

CAVEMAN LOGIC



THE PERSISTENCE
OF PRIMITIVE THINKING
IN A MODERN WORLD

HANK DAVIS

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HANK DAVIS

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My parents, Sarah and Al Davis, offered religion as part of my cultural identity. The details were a bit fuzzy and they were never shoved down my throat. My parents and extended family tolerated a certain manner of questions; in fact, they seemed to enjoy them. I grew up assuming that Jews, indeed people of all religions, loved to discuss and debate their faith. Obviously, I was wrong. My parents wanted and expected me to be a good boy. Being smart and being kind were the two biggest virtues in our home. Both were independent of religious training or pressure of any kind. I was never threatened with God's vengeance or "going to hell." I couldn't even imagine such things. There were other, gentle incentives for "being a mensch."

One way or another, I've been writing this book for over thirty years. That means I have countless students and colleagues to thank, whose influence was indelible. None more so than Harry Hurwitz, a fine friend and mentor as one can have. I am also thankful to Martin Daly, who in the course of a casual conversation informed (or perhaps reminded) me that I was an evolutionary psychologist. He didn't have to tell me twice.

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Friends and colleagues supplied me with a steady diet of articles about Caveman Logic in its many, sometimes bizarre forms. There seemed no limit to them. Fortunately, these friends were also willing to discuss the ideas they had provoked and critique what I had written about them. I thank Doug Reberg and Scott Parker for their insights. I also thank Kat Bergeron, Chris DiCarlo, Alan Wildeman, Loren Lind, and Colin Escott for their contributions. I am also grateful to Chris Scimmi, a fine artist, for creating the Caveman image that appears throughout this book.

There was also plenty of moral support for what I was doing. I thank Beth Scimmi and Susan Simmons for those simple "How's the book coming?" or "What did you write about today?" queries. I never felt like I was working alone.

Many of us working in this field have been provoked, one way or another, by the scholarship of the late Steven Jay Gould. Gould and I were born in the same year and we both grew up in New York—him in Queens and I in the Bronx and Yonkers. We disagreed strongly about the virtues of evolutionary psychology, but we shared the broader conviction that comfort is a poor substitute for rationality in shaping one's worldview. When Gould and I found ourselves sitting side by side at dinner after his commencement address at my university, we talked nonstop. Almost all of it was about baseball. Not baseball as a metaphor for life or natural selection, but baseball as a game we had both played as children and watched, analyzed, and written about as men.¹

I think my parents would have been proud of this book. Maybe a little surprised, but proud. Most of all, they would have been pleased that I was happy with the result and had thoroughly enjoyed the process of creating it.

INTRODUCTION

Diana Duyser saw the face of the Blessed Virgin staring up at her from a grilled cheese sandwich she had begun to eat. The Florida resident sold the remainder of her meal on ebay.com for \$37,000. Guadalupe Lopez, the mother of actress Jennifer Lopez, walked into a casino in Atlantic City to play the slot machines. She eyed the huge prize, uttered a few heaven-bound words, then sat down to play. Before the dust cleared, she had won a jackpot of \$2.4 million. In the press conference that followed, Ms. Lopez called her winnings “proof of the power of prayer.”

Few Americans would disagree with her. A June 2008 survey¹ revealed that about a third of Americans believe they receive answers to “prayer requests” at least once a month. Eighty percent of respondents believe in angels and demons as active forces in their everyday lives. This goes beyond mere belief in God, which clocks in at about 92 percent according to the same poll. No one was doing formal surveys of superstitious belief or religiosity in medieval Europe, but it’s hard to imagine the results would have been a whole lot different.

Both Lopez’s statement and seeing the image of a religious icon on a piece of fried food are prime examples of what we will refer to as *Caveman Logic*. So is our tendency to utter a reflexive “Thank God!” when something good happens to us, or to blame vengeful deities or spirits when natural disasters occur (“New Orleans must have had it coming!”). Fear, irrationality, and superstition are rapidly moving to the mainstream of American culture. International surveys confirm that the United States has lost its preeminence in education and science. In their stead, we rival Middle Eastern and African nations in measures of religiosity.

Yes, it’s true that we can fit more songs than ever on an iPod and we regularly expand the boundaries of medical knowledge. But we also show the sophistication of a Neanderthal in evaluating fragmentary evidence and are still prone to reaching conclusions about ghosts, “signs,” and magical powers in the world around us. We can design and repair rocket engines, but most humans are unable to confine that primitive part of their minds to the back burner. Caveman Logic continues to inform the most personal side of our belief systems.

In this book, we have chosen the caveman as a symbol of our less-rational, more-superstitious self. I hate to pick on cavemen and stigmatize them any further. Cavemen have been turned into caricatures in popular culture by everything from cartoons like *The Flintstones*, *B.C.*, *Alley Oop*, and *The Far Side* to a series of highly successful commercials by GEICO Insurance (“So simple, even a caveman can do it”).² These depictions all convey misinformation for comic effect. But there is one trait we can be pretty sure of: cavemen were not very bright. Few of us would consult a caveman for financial or romantic advice; nor would we want to worship with one. Yet, in a sense, we do all three. That’s how much power our Stone Age minds have in everyday affairs.

While we can parody those who worship fried food or bargain with deities to intervene in their everyday affairs, these kinds of activities remain alarmingly widespread. Why are we so illogical and why do we reach similar superstitious conclusions the world over? This book examines both of these questions and finds answers rooted in evolutionary psychology.

Evolutionary psychology is a relatively new field that offers a scientific, indeed a biological, approach, to understanding human behavior. Unlike other fields of psychology, an evolutionary

approach attempts to understand humans as part of the biological world in which they evolved. Many of those puzzling, irrational behaviors may stem from adaptations made by our ancestors. If so, we are stuck with mental modules that weigh us down in both laughable and dangerous ways. That mental equipment we carry in our modern skulls is over a hundred thousand years out of date. But instead of challenging our limitations and trying to remedy their effects, we create cultural institutions that normalize them. At this rate, we'll remain stuck in the Pleistocene for years to come.

I don't blame our prehistoric ancestors for being who they were. They did their jobs by surviving and reproducing and contributing to the chain of events that led to us. Their world was very different from ours and they understood a lot less about their place in it. Most of what we inherited from them, mentally speaking, is pretty impressive. From an evolutionary point of view, we are the descendants of a long line of successful competitors. But times have changed. The Pleistocene Age, when the bulk of human evolution took place, is over, although it left some deep marks on our minds. Fortunately, they weren't written in indelible ink.

Is this book taking potshots at a few primitive and superstitious individuals? Has magical thinking gone the way of the Middle Ages, if not the Stone Age? Sadly, the answer to both questions is no. Caveman Logic is alive and well in our everyday lives. Our ancestors who made it through the Pleistocene Age did so with brute force and a brain full of "primitive instincts." Most of that brute force is long gone or illegal, but some very primitive forms of mental life are still with us today. Worse yet, those cognitive and perceptual flaws often function unchallenged in our daily lives. Their roots may lie in the Pleistocene Age, but their costs in the modern world are very real. Those winners in the relentless competition that preceded us passed along everything they had. We got the full package, warts and all. At best, we are saddled with too many mistaken beliefs. At worst, we may end up annihilating each other.

We need to see our defective Stone Age minds for what they are if we ever hope to drag ourselves kicking and screaming, into the twenty-first century. This book advocates a difficult transition from the Pleistocene to the modern age. Our bodies seem to be standing up rather well; it's our minds that are slipping into obsolescence.

Is such a transition possible? Will it require a brain transplant to fix the problems we identify here? I believe we can do it without surgery. The good news is that we actually have something to say about how we use our minds. We may be predisposed to Caveman Logic but we are not bound by it. Biology is not destiny.

Our Stone Age brains will continue to send us hair-triggered perceptions and conclusions that are just plain wrong. What we need more than anything is the will to question those messages as quickly as they occur. It won't be easy. Those autopilot reactions not only feel "right"—they often feel "good." They have been second nature to us for so long that we can't imagine not accepting them on face value.

Caveman logic persists for another reason as well: it receives social support. That's no small incentive when it comes to human behavior. We are arguably the most social species on the planet and consensual validity counts for a lot with us. But we can level the playing field a bit by developing support systems for those courageous people who do question their Stone Age reactions. At present there is very little of that support available.

If we fail to do any of this, we are relinquishing control to our ancestors. Whether or not we take those first few halting steps out of the Pleistocene night is the agenda of this book. It's time to unlock

the manual override portion of our brains, put those primitive autopilot settings into storage, and explore the real mental potential of our species.

Chapter 1

THE ROAD TO IMPERFECTION

THE CRADLE OF LIFE

Human beings evolved in a world unlike the one we inhabit today. Our sense of history, as it is taught in high school and portrayed in films, doesn't begin to do justice to what our species has been through.

Going back two hundred years for an entertaining "historical drama" leaves us squarely in modern times, evolutionarily speaking. Other than different hair and clothing styles, that brief journey hasn't begun to move us out of the modern world. Even if we go back to the time of Jesus or, further yet, to ancient Greek civilization, we're still in modern times. Gone are the trains, planes, automobiles, and iPods, but if we could magically visit these times and places, we'd still see recognizable humans acting in recognizable ways. That is why stories set in so-called ancient times still resonate with us today. The settings are very recent.

Human beings may be a very new species in terms of life on Earth, but we still go back a long time. The hominids that would eventually become humans split away from a common ancestor, leaving the apes behind about 6 million years ago. Those early proto-humans went through a hell of a lot so you could download music and buy airline tickets online. The selection pressure on them to survive and reproduce was tremendous, and living conditions were harsh beyond our imaginations. The physical appearance of these early hominids was also different from what we take for granted today. Physical changes were evolving and accumulating slowly in both the minds and the bodies of our early ancestors.

Natural selection was in no hurry. On one hand, it is a ruthless efficiency expert, heartlessly excluding those features that do not maximize reproductive success. On the other hand, it can only select among existing alternatives. That slows things down. Natural selection can't cause giraffes to grow long necks just because the food supply happens to be located above their heads. But if a relatively long-necked individual does show up, he or she is more likely to experience reproductive success. Because that longer neck is coded in the individual's genetic material, and because that individual may be more successful than its short-necked competitors, long-necked giraffes may gradually become more numerous in the population.

Plainly, evolution through natural selection only works on traits that have a genetic basis. Heredity is the cornerstone of Darwinian theory. Without it, the effects of natural selection would be confined to a single generation. Every generation would be starting from scratch. If some trait (e.g., a snazzy new hairstyle) were acquired during an individual's lifetime, then natural selection could do nothing with it other than conferring some transient rewards (perhaps a few more sexual partners). Here on Earth, almost every important behavioral and physical feature of plant and animal life is transmitted genetically and is directly vulnerable to selection pressure. Thus, traits that lead to greater reproductive success eventually spread and often become standard equipment for a species.

Traits that meet environmental challenges and enhance reproductive success are known as *adaptations*. When the person carrying the genes for these traits reproduces, there is a chance the traits

will be carried into the next generation. The final results also depend on the genome of the sexual partner. For all the pleasure it produces, sexual reproduction also carries some disadvantages. The most obvious is that each partner contributes only half of the new genome.

It makes sense that individuals do not mate indiscriminately. No one, whether a Nobel laureate or a tree frog, wants a substandard partner. All forms of animal life have evolved methods for “screening” potential mates in order to select those with the best genomes. Such screening need not be conscious; indeed, it rarely is, even among our own species. Human mating rituals, whether practiced at high school dances or in so-called primitive societies in the Amazon basin, are only one example of this. A zoologist could dazzle us with stories of how other animal species choose or attract partners. One of my favorites involves the gladiator frog (*Hyla rosenbergi*). As in most species, the female is very particular when it comes to choosing the father of her offspring. Since “toughness” is a desirable trait in this pugnacious species, the female practices a very simple screening technique. She approaches her potential mate and literally does her best to knock him off his feet. If she succeeds, that’s one Mr. Froggie that won’t get lucky with her.

Natural selection is not really a very contentious process despite the uninformed political debate that swirls around it. At its most basic level, natural selection simply means that heritable differences within a species lead to different levels of reproductive success. The most successful adaptations tend to spread in the population. That hardly seems like a difficult or dangerous idea. Dog breeders routinely take advantage of it, substituting their own preferences for the traits that nature might select.

According to most surveys, the majority of Americans do not “believe in” Darwinian evolution. This seems an unfathomable state of affairs in the twenty-first century. Obviously, someone has to understand a viewpoint before deciding whether to accept or reject it. I’ve talked to enough high school students and teachers to conclude that Darwinian evolution is neither well taught nor well understood. It is entirely possible that the view of Darwin many Americans reject would also be rejected by most scientists. It is simply wrong. The misunderstanding is so pervasive. Most people can’t even tell you the name of Darwin’s famous book. Ask someone and, if they know the book at all, they are likely to report *Origin of the Species* rather than *On the Origin of Species*. It is a subtle difference, but quite telling. Even Spencer Tracy, appearing as Clarence Darrow in the award-winning 1960 film *Inherit the Wind*, got it wrong.

At a time when debates over the teaching of evolution are turning neighbor against neighbor and throwing local school districts into chaos, it would seem criminal not to bring combatants to a common understanding. *Then* let them debate. This has plainly not happened and is a glaring fault of the American educational system. When students tell me (as they occasionally do in Introductory Psychology classes) that they do not accept Darwin, I usually ask them what they mean. I cannot recall a single occasion when such a forcefully opinionated student has gotten it right. The most frequent response is, “It means we come from monkeys.” Who wouldn’t reject that? Whether by incompetence or willful misrepresentation, natural selection is just not getting a good hearing.

Perhaps if people *understood* natural selection, they’d be more likely to *accept* it. The principle does not seem very threatening (although the wrongheaded version can be quite upsetting to many). Moreover, as Richard Dawkins argues, natural selection is inevitable once you accept a few basic premises. Susan Blackmore concludes in her book *The Meme Machine*, “If there is a replicator that makes imperfect copies of itself, only some of which survive, then evolution simply *must* occur. . . . The inevitability of evolution is part of what makes Darwin’s insight so clever. All you need is the

right starting conditions and evolution just has to happen.”¹

So what conditions must be in place for this inevitable process to occur? For one thing, we are replicators. Human beings replicate sexually. Some anti-Darwinians may be uncomfortable acknowledging that process, but it is nonetheless true. I have never heard an anti-Darwinian debate hereditarily. Most, if not all, accept that we pass along our genetic information, which is then combined with our partner’s contribution to form a new organism. That is not contentious. The fact that our offspring are composed of a mixture of maternal and paternal DNA is also not contentious. Every gene you carry came from either your mother or your father. No one debates that.

So far, so good. We’ve got the “replicator” part into the acceptance column. What about that “making imperfect copies” part? This simply means that copying errors occur. They don’t occur very frequently (maybe about one in a million), but they do occur. These errors are called *alternative alleles* or, more commonly, *mutations*. They result in some change in the phenotype. Most of the time they are inconsequential. When they do matter, they are usually negative. In other words, the ancestral allele was a better deal than the mutated one. And so the mutation does not spread in the population. But the important point here—and it is indeed a central point to natural selection—is that mutations, those inevitable copying errors, provide variation in the human genome. Variation is *good*. You wouldn’t want uniformity or perfection. Those errors are essential to the survival of the species. If there were no errors (i.e., if copying were perfect), there would be no variation among phenotypes and nothing for natural selection to work on.

So far, we have upset no one in the audience, regardless of whether seated on the extreme right or left side. What’s next? Those slight variants go forth into their environments and some of them do better than others. You might not like the idea of competition, but it is an inevitable part of life on this planet. Some of those mutations result in greater reproductive success than others, as members of the species compete with each other for precious resources. The environment is a filter, and some traits lead to greater reproductive success than their alternatives.

As Darwin argued in 1859, occasionally animals undergo sufficient change to become reproductively isolated. Geography contributes to this isolation as well. When these noninterbreeding populations become sufficiently differentiated, a new species has been formed. Rats and mice are good examples: they remain closely related, but as long as we have known them they have been separate species with a common ancestor. They share physical and behavioral traits, but they also have differences in size and behavior.

And there you have it. An absolutely blind and lawful process without values or agendas. It may not be the stuff of fairy tales or creation myths, but it grinds away in its relentless way, producing its outcomes. My colleague Martin Daly has stated it eloquently: “Natural selection doesn’t have goals, but it’s the reason organisms do.”² That’s a wonderful summary of life on this planet, although the idea is a bit difficult for some people to grasp. It also doesn’t help that natural selection moves very slowly, making the concept an even more difficult sell.

True, there is no father figure/deity with agendas we can talk about in human terms. But that isn’t Darwin’s fault, any more than Newton was responsible for the law of gravity. In any case, natural selection is part of a world full of wonder, willing to reveal itself as we ask the right questions and pool our knowledge. The universe is no less thrilling as we gradually uncover its secrets and confront its mysteries. And we do so using the splendid intelligence our species has evolved. What could be more uplifting than that?

It's worth remembering that part about copying errors. If all individuals were identical (e.g., in a cloned population), selection would be forced to stand still. All it would take is a single parasite or predator to detect a weakness and a whole population would be at risk. The Irish potato famine of the mid-nineteenth century is a widely cited example of such vulnerability. Historians often point to Ireland's dependence on a single crop as the key to the tragedy, but it was more than that. Genetic variation could have saved the Irish potato crop. Without it, a single form of water mold (*Phytophthora infestans*) was able to destroy the crop almost overnight. Genetic variation is an essential building block for the design of well-adapted individuals, and it is also a source of resistance when a species comes into contact with predators, be they four footed or single celled. As many as 10 million people were killed by the Irish potato famine by 1850 and perhaps twice that number were forced to immigrate to the United States, Canada, Australia, and other parts of Great Britain. The expression "Celebrate Diversity" takes on new meaning when you consider how natural selection works.

THROUGH A MICROSCOPE DARKLY

Although molecular biology is well beyond the scope of this book, there are several basic things we need to cover. The collection of genes in an organism, called its *genotype*, is largely responsible for creating (with some help from the environment) the organism's observable traits, collectively called its *phenotype*. Genes are composed of deoxyribonucleic acid (DNA). DNA contains the instructions that specify which proteins should be made. By doing this, the DNA is responsible for shaping the phenotype.

If stretched out for display, every cell in your body contains about six feet of DNA. Every nine hundred cells therefore produce over a mile of DNA. Because the human body contains as many as 100 trillion cells, our bodies house over a billion miles of DNA. That's a pretty large number. The distance to the sun is only 93 million miles, in comparison.

We are still learning about DNA. It seems that every time we look at the human and chimpanzee genomes side by side, the degree of similarity has grown. Other than making glib statements like "Humans and chimps are more related than mice and rats," what do we really know? As I write this in 2008, it seems the less I say about this area of research, the better. Almost anything is likely to become obsolete in short order. Craig Venter has decoded the human genome and made his own diploid genome available on the Web (www.jcvi.org).

We have watched estimates of the "degree of overlap" between human and chimpanzee increase from 97 percent to nearly 99 percent in the span of less than ten years. At the same time, estimates of the number of base pairs in the human genome seem to be dropping at a steady rate. Prior to mapping the human genome in 2000, estimates of the number of human genes were fixed at about 100,000. Shortly thereafter, that number fell to about 25,000, a dramatic drop by any reckoning. Had I written this book a year ago, that number would have stood at about 22,000. By the time you read this, it may lie below 20,000. The estimate keeps shrinking, yet the human genome remains firmly in place. Plainly, the number of genes is not the whole story of what makes us distinctly human.

Somewhere, somehow, there are "switches" in the genome that tell our genes when to turn on and express themselves, thus turning a genotype into a phenotype. The switches that turn genes on and off are not well understood. Some of them lie within the genes themselves. Others are thought to lie

within the so-called “junk DNA,” poorly understood matter that comprises the large majority of the genome. The picture is even more complicated. In 2006, it was reported that individual differences may result from previously undetected variations in the number of times that certain key genes are copied in the genome. Preliminary findings suggest that entire sequences may be repeated as many as ten times, differing widely between individuals and yielding differences in the overall “copy number” of genes. Perhaps we have ignored material such as this or “junk DNA” for too long, focusing instead on the more obvious proteins that were easier to measure and investigate.³ In any case, high school genetics books (often called molecular biology texts in universities) are losing their resale value almost as quickly as they are published. It has become that difficult to stay current.

BACK TO THE PLEISTOCENE

Our own ancestors (don't visualize your grandfather here; try to imagine someone who lived two hundred thousand years ago) lived in small nomadic bands. A lot of inbreeding occurred and most of the persons within the band were genetically related. They made a living by hunting together and gathering nuts and fruit that grew locally. These activities were fraught with peril. Animals that were being hunted for food had no interest in being eaten. They had their own concerns about survival and reproduction and vigorously resisted our attempts to turn them into table scraps. Even nuts and berries that were available locally presented difficulties for our ancestors. “Nuts and fruit” may sound like a healthy diet today, but much of that locally grown produce had an agenda of its own that probably did not include traveling through a human digestive system.

In short, food sources were, to quote a vivid description, “scarce and antagonistic.” Food acquisition and storage were only a few of the daily problems facing our hominin ancestors. *Hominin* is the term we want here, since we're concerned with only humans and chimps, not with the other great apes. Their survival was also threatened by environmental predators. Some of them were other humans whose traveling bands were anything but friendly or cooperative. The study of present-day “primitive” people like the Yanomamo of the Amazon rainforest provides some insight into the perils of Pleistocene life, including competition between neighboring social groups and the kind of “spoils” military victory entitled the winner to claim. Murder rates in contemporary cities like Detroit and Miami have nothing on so-called primitive cultures and, presumably, the Pleistocene world in which our ancestors lived.

In addition to human predators, our ancestors also faced threats from animals that viewed us as potential food sources and enthusiastically hunted us as we did them. But perhaps the greatest perils all came from the smallest members of the living environment. Microscopic parasites represented, as they do today, a major threat to human health and survival. Imagine facing a predator that is invisible, deadly, and whose ways are beyond your understanding or control. Even if you could defend against it using some poorly understood natural remedy, the predator could mutate quickly to work around whatever paltry defense you could put in its way.

This scenario partially describes the life of our ancestors. For them, the workings of the physical world must have seemed unpredictable, unfathomable, and truly frightening. Perils were almost constant and comprehension was minimal. Keep this in mind when you're trying to imagine the kinds of mental processes that would have helped serve survival and reproduction. Understand also that much human evolution took place before there was written or spoken language. (The Sumerian

invented written language around 3000 BCE.) If someone could not state his business clearly, it would have helped to be able to read his intentions and trustworthiness using other means. Long before there was spoken language, there was body language. Anyone who could send and receive it fluently was at a considerable advantage.

Something else to consider: there were no external agencies for the enforcement of right and wrong. Social rules and alliances may have been in place, but the notion of codified “laws” or individuals whose job it was to enforce the laws was unknown for much of human history. If anyone were going to detect and punish that cheater, it had better be you. Rule breaking, nonreciprocity, and cheating were major issues for our ancestors and exerted strong selection pressure on the design of their minds. Such mental “circuitry” continues to play a major part in our lives today, long after formalized social rules and legal systems have reduced the need for it.

For well over 3 million years after splitting away from the apes, our species remained largely unchanged socially, cognitively, or physically. These early hominins were not very impressive by today’s intellectual standards, although they were the best the Earth had to offer at the time.

Then something happened. Just what that something might have been remains a matter of conjecture. The results were a series of dramatic changes to our ancestors that led to a near doubling in the size of their brains and an exodus from the African continent by *Homo erectus*. Compressing millions of hominin history into a paragraph or two can only trivialize or omit important events, but the bottom line is this: over this period, our species grew in stature, dispersion, and intelligence. It is the last of these that mattered most. Competition for finite resources on the planet has always included species and individuals who were stronger or more numerous than our ancestors. But this competition was never smarter.

By 500,000 years ago, our ancestors were busy defining their dominance. When we think of ourselves as a species, we are usually picturing the anatomically modern version known as *Homo sapiens*. But there is a direct line between the modern *H. sapiens* and earlier hominins like *Australopithecus*, *Homo habilis*, and *Homo erectus*. The physical changes, most notably in stature and relative brain size, occasioned a growing range of intellectual abilities.

That final 500,000 years, composing barely 10 percent of our development, was a time of many crucial changes in our species. Probably the two most important changes, in terms of what our lives have become today, were language and domestication. It is virtually impossible to overstate the importance of language in defining who we are or our range of accomplishments. Communication is widespread within the animal kingdom; language is not. Using labor-intensive procedures, we may train a chimpanzee or a parrot or a gorilla to ask for a tickle or tell us the number of items on a computer screen. But as we know and employ it every day, language remains the sole domain of our species. Indeed, getting a human *not* to learn language is quite a feat. How important is language to other aspects of human accomplishment? Make your own “Top 10” list and try to imagine any of those feats emerging without written or spoken language.

Domestication may seem an odd choice for the second most important milestone in human development but, when it occurred about ten thousand years ago, our species took a giant step forward. To bring plants and animals—essential sources of food and labor—under our control was a turning point for our species. Consider the effects of freeing our ancestors from the daily toils and perils of searching for sustenance. Now they could pursue other matters, perhaps the very things that make our species so noteworthy. Nothing on your “Top 10” list would have been accomplished if our species

had been half starved or had its time consumed with hunting, berry picking, and back-breaking labor. Domestication goes well beyond pet dogs and cats.

We were not always the only human species on the planet. Most people know that other humans came *before* us but are surprised to learn that different species of humans lived at the same time. The most conspicuous example is *Homo neanderthalensis*.⁴ Neanderthals, who have become figures of almost cartoonlike proportions in popular culture, were actually successful competitors who lived as recently as 28,000 years ago. *H. sapiens* and Neanderthals diverged from a common ancestor about 370,000 years ago, and Neanderthals lived successfully in Eurasia for nearly 200,000 years. They were not mere brutes or scavengers, as occasionally portrayed. Evidence from 60,000 years ago indicates that Neanderthals buried their dead ceremonially with medicinal plants or flowers. Even more important, they carried a version of the FOXP2 gene associated with human language ability. Shorter and stockier than *H. sapiens*, Neanderthals eventually disappeared along with *Cro-Magnons*, our ancestors in western Europe. When we hear stories of elaborate cave paintings and burial sites in France and Spain, it is the Cro-Magnons who were responsible. In their book, *Biology, Evolution and Human Nature*, Timothy Goldsmith and William Zimmerman describe Cro-Magnons as “intellectually and emotionally very much the same as ourselves.”⁵

The bottom line is that when you think of ancestors, you’re likely to stop the search at the level of great-grandfather. When you think of history, images of George Washington often come into view. Neither is particularly relevant to the issues in this book. The ancestors we have in mind here are shared by you, me, and George Washington. We’re talking about our *species’* ancestors. Whether we like it or not, the solutions to their numerous struggles are reflected in our genome today. For better or worse, their successes are translated into the mental and physical equipment we carry with us in the modern world. We’re talking about far more than eye color or hair texture. These are about basic species-wide human qualities and predispositions. They are there whether your hair is curly or straight, blond, brunette, or receding fast.

And there you have it. A journey that began its final leg about 6 million years ago, simmering without much change for much of that time, suddenly coming to a boil in the last half a million years and then reaching a frenzy of activity during the past 50,000 to 100,000 years—an era called the Pleistocene. This “history” is plainly very different from the images conveyed by Julius Caesar, Abraham Lincoln, or World War II. It is also ancient and lengthy. And through it all, our species was undergoing physical and mental changes that best adapted it to life under conditions that barely resemble our present world. The genetics that underlie these adaptations were carried forward even after they ceased to be particularly useful. As the expression goes, “Evolutionary wisdom is paleo-wisdom.” It is always out of date. It reflects where we came from. The proverbial Cradle of Life where our minds were formed.

THE ILLUSION GENERATOR

The human mind is an illusion generator. Since you *have* a human mind, that statement probably either feels wrong or like an insult. It is neither. Patterns are everything to us. We hunger for them. We revel in them. They are the basis for art, literature, music, and much more in our lives. But our perceptual system that is so geared to wrestling patterns out of complex arrays of stimuli is bound to produce some false positives. From time to time we are going to see or hear what is not there, and

those cases will seem no less compelling to us. They are the territory of this book.

You have sense organs (we'll focus on the eye and the ear) and an apparatus for interpreting the information those organs provide. That's where your mind comes in. Strictly speaking, we are talking about your brain, which is a modular organ. Our focus here is with the *interpreter function*—the part of your brain that takes all those raw sensory impulses just forwarded by your eyes or ears and does its job by trying to make sense of what it has registered. There are a lot of other jobs your brain does—regulates your body temperature, controls your arousal level, modulates your response to pain in your left foot, and so on. All of those things and a lot more are beyond the scope of this book. It is the function of the brain we loosely call “the mind” that is our focus.

Technically speaking, our eyes and ears are flawed too. Yes, they are a marvel of engineering that took millions of years to evolve. But they are incomplete: they are not responsive to all the sights and sounds out there. In fact, they are responsive to a very narrow range of what exists around us. Imagine a line stretching for over a mile. It represents all the stimuli, the physical waveforms if you prefer, that you might see or hear. Now imagine going up to that very long line and sticking a pin into it. The head of that pin represents the range of stimuli you can actually see and hear. All the rest in both directions is beyond your capability. For some people, that news alone is startling. They've always assumed they can see and hear everything there is to see and hear. It's true that older folks may need eyeglasses or a hearing aid, but prior to that all the sensory information in the world must have been getting through, right?

Nothing could be further from the truth.

As rich and beautiful as the world may look and sound to us, it is based on a tiny little bandwidth of raw sensory information that we manage to glean. For example, wavelengths longer than those for the color “red” are called “infrared.” We cannot see them. Similarly, wavelengths shorter than those for the color “violet” are called “ultraviolet.” Again, we are blind to such energy, although it is measurably present all around us. Our ears are similarly insensitive to sound waves that lie above and below the audible part of the spectrum (roughly between 20 and 20,000 Hz or cycles per second). That energy is there. Some of it we might have heard when we were younger or before we attended too many rock concerts. But, even then, we were relatively impoverished. Those other wave frequencies just couldn't get through. Our problem was simply that we are human.

Nevertheless, the information we do see and hear seems enough; it constitutes reality to us and gives us the illusion of a complete world. We may be vaguely aware that other animals see and hear different things than we do. Dogs (and rats and many other mammals) can hear high-frequency sounds we can only imagine. Bees can see polarized light; hawks can see accurately at distances we can approximate only by using high-tech intervention.

But, the truth is, none of these sensory deficits matters as much as the limitations of our mind. We don't *need* to see and hear everything out there. We are getting more than enough raw sensory information to function at a very high level. It is what we make of those raw sensations that creates our problems. Those cognitive and perceptual problems are the subject matter of this book. The science of psychology makes the distinction between sensation and perception. Sensation refers to the structure and activity of our sense organs. Again, that is not the focus of this book. Perception, on the other hand, is how we perceive the world is the story of what our minds do with those raw sensory inputs. Once our minds get involved in the process, we are in for a bumpy ride.

Most Introductory Psychology textbooks contain sections on optical illusions. There are relative

few of them and they are well studied. Most students enjoy reading about them because, like watching magic tricks, they provide some excitement. They violate your expectations and create experiences that you *know* can't be happening in the real world. But even optical illusions are just a hint of the mental distortions that are part of our everyday lives.

Introductory Psychology books also contain sections on common errors in thinking. These come a lot closer to our concerns here. Compared to optical illusions, these cognitive shortcomings are less well studied, although that is starting to change. They go by different names such as “heuristics” and “biases” and often appear in chapters of Introductory Psychology books labeled “cognitive psychology.”⁶ There is even some controversy over whether they are assets or liabilities. In truth, they are both. The real problem is our failure to recognize them for what they are and take steps to remedy them.

Let's consider a simple example. If you depended strictly on a literal interpretation of your sensory evidence, there would be good reason to believe that (1) Earth is flat, and (2) the sun, moon, and stars rotate around our planet, which remains fixed at the center of the universe. In fact, that is exactly what people believed until fairly recently in human history. They did not question the evidence of their senses and found it both threatening and, in some cases, quite offensive to have these beliefs challenged.

The reason their beliefs were challenged is that scientific advances provided more-sophisticated ways of gathering evidence. This new evidence became more and more difficult to ignore and it bore directly on how we saw our planet and its place in the solar system. As word spread, it became increasingly threatening to certain institutions whose power was vested in the status quo, no matter how wrong it was. The Catholic church, for example, used all the authority at its disposal to suppress the idea that Earth revolved around the sun, and it brought severe penalties (ranging from excommunication to death) to those, such as the astronomer Copernicus, who professed an alternative viewpoint. Institutional resistance is not uncommon in cases where science challenges widely held but outdated viewpoints. Although not as powerful as the Catholic church, there remains to this day a Flat Earth Society.

This is not simply ancient history. It has everything to do with issues facing us today. Ask yourself why flat earth and center of the solar system beliefs were so widely held a thousand years ago. The answer quite simply is that the human mind did the best job it could with the available evidence of its senses, and that the conclusions it reached, however wrong, were socially supported. The person on the street in the year 1242 had essentially the same mind you do. He had far less information than you have, but he was subject to the same perceptual illusions, needs, and social pressures that you are. Arguing about Earth's place in the universe made no sense because, as far as he could tell, the status quo seemed right. Moreover, it felt good, even comforting, to think that he and his family were important enough to be living at the center of the universe. And, speaking of his family, they also seemed to share this view, as did his closest friends and associates. Challenging this view, even if he had some evidence or doubts, would only bring conflict. Life was stressful enough already.

And so for many years Earth remained flat and at the center of the universe, at least according to popular belief. Don't make the mistake of believing that such ignorance or defensiveness was confined to the Middle Ages. Transitional times, as far as ideas are concerned, are often ugly periods in human history. Arguably, such ignorance and resistance are even more egregious during more enlightened times like the present.

In some ways, we are the lucky ones. Our civilization has never been as knowledgeable as it is today. There has never been as much scientific understanding of the world around us as there is right at this moment. We have put many faulty beliefs behind us. Yet, because our minds are no more evolved than they were a thousand years ago, we are just as vulnerable to illusion, comfort, and social pressure as our ancestors were. Faced with incomplete sensory evidence, we are just as likely to come to wrong conclusions and then fight passionately to maintain those views because of the comfort and stability they provide. We may be less ignorant than our ancestors, but all the hard-won additional information does us no good if we don't let it inform our thinking.

TWO TYPES OF ERRORS

Broadly speaking, there are two ways you can make a perceptual mistake: You can fail to see something that is there, or you can see something that isn't there. Neither is good, but as errors go, these two mistakes may not be equally costly. Imagine that you're in charge of designing the justice system for a new society. If your citizens decide the worst thing that can happen is to let a murderer go free, then you will require a fairly low standard of evidence. In this way, you'll probably catch every murderer in sight. Nobody will escape detection. The problem is, you'll probably also prosecute a few people who weren't actually murderers. Think of these as *Type I errors*. By allowing a few *Type I errors* (i.e., "false positives") to occur, you worry a lot less about real murderers going free. Those are called *Type II errors*, and you've just about eliminated them in your system.

But imagine that your new justice system has a different set of priorities. What if its primary concern is to never execute an innocent man. In other words, *Type I errors* are absolutely intolerable. And so you raise the threshold for a conviction so high that you can virtually guarantee that no innocent person will be wrongly executed. Of course, in doing so, it's likely that a few real murderers will get away.

This simple lesson in statistical decision theory makes an important point. The probability of *Type I* and *Type II* errors are related. You decide which is more important to you and set the threshold accordingly. There are always risks of errors occurring when you make decisions based on incomplete information. You simply have to decide which of the two kinds of mistakes will be better tolerated. I have many middle-aged male friends who debate the merits of a PSA test for prostate cancer. The test almost never misses an actual case of the disease, but it is notorious for false positives. As a potential victim of the disease, would you want to be sure that nothing life threatening has slipped by undetected, even if it means worrying needlessly after being told about a condition you actually didn't have?

Natural selection of the human perceptual system faced these issues quite some time ago, and it's not clear which approach to the *Type I* versus *Type II* errors it took. Imagine the following scenario. One of your ancestors is walking through the forest and sees something on the path ahead. It might be a predator. Then again, it might be a random array of shapes and textures amounting to nothing. If he believes it to be dangerous, he takes the appropriate defensive steps. Perhaps he freezes or arms himself or flees. What's the best that can happen? He survives a lethal encounter and gets to live and function another day. What's the worst? A false positive. He finds himself with heart pounding, pulse racing, hiding behind a tree with a spear drawn for no good reason. It was only a pile of twigs on the path. He's wasted some effort and experienced a baseless fear. But he gets to go home, eat dinner, and

snuggle with his mate. Maybe he's even got a good story to tell, if such things were part of hominin social life.

Now consider an alternative scenario. The same individual sees something ahead that might not constitute a threat. Rather than assume the worst and squander some autonomic arousal, his perceptual system does not integrate the shapes and register the pattern as a threat. The best that can happen? He saves some calories, does not flee or freeze needlessly, and can boast a perceptual system more finely attuned to physical realities around him. The worst that can happen? A false negative, or Type II error. By not interpreting those stimuli as a threat, he fails to flee. Type II errors in this context are probably fatal. This hypothetical hominin is less likely to become anybody's ancestor.

In short, perceptual accuracy was not an agenda of natural selection. Survival and reproduction were. The worldview of this less successful hominin may have been more realistic than that of his neighbor who scampered away from nearly everything and also saw faces in the clouds. But, again, accuracy wasn't the real concern. Survival and reproduction were. Over time, natural selection probably favored perceptual systems and pattern detectors that were hyperreactive enough to make their share of Type I errors. In a perilous world, Type I errors tend to be less costly. And one of natural selection's mottoes has always been, "Better deluded than dead."

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