against their will.

Race and Politics

Putting people into categories has been evolutionarily functional for individuals in the past—Us and Them distinctions are rooted in lived history. Consequently, people still look for shortcuts to separate people by their differences. Skin color continues to be a convenient sign, even now. Birth certificates often list race, color, or some combination of the two as identifying physical characteristics.

In the United States the most common options for birth certificate identification and other official records are black, white, Asian, Indian or Alaskan Native, and Native Hawaiian or Other Pacific Islander. Race in the United States is also coded by geographical origin: African American, Latino (and the large subgroup Mexican-American), Asian American, Native American,

and European-American or Caucasian (an inaccurate descriptor of where most white people "originate").

Race used as an index to categorize individuals and groups has been strongly denounced for compassionate reasons—most notably to reject claims of racial hierarchies that were used to justify the African slave trade and eugenics, particularly the Nazi's murder of Jews and Romani gypsies that sparked World War II.

In the wake of the Nazi atrocities, the anthropologist Ashley Montagu wrote a highly influential book—*Man's Most Dangerous Myth: The Fallacy of Race*—in 1942. Montagu made a strong case against using race as a way to categorize people. He claimed that race has no basis in biology.[44]

Montagu's argument that race is a scientifically useless and politically dangerous category was well received by many intellectuals, especially academics. Many social scientists stopped using race as a demographic variable in their research. At the time, most biologists also believed differences among human populations could not be explained by biological markers. Race became more an ethical issue than an empirical one. Well-informed, fair, and respectful people should not invoke race as a way of talking about difference. To do so would be racist.

Evolutionary theory got unfairly caught up in the criticism. As Sapiens dispersed globally, groups settled into relative isolation from each other. Differences naturally emerged. *But evolutionary theory does not support any scenario that privileges one group of people over another.* The evidence on this issue was clear to Charles Darwin nearly 200 years ago when he reasoned that human races are so similar because they descended from a common progenitor.[45] Darwin was a dedicated abolitionist, who believed that all human beings have the right to exercise their full potential.

Regardless of the biological complexities and political implications, race remained a common way for people to talk about each other in everyday conversation. Eventually, race also returned as a standard demographic variable that is still commonly used in social science research.

Racial Pride

Beginning in the 1960s, many African Americans began to publicly embrace and promote blackness as a signal of racial pride. Popular culture and politics were the grounds upon which the movement gained traction. The classificatory terminology "Negro" and "colored" were discarded as self-referential labels. James Brown's popular song "Say It Loud, I'm Black and I'm Proud" and Nina Simone's "To Be Young, Gifted, and Black" served as iconic statements. Black Power became a political and cultural rallying cry. The Black Panthers organization fought aggressively for social justice. Decades later, the Black Lives Matter movement mirrored early activists' efforts to own the racial category, re-name it, and transform its significance from negative to positive. Appropriation of the "N word" by some African Americans conformed to the same logic.

African Americans were not the only group to invoke race for political reasons. Among other cases in the United States, the plight of Japanese American citizens interred during World War II, the suffering of Chinese American immigrant laborers, and the abuse of Mexican farm workers were linked to racial discrimination and inspired calls for social justice.

Ironically, race became a demographic classification that minority groups could leverage to assert their rights and gain access to resources. But as the political and economic grip held by white Americans and Europeans began to slip away in recent years, a White Nationalism movement has also become more publicly visible, inspiring appalling acts of domestic terrorism. An outpouring of Us versus Them racial prejudice is being stoked in mass media and social media by authoritarian politicians in the United States, Europe, Brazil, and elsewhere.

Race and Biology

Through all the controversies, the empirical question of whether or not race constitutes a biological category never went away. Today, advances in research technology allow for much more detailed analyses of genetic composition. Recent studies conducted by Harvard geneticist David Reich confirms that genetic differences do exist across diverse populations.[46] Race is not a mere biological myth. But the new scientific evidence does not sort people into immutable racial categories. Far from it.

Sapiens' genetic heritage has been traced back to our origins in Africa and everywhere we have gone since then (**Chapter 2**). Over time, ancestral migrations created some populations that were almost completely isolated from each other. For instance, the primary European and African gene pools evolved independently for almost all of the past 70,000 years. The ancestors of today's West Africans, East Asians, and indigenous Australians lived separately for more than 40,000 years. These migratory histories represent more than sufficient time for the forces of evolution to work on separate populations.[47]

Skin color, bodily dimensions, susceptibility to disease, and some behavioral and cognitive traits are reflected in genetic variation across different human populations.[48] But these findings must be interpreted correctly. *The genetic differences do not indicate that separate categories of human groups exist.* Differences between and among populations today are small when compared to the commonalities.

WHO IS BLACK IN THE UNITED STATES AND BRAZIL?

As a result of massive slave trade conducted over more than three centuries, the United States and Brazil have the largest number of African descendants living outside Africa today. But people of recent African heritage are perceived differently in the two countries. In the United States, a person with just "one drop" of African blood (estimated by family history in recent centuries; we all have African blood) may be considered black. But in Brazil a person whose recent ancestry is seven-eighths African would not be considered black.

How people are perceived racially is shaped by history and culture. African slaves were categorized in different ways by the legal systems in the United States and Brazil.[49] In the United States, individuals were classified by state governments as either black or white.[50] That way of categorizing people has largely persisted until this day. No polarizing legal definition of race was made in Brazil, although the treatment of slaves in the South American county was unspeakably harsh. In any event, the distinction between "free" and "slave" was drawn less clearly by the Portuguese Catholic colonizers in Brazil than it was by northern European Protestants immigrating to North America. Consequently, mixed race individuals in Brazil today are not categorized by the blanket term "black."

FIGURE 12.4 Brazil. Courtesy of Yasuyoshi Chiba/Getty Images

Other factors contribute to contrasting perceptions of race that are made in the two countries.[51] Most Portuguese

immigrants to Brazil were males who arrived unmarried or without their families. Conditions for miscegenation were ripe. By contrast, most immigrants to North America arrived as families. Intermixing was less common.

In part because of its geographical proximity to the mother continent, Brazil has continued to maintain active trading and cultural alliances with Africa, typically with Portugal's former colonial states. Contemporary Brazilian culture—especially *Carnaval*, *samba*, and the martial art *capoeira*—reflect this distinct African heritage and are strong sources of cultural pride.

Because race never became much of a high-profile political issue in Brazil, racism today often takes a less explicit form there than it does in the United States. But inspired in part by American black political activism, global media, and popular culture, the Brazilian Black Movement today has made the plight of the poor black population a salient political issue. And in the United States, the more racially and ethnically diverse Generation Z and the Millennial generation (individuals between five and forty years of age) support racial and social justice, interracial marriage, and racial and gender diversity much more strongly than previous generations did.[52]

Elusive Ancestry

Global migration, trade, and travel over recent centuries have accelerated genetic mixing and ethnic convergence. With remarkable advances available in consumer science, DNA-based ancestry tests have become very popular. Many people want to know their racial composition.

This curiosity has led to surprising results. For example, North Americans who have always considered themselves to be white may discover they descend not only from Ireland or Germany but also from East Asia or the Middle East. Because African populations intermixed on the huge continent for tens of thousands of years, it is particularly difficult to tie DNA evidence to identify specific geographic areas on in Africa for any person of recent African heritage.

Individuals looking for detailed accounts of their racial history therefore should treat data provided by genetic ancestry sites skeptically. Ancestry research does a better job describing macro-level histories. For example, because Neanderthals arrived in Europe and Asia before Sapiens and mixed with them to some extent, most Caucasian and Asian people today carry some Neanderthal DNA in their genome.[53] Due to more recent intermixing, some East Asian populations carry Denisovan DNA.[54] Intermixing with Neanderthals and Denisovans provided evolutionary benefits for Sapiens. Neanderthals contributed a keratin protein that makes skin more protective. A Denisovan mutation helps humans who live in mountainous regions adapt to high altitudes.[55]

The farther back we look, the more diluted our pool of ancestors becomes. No single race can accurately claim genetic superiority over others because we all descended from mixed groups that no longer exist *and* the amount of genetic variation within any human population is great. Because of the empirical complexities and the ethical and political complications, the geneticist David Reich and others advise that societies should find ways other than race to talk about genetic differences.

Acknowledging that biological and genetic differences exist does not imply racism. To conclude that genetic differences between population groups are so small that they must all be ignored doesn't advance scientific knowledge. Future scientific research will likely continue to reveal genetic differences between groups of genetically related populations. But one scientific conclusion and ethical position will remain constant and true: Individual genetic differences *within* a population vary much more than mean differences *across* groups on any genetic indicator. Every individual should be treated as unique person.

Cultural Identity

The terms "ethnicity" and "ethnic identity," "race" and "racial identity," and "culture" and "cultural identity" are often used interchangeably in everyday language to mean the same thing. Of these closely related terms, culture and cultural identity are the most familiar and inclusive.

Ethnicity always implies ancestry or race. Culture does not. Many strongly held cultural identities have little or nothing to do with ethnicity or race. For example, a number of religious congregations are ethnically and racially diverse but share a strong cultural identity centered on the beliefs and practices of their commonly held faith. Indeed, the major proselytizing faiths—Christianity and Islam—count on the ability of religious ideology to overcome ethnic or racial differences.

Cultural identities can best be understood as the personal associations and affiliations people have with groups that represent particular values, ways of life, and activities. Most people form and maintain multiple culture identities. But being able to freely choose one's cultural alliances and identities assumes the individual can operate autonomously, which is not always the case. Many cultural identities are imposed, encouraged, forbidden, or restrained by the norms and demands of the cultures into which a person is born or later exposed (**Chapter 9**).

Cultural identity has the same generally understood meaning as ethnic identity when it refers to ideas like nation, language, religion, food, or sense of time. But passionately held cultural identities can also reflect emotional engagement with sports teams, musical artists, media celebrities, diets, consumer products, brand names, and countless other entities.

Social belongingness is essential to cultural identity. The social nature of identity is often fulfilled when individuals attend cultural events that attract throngs of people—celebrations, concerts, religious services, or sporting events, for example. Virtual cultural communities can fulfill the social component of belonging too.

Multiculturalism

In policy and practice, for the most part the United States has adopted a multiculturalist approach to identity. Distinctions made between Us and Them become normative in matters related to cultural

FIGURE 12.5 Cubs' fans. People of all ethnic backgrounds who grew up in the Chicago area might develop a strong cultural identity with the city and the Chicago Cubs baseball team. Winning the baseball World Series further confirmed multi-ethnic Chicago Cubs fans' cultural identities. Wearing team merchandise serves as a badge of cultural membership. Courtesy of Tasos Katopodis/Getty Images

identity. We distinguish among African American, Asian American, Mexican American, Jewish American, Muslim American, LGBTQ+, and many other subgroups of citizens. The underlying assumption of multiculturalism is that whole of the nation is comprised of diverse elements that should be acknowledged and celebrated. Every individual should be considered not only equal but uniquely valuable. But groups are pitted against each other and against the majority ethnic group for recognition, rights, and access to resources.

Identity Politics

President John F. Kennedy implored people to ask, "What can I do for my country?" Today, the power of personal identity makes that kind of sacrifice seem quaint. Now, one burning question seems to be, "What does my country owe me by virtue of my identity?"[56] Maneuvering for political or economic benefit on the basis of cultural status is **identity politics**. Especially as economic inequality grows, some people who feel left out of the mainstream assert a right to equal opportunity based on minority status.

Identity politics began in earnest last century in the United States with the advent of "hyphenated" groups, most notably African-Americans. By identifying foremost as a minority, African-American activists and their supporters claimed special status based on ethnic identity and demanded that social justice be served. Affirmative action, prison reform, anti-police brutality, and reparations represent policies and proposals for social justice that have been driven by ethnic and racial identity.

Identities centered on other distinguishing cultural categories emerged for the same reasons—recognition and rights. Sexual minorities, gun owners, religious congregants, people with disabilities, and many other categories identify people by their cultural differences.

The trend toward identity politics in the United States may have grown to the point where differences within the overall population have become more salient for many people than what is shared.[57] The core issue that emerges from fast-paced cultural change is the meaning of community. With whom will we identify and cooperate in the future? How does communication influence the way we imagine ourselves with others?

Community

Soon after publication of Charles Darwin's *The Origin of Species*, the English sociologist and philosopher Herbert Spencer put forward the idea that entire human societies function like biological organisms.[58] Interpreting the role that natural selection plays in evolutionary theory, Spencer argued that inherently superior varieties arise among humans. He said that colonialism, racism, and economic inequalities are the natural products of inborn differences that exist among individuals and groups. The rise of inevitable differences should be embraced, not lamented. Societies should not take measures to correct the immutable laws of nature.

That is how the term "survival of the fittest" was born. Those were Spencer's words, not Darwin's, but the perspective is often referred to misleadingly as "social Darwinism."

Charles Darwin himself was no social Darwinist. His work was **humanistic**—concerned with the well-being of all living things. Darwin wrote extensively about community. He provided evidence demonstrating how animal species build community through altruism. He observed that animals control their emotions in order to avoid conflict. But Darwin also wrote that only humans can reflect critically on their past actions and assess the motives for doing what they do—approving of some actions and disapproving of others.[59] People routinely make good moral decisions for the good of their communities. Moreover, humans have reflexive consciousness; we are aware of the world around us, and we know we are aware.

Acting with moral clarity and possessing a strong identity work to individual and collective advantage. Yet communities around the world today confront existential threats. Social and economic inequality; distressing patterns of global migration; and a retreat into racial, political, cultural, and religious tribalism are chief among them.

Inequality

The primary indicators of human well-being at the global level have improved greatly over the past two centuries.[60] Violence, poverty, illiteracy, malnutrition, and infectious diseases have decreased significantly. People worldwide enjoy greater access to education, improved gender parity, increased life expectancy, better health, and greater prosperity than ever before. More people today own small luxuries like televisions and mobile phones.

In absolute terms, humanity is doing well, especially for people who live in the more developed parts of the world. But in relative terms, a different picture emerges. Income inequality is increasing everywhere. It's now at its highest point in the world's richest country—the United States.[61] The consequences are severe. Gross inequality and relative poverty create multiple levels of personal and societal stress. A person who loses economic standing experiences the high emotional cost of not only being poor but *feeling* poor. The coal miners and rural residents of Appalachia that helped elect Donald Trump said their self-worth and social standing were rapidly disappearing along with their wages.[62] Many working people in Western Europe register the same complaint.

Suffering income inequality negatively affects a person's ability to reason logically, be compassionate, and act with moral uprightness. Job insecurity exacerbates feelings of interpersonal distrust. Peoples' physical health and immune system suffer under economic stress.[63] Even individuals who thought they were secure in modern nations become anxious as artificial intelligence, robotics, legal immigrants, guest workers, and undocumented individuals take over their jobs.

Complex Migration

Sapiens have always been on the move. But driven mainly by civil war, political instability, overpopulation in poor countries, climate change, gang warfare, and economic desperation, people are migrating in unprecedented numbers. The effects are unsettling.[64]

Sudden Diversity

The speed of life and disorienting presence of the encroaching "other" today threaten the identity and stability of cultural groups. Living in an era of accelerated migration means that everyone must adapt to sudden challenges brought on by ethnic, racial, and cultural diversity.

Many people around the world say they oppose migration into or out of their countries. The case of the United States is particularly complicated. The country has the world's largest foreign-born population (nearly 50 million people, about 14 percent of the overall population).[65] More than two-thirds of the American public believes that openness to people from the around the world is essential to national identity. They think people of different races, ethnic groups, and nationalities make the United States a better place to live. Yet more Americans say they want less migrants coming into the country than those who say they want more.

Although young people tend to be accepting of foreigners, the overall level of **xenophobia**—the dislike of people from other countries—remains stable in high-income countries around the

world.[66] In matters of immigration, the Us-Them dichotomy takes an Insider-Outsider form. It's convenient to blame foreigners and foreign influence when people feel insecure. For many people in the West, the "others" include immigrants and terrorists. In the Arab world, outside forces of modernity—gender equality, religious freedom, political democracy, global media, and popular culture—threaten religious sanctity and cultural norms. Immigration to Asian nations remains miniscule and largely unwelcome.

Authoritarian and xenophobic political parties in many Western nations are gaining popularity by stoking fear about newly arriving immigrants. Economic and social costs are magnified. Conservative media fuel the backlash. The power of a single compelling media anecdote—a foreign-born man brutally murders a native woman, for example—helps crystallize anti-immigrant sentiment.

Inside their own countries, people are migrating from small communities to large cities in record numbers.[67] Individuals left behind in the small communities experience a profound identity crisis.[68] But adjusting to life in big cities for new arrivals is difficult too. Poor people moving to megacities like Mumbai, Sao Paulo, Cairo, or Mexico City face extraordinary challenges to their safety, health, and quality of life. The impact is cultural and economic but also biological and neurological. Within a short time period people brought up in dense urban areas develop a larger amygdale—the region of the brain involved with fear and anxiety.[69]

Urban problems intensify from the effects of large-scale, in-bound migrations for the middle class residing in population centers. Physical barriers go up as people press into the more densely populated parts of the world.[70] Walls are constructed between nations. Gated communities and fences keep residents separate inside population centers. Security guards watch over religious institutions, schools, government buildings, banks, and shopping malls.

Greatly accelerated patterns of migration create defensive reactions that can be explained by evolutionary principles related to the need for safety, identity, and community. Trust breaks down. Outsiders become potential predators. Generosity expressed toward strangers diminishes, especially when the incoming migrants differ ethnically from the population in place.

Positive Effects

Increased migration also brings many tangible positive effects. For any biological species, concentrated population growth allows more mutations to appear, making it possible for an increasing number of good solutions to be selected. As life evolves to greater and greater intricacy, complex organisms enjoy more opportunities to communicate and cooperate with their own and other species. Beneficial interdependencies arise.

Human migrations bring people of different ancestry and genetic makeup into contact. Eventually, sexual reproduction involving individuals of differing populations increases genetic variation within groups and decreases variation across groups.[71] The net effect is healthier internal populations and reduced genetic, ethnic, and cultural differences between populations.

Innovation and discovery speed up too because fast globalization, cultural mixing, and the revolution in information and communications technology are all taking place at the same time. In many respects, the more massive, diverse, and urbanized a human population becomes, the more open it will be. That's one reason why big cities today foster so much creative production. Good ideas burst forth when free thinking and originality are rewarded.

By virtue of their proximity and the way social and professional networks operate, communication in densely populated areas is also more efficient and convenient, contributing to collaboration and cultural change. The opposite is also true: Change flourishes less quickly in traditional settings, especially where education is undervalued and religion is prominent.[72]

Together? Or Alone Together?

The cultural historian Steven Johnson presents a comforting image of ethnic, racial, and cultural togetherness to conclude his book *Wonderland*, an argument for the importance of play—doing fun things we don't have to do—in human development.

Johnson describes a scene on the Fourth of July—America's Independence Day—at Prospect Park, a huge expanse of green public space in Brooklyn, New York. Like many urban parks along the eastern seaboard of the United States, Prospect Park gives local residents a chance to get out of their homes and workplaces during the hot and humid summer months to enjoy themselves—to play—in shared space.

The scene Johnson describes is familiar to people living in many cities throughout the Western world, but especially in the ethnically diverse United States: Korean Americans picnic together in the shade of a sprawling elm tree while a family of Hasidic Jews strolls down the path behind them. Puerto Rican families barbecue *pinchos* (kebabs) of chicken and pork. Diverse young Brooklynites chase each other up and down the hill playing Frisbee. Old couples sit on park benches reading foreign language newspapers. Rap, salsa, and acoustic guitar music fill the air.

Steven Johnson explains the nature of Brooklyn's multicultural Fourth of July event as a remarkable product of long-term economic and cultural globalization. Trade has expanded steadily throughout Sapiens' history. But the range and frequency of long-distance transactions increased markedly with the onset of the global spice trade 500 years ago. Today, Johnson muses, the globally interconnected world created by European and Asian spice traders can be found "just down the street."

In striking contrast to the festive scene at Prospect Park, the cover of the paperback edition of Sherry Turkle's book *Alone Together* pictures people walking independently in different directions all with their heads down, checking their phones.[73] As a professor of social studies of science and technology, Turkle's main point is that social life has become more organized around communications technology and less on face-to-face interaction. Living in an age of global connectivity offers obvious advantages, she says, but ultimately leaves people feeling alone.

The bustling activity at Prospect Park compared to the isolated way people use their phones at first seems to offer competing metaphors for the current state of human relations. Are we in this world together? Or are we just alone together?

Both scenarios depict the same tendency manifested in different forms.

The ethnically diverse groups in the park share the same space and celebrate an inclusive occasion. They interact face to face. But they do so in the most comfortable way—separately as groups. Many immigrants feel vulnerable in new territory, especially at first. They stay mainly within their ethnic communities in order to feel personally secure and keep their cultures alive. They form diasporas—communities of ethnically or culturally related people living outside their places of geographical origin.

The solo phone-checkers take social isolation and cultural experience down to the individual level. But they constantly use their phones to connect with others, even if just by text message.

As we become increasingly autonomous agents of life experience, we still need to interact and cooperate with others. The instinct to connect, communicate, and collaborate runs deep. But as the world becomes more connected and transparent, it also becomes more threatening. Identities sharpen when cultures come into contact—especially at the pace with which human movement and technological development are taking place now.

Group

The contrasting sides of immigration reflect the challenges of living together. Reasons for the retreat into tribes around the world today can be traced to behavior that was formed originally in deep

ancestral history. We evolved to cope with life in small enclosed groups.[74] Protecting the group and making it strong has always been our survival strategy. But what constitutes "the group"?

Forming Communities

Over long expanses of time, Sapiens' primordial alliances grew into communities, cultures, and civilizations. Along the way, the size of our ancestral groups increased from dozens to hundreds and eventually to many thousands of individuals. The size of the early ancestral communities was determined biologically, just as it has been for the other primates.[75] The upper limit of group size developed according to the ability of individual members to form and maintain secure social relationships. That number depends first of all on the brain's capacity to process information—in this case, its ability to keep track of who's who in the social milieu.

The size of our early ancestral groups also reflected the ways various populations responded to their physical and social environments. Biology, cognition, and habitat influence each other. *Population size for each group at any point in time became a function of optimum survival rates situated in particular cultural contexts.*

Flexibility in living situations is key. The configuration of animal groups is naturally fluid. Most primate species live in complex, multilayered social systems. The shape of their communities is affected by the dynamics of **fission-fusion** behavior. Animals split apart and regroup in different ways. They move into and out of subgroups and factions. Individuals spend time alone. Sometimes they leave their groups permanently.

Trust

Driven by Sapiens' biological and social needs and fueled by cognitive growth and developing communication ability, learning how to cooperate in complex ways became necessary. But that collaborative disposition was actualized for tens of thousands of years within small populations. Outsiders were considered untrustworthy and potentially dangerous. Conflict between groups developed around competition for resources and access to sexual partners.[76]

Learning to trust individuals outside our native groups has been a gradual process. At first, differences among Sapiens were minimal. The outsiders that hunter-gatherer groups encountered came from just a short distance away. Tribes were racially indistinguishable.

As we developed our communication skills, interactions with other groups became more common and productive at greater and greater distances (**Chapters 5 and 6**). Wars, other forms of intergroup conflict, and the oppression of one group by another have never been eliminated. But over time cultural groups have become increasingly able to avoid violent conflict. The worst forms of inhumanity that Sapiens have inflicted on each other have receded markedly, especially during the past 500 years. Consciousness raising brought about by expanding circles of trade and the constraining effect of civilizations on daily life have combined to produce a pacifying effect overall.[77]

An Evolving World Divided

Sapiens' development in recent centuries has made it possible for much of the world's population to live in safe, comfortable, and inspiring ways. We've eradicated many diseases, created stunning works of art, mastered flight, mapped the human genome, developed theories of relativity and quantum mechanics, created the United Nations and its Declaration of Human Rights, launched the Internet, and invented phones that can call anywhere from everywhere. People think and work together in multiple languages across wide expanses of space and time.

Yet the mood around the world reflects the presence of deep divisions among human populations. Many people are frustrated. Others are angry. How can that be explained?

Conflicting Instincts

Social inclusion is hardwired into our emotional makeup, decision-making, and ordinary behavior. Although the Us-Them impulse instinctively frames social behavior, our brains are also biased to get along with others.[78] We are social primates. We have been shaped by natural selection to live in tribes so that we can cooperate, the key to survival.[79] People naturally bond with others with whom they share physical space, values, allegiances, and experiences. Cultures form around those social affiliations. Identities spring from the cultures.

But social exclusion is hardwired in human cognition too. The human brain secretes chemicals that align with insider-outsider discriminations beginning in the first few months of our lives.[80] Winnowing down the size of our primitive groups created the original Us-Them distinctions that formed the cognitive and behavioral foundation of today's tribalism. Our genes, other biological factors, and the social and cultural environments inhabited by our predecessors right up to the present day have imbued us with strong self-preserving prejudices.

Evolutionary forces thus bring humanity together in some ways and push it apart in others. This conundrum foreshadows the most crucial issue global humanity faces today—a crisis of community. What does community mean in a globalized cultural environment? Where do the boundaries and openings of community exist?

Polarizing differences that exist today between and among population groups grew over time from multiple causes. But to explain the lack of harmony between some of the largest groups, we must address the unique role of religion, the force of its ideas, and its association with politics and morality. Why do religious communities pose a unique threat to prospects for a more inclusive global community?

Religion and Community

Sapiens began to solve daily challenges by working together as informal partners and coalitions. From these alliances, ancestral populations developed a sense of group mindedness that became represented in routine social behavior. Sapiens populations moved from working together jointly in small groups to acting together collectively as larger communities.[81]

Ancestral cultures gradually developed beliefs and behaviors that defined the groups and infused their members with a common identity (**Chapter 11**). Sharing commitment to a belief system allows genetically unrelated individuals to trust each other and cooperate. Religions have persisted over time because their congregations tend to be composed of reliable members who follow the rules. In turn, the congregations protect their members. In this crucial sense, religion fosters the building and maintenance of community. The benefits of belonging to a religious community seem apparent. Religious people are more likely than nonreligious individuals to report they are physically healthy, happy, more honest, and more willing to volunteer for charitable causes.[82] Having a clear belief system has proven to be conducive to personal happiness.

However, the belief system need not be religious.[83] In evolutionary terms, going to church, synagogue, or mosque regularly is best understood as community belonging and involvement. Attending church or other religious services, the typical measure of religiosity, can be satisfied other ways.[84] For instance, living with a strong sense of community, a generous social welfare system, and well-functioning institutions, the happiest countries in the world make up the Nordic region—Finland, Norway, Sweden, Iceland, and Denmark—some of the world's least religious nations.[85]

POLITICAL RELIGION

Believing in the same foundational narrative, even when it is widely known to be fictional, can inspire people to cooperate, form communities, and develop fiercely held group and personal identities.[86] Bolstered by the symbolic power of their stories, rituals, and iconography, many devotees of the major religious faiths have asserted indisputable truths and refused dialogue at a time when world peace and human well-being depend on tolerance and inclusion.

The idea of community assumes common goals and shared values that unite a population, even in secular nations with diverse political factions. But underneath the veneer of "the nation," "the people," and assertions of who "we" are, strong differences have emerged about the true meaning of community.

Religious faith inspires a level of emotional commitment that is not often matched by other forms of social organization, including political parties at the highest levels of government. For instance, the American vice president Mike Pence declared in a tweet: "I'm a Christian, a Conservative, and a Republican . . . in that order! And I'm a card-carrying member of the NRA (National Rifle Association)."

Being an American wasn't mentioned. But what the vice president tweeted represents feelings held by millions of Evangelical Christians in the United States. It's why Pence and other Evangelicals were willing to tolerate Trump's moral failings in order to promote their fundamentalist agenda, especially banning abortions and limiting the rights of homosexuals.

Christian conservative Republicans also are overwhelmingly white, another line of personal identity Pence failed to point out. As racial tensions have become more heated in recent years, a strong correlation between religious fundamentalism and racial enmity has emerged.

Communication and the Common Good

Beyond responding to catastrophic climate change, the biggest challenge facing the global population today is creating a broader sense of community. The differences among us can only be resolved gradually. Major disruptions should be expected. Liberal values as a world ideal are receding. Martin Luther King's plea quoted on the first page of this chapter—that all his fellow Americans should do the morally right thing and create a nation founded on altruism, shared moral principles, and a common vision—seems like a bygone dream.

There is nothing inherently optimistic or pessimistic about communication or evolution. Communication does not act as a monolithic force for good or bad. Evolution has no design and no goal. Still, our capacity for critical reflection makes it possible to stand up against the excesses of our self-preserving instincts. The challenge facing humankind is to overcome the boundaries of identity in order to get along under conditions that are inherently stressful.

Nothing in evolutionary theory guarantees or prevents success at any stage of human history. Yet even Charles Darwin believed that our "social instincts and sympathies" can eventually be extended to people "of all nations and races."[87] Still, to advance from historically insular forms of community to inclusion at the scale that is needed now will require nothing less than a sweeping humanitarian revolution.[88]

Chapter Summary

The crucial evolutionary principle of other-directedness takes form as rule-governed moral behavior. Morality refers to a shared sense of what is considered by a cultural group to be right and

wrong and involves a system of interests where the entire community is taken into account. The biological and cultural origins of morality and empathy rest in kinship relations, reciprocal altruism, guilt, and shame. Our evolutionary roots explain the basis of religion-based morality, cultural tribalism, and "Us vs. Them" thinking.

The primary vectors of composite personal identities are gender/sexual orientation, ethnicity/race, and culture. All forms of identity are constructed through the lens of gender identity. Racial and ethnic identities have resulted from global migratory patterns over tens of thousands of years. Race has been an especially troubling category of human difference with origins in biology and culture and implications for politics. Cultural identity, multiculturalism, and identity politics have become prominent themes in the current era as Sapiens sort out our similarities and differences.

The impact of growing social and economic inequality together with sudden ethnic diversity brought on by rapid migration and technological development have created a crisis of community. Expanding trust and creating a broader sense of community in a world of competing instincts and religious factionalism poses a great challenge to our common humanity. Any realistic assessment of the opportunities and limits of human cooperation must consider objections raised by religious conservatism, politics, and media. Evolution offers no guarantees. The last best hope is for a sweeping humanitarian revolution to take wing.

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