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 b fuzzy and they were never shoved down my throat. My parents and extended family tolerated ar manner of questions; in fact, they seemed to enjoy them. I grew up assuming that Jews, indeed peop of all religions, loved to discuss and debate their faith. Obviously, I was wrong. My parents wante and expected me to be a good boy. Being smart and being kind were the two biggest virtues in ou home. Both were independent of religious training or pressure of any kind. I was never threatened wi God's vengeance or "going to hell." I couldn't even imagine such things. There were other, gentl incentives for "being a mensch."

One way or another, I've been writing this book for over thirty years. That means I have countle students and colleagues to thank, whose influence was indelible. None more so than Harry Hurwitz, fine a friend and mentor as one can have. I am also thankful to Martin Daly, who in the course casual conversation informed (or perhaps reminded) me that I was an evolutionary psychologist. H 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 man sometimes bizarre forms. There seemed no limit to them. Fortunately, these friends were also willin to discuss the ideas they had provoked and critique what I had written about them. I thank Dou Reberg and Scott Parker for their insights. I also thank Kat Bergeron, Chris DiCarlo, Alan Wildema Loren Lind, and Colin Escott for their contributions. I am also grateful to Chris Scimmi, a fine artis 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 Susa Simmons for those simple "How's the book coming?" or "What did you write about today?" queries. 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 th late Steven Jay Gould. Gould and I were born in the same year and we both grew up in New York—h in Queens and I in the Bronx and Yonkers. We disagreed strongly about the virtues of evolutionar psychology, but we shared the broader conviction that comfort is a poor substitute for rationality shaping one's worldview. When Gould and I found ourselves sitting side by side at dinner after h commencement address at my university, we talked nonstop. Almost all of it was about baseball. N baseball as a metaphor for life or natural selection, but baseball as a game we had both played 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 they would have been pleased that I was happy with the result and had thoroughly enjoyed the proce of creating it.

INTRODUCTION

Diana Duyser saw the face of the Blessed Virgin staring up at her from a grilled cheese sandwich sh had begun to eat. The Florida resident sold the remainder of her meal on ebay.com for $37,00 Guadalupe Lopez, the mother of actress Jennifer Lopez, walked into a casino in Atlantic City to pla the slot machines. She eyed the huge prize, uttered a few heaven-bound words, then sat down to pla Before the dust cleared, she had won a jackpot of $2.4 million. In the press conference that followe Ms. Lopez called her winnings "proof of the power of prayer."

Few Americans would disagree with her. A June 2008 survey[1] revealed that about a third Americans believe they receive answers to "prayer requests" at least once a month. Eighty percent respondents believe in angels and demons as active forces in their everyday lives. This goes beyon mere belief in God, which clocks in at about 92 percent according to the same poll. No one was doin formal surveys of superstitious belief or religiosity in medieval Europe, but it's hard to imagine th 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 prim examples of what we will refer to as *Caveman Logic*. So is our tendency to utter a reflexive "Thar God!" when something good happens to us, or to blame vengeful deities or spirits when natur disasters occur ("New Orleans must have had it coming!"). Fear, irrationality, and superstition ar rapidly moving to the mainstream of American culture. International surveys confirm that the Unite States has lost its preeminence in education and science. In their stead, we rival Middle Eastern ar 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 th boundaries of medical knowledge. But we also show the sophistication of a Neanderthal in evaluatin fragmentary evidence and are still prone to reaching conclusions about ghosts, "signs," and magic powers in the world around us. We can design and repair rocket engines, but most humans are unabl to confine that primitive part of their minds to the back burner. Caveman Logic continues to infor 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 hate to pick on cavemen and stigmatize them any further. Cavemen have been turned into caricatur in popular culture by everything from cartoons like *The Flintstones*, *B.C.*, *Alley Oop*, and *The Far Si* to a series of highly successful commercials by GEICO Insurance ("So simple, even a caveman can d it").[2] These depictions all convey misinformation for comic effect. But there is one trait we can b pretty sure of: cavemen were not very bright. Few of us would consult a caveman for financial romantic advice; nor would we want to worship with one. Yet, in a sense, we do all three. That's ho 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 the everyday affairs, these kinds of activities remain alarmingly widespread. Why are we so illogical an why do we reach similar superstitious conclusions the world over? This book examines both of the questions and finds answers rooted in evolutionary psychology.

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

approach attempts to understand humans as part of the biological world in which they evolved. Ma
of those puzzling, irrational behaviors may stem from adaptations made by our ancestors. If so, we a
stuck with mental modules that weigh us down in both laughable and dangerous ways. That ment
equipment we carry in our modern skulls is over a hundred thousand years out of date. But instead
challenging our limitations and trying to remedy their effects, we create cultural institutions th
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 survivi
and reproducing and contributing to the chain of events that led to us. Their world was very differe
from ours and they understood a lot less about their place in it. Most of what we inherited from the
mentally speaking, is pretty impressive. From an evolutionary point of view, we are the descendan
of a long line of successful competitors. But times have changed. The Pleistocene Age, when the bu
of human evolution took place, is over, although it left some deep marks on our minds. Fortunatel
they weren't written in indelible ink.

Is this book taking potshots at a few primitive and superstitious individuals? Has magical thinki
gone the way of the Middle Ages, if not the Stone Age? Sadly, the answer to both questions is n
Caveman Logic is alive and well in our everyday lives. Our ancestors who made it through th
Pleistocene Age did so with brute force and a brain full of "primitive instincts." Most of that bru
force is long gone or illegal, but some very primitive forms of mental life are still with us toda
Worse yet, those cognitive and perceptual flaws often function unchallenged in our daily lives. The
roots may lie in the Pleistocene Age, but their costs in the modern world are very real. Those winne
in the relentless competition that preceded us passed along everything they had. We got the fu
package, warts and all. At best, we are saddled with too many mistaken beliefs. At worst, we may en
up annihilating each other.

We need to see our defective Stone Age minds for what they are if we ever hope to drag ourselve
kicking and screaming, into the twenty-first century. This book advocates a difficult transition fro
the Pleistocene to the modern age. Our bodies seem to be standing up rather well; it's our minds th
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 abo
how we use our minds. We may be predisposed to Caveman Logic but we are not bound by it. Biolog
is not destiny.

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

Caveman logic persists for another reason as well: it receives social support. That's no sma
incentive when it comes to human behavior. We are arguably the most social species on the planet an
consensual validity counts for a lot with us. But we can level the playing field a bit by developin
support systems for those courageous people who do question their Stone Age reactions. At presen
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 tal
those first few halting steps out of the Pleistocene night is the agenda of this book. It's time to unloc

the manual override portion of our brains, put those primitive autopilot settings into storage, an
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 taug in high school and portrayed in films, doesn't begin to do justice to what our species has been throug

Going back two hundred years for an entertaining "historical drama" leaves us squarely in mode times, evolutionarily speaking. Other than different hair and clothing styles, that brief journey hasn begun to move us out of the modern world. Even if we go back to the time of Jesus or, further yet, Greek civilization, we're still in modern times. Gone are the trains, planes, automobiles, and iPod but if we could magically visit these times and places, we'd still see recognizable humans acting 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 tim The hominids that would eventually become humans split away from a common ancestor, leaving th apes behind about 6 million years ago. Those early proto-humans went through a hell of a lot so yo could download music and buy airline tickets online. The selection pressure on them to survive an reproduce was tremendous, and living conditions were harsh beyond our imaginations. The physic appearance of these early hominids was also different from what we take for granted today. Physic changes were evolving and accumulating slowly in both the minds and the bodies of our ear ancestors.

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

Plainly, evolution through natural selection only works on traits that have a genetic basis. Heredi is the cornerstone of Darwinian theory. Without it, the effects of natural selection would be confine to a single generation. Every generation would be starting from scratch. If some trait (e.g., a snazz new hairstyle) were acquired during an individual's lifetime, then natural selection could do nothin with it other than conferring some transient rewards (perhaps a few more sexual partners). Here o Earth, almost every important behavioral and physical feature of plant and animal life is transmitte genetically and is directly vulnerable to selection pressure. Thus, traits that lead to great reproductive success eventually spread and often become standard equipment for a species.

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

will be carried into the next generation. The final results also depend on the genome of the sexu partner. For all the pleasure it produces, sexual reproduction also carries some disadvantages. Th 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 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 consciou indeed, it rarely is, even among our own species. Human mating rituals, whether practiced at hig school dances or in so-called primitive societies in the Amazon basin, are only one example of this. zoologist could dazzle us with stories of how other animal species choose or attract partners. One my favorites involves the gladiator frog (*Hyla rosenbergi*). As in most species, the female is ver particular when it comes to choosing the father of her offspring. Since "toughness" is a desirable tra in this pugnacious species, the female practices a very simple screening technique. She approaches h potential mate and literally does her best to knock him off his feet. If she succeeds, that's one M Froggie that won't get lucky with her.

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

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

At a time when debates over the teaching of evolution are turning neighbor against neighbor an throwing local school districts into chaos, it would seem criminal not to bring combatants to common understanding. *Then* let them debate. This has plainly not happened and is a glaring fault the American educational system. When students tell me (as they occasionally do in Introductor Psychology classes) that they do not accept Darwin, I usually ask them what they mean. I cannot reca a single occasion when such a forcefully opinionated student has gotten it right. The most freque response is, "It means we come from monkeys." Who wouldn't reject that? Whether by incompeten 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 do 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 bas premises. Susan Blackmore concludes in her book *The Meme Machine*, "If there is a replicator th makes imperfect copies of itself, only some of which survive, then evolution simply *must* occur. . The inevitabilty of evolution is part of what makes Darwin's insight so clever. All you need is th

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 a replicators. Human beings replicate sexually. Some anti-Darwinians may be uncomfortab acknowledging that process, but it is nonetheless true. I have never heard an anti-Darwinian deba heredity. Most, if not all, accept that we pass along our genetic information, which is then combine with our partner's contribution to form a new organism. That is not contentious. The fact that o offspring are composed of a mixture of maternal and paternal DNA is also not contentious. Every ge 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 "make imperfect copies" part? This simply means that copying errors occur. They don't occur ve frequently (maybe about one in a million), but they do occur. These errors are called *alternati alleles* or, more commonly, *mutations*. They result in some change in the phenotype. Most of the tim they are inconsequential. When they do matter, they are usually negative. In other words, the ancestr allele was a better deal than the mutated one. And so the mutation does not spread in the populatio But the important point here—and it is indeed a central point to natural selection—is that mutation those inevitable copying errors, provide variation in the human genome. Variation is *good*. Yo wouldn't want uniformity or perfection. Those errors are essential to the survival of the species. there were no errors (i.e., if copying were perfect), there would be no variation among phenotypes ar 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 left side. What's next? Those slight variants go forth into their environments and some of them c better than others. You might not like the idea of competition, but it is an inevitable part of life on th planet. Some of those mutations result in greater reproductive success than others, as members of th species compete with each other for precious resources. The environment is a filter, and some trai lead to greater reproductive success than their alternatives.

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

And there you have it. An absolutely blind and lawful process without values or agendas. It may n be the stuff of fairy tales or creation myths, but it grinds away in its relentless way, producin outcomes. My colleague Martin Daly has stated it eloquently: "Natural selection doesn't have goal but it's the reason organisms do."[2] That's a wonderful summary of life on this planet, although th idea is a bit difficult for some people to grasp. It also doesn't help that natural selection moves ve 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 Darwin's fault, any more than Newton was responsible for the law of gravity. In any case, natur selection is part of a world full of wonder, willing to reveal itself as we ask the right questions an pool our knowledge. The universe is no less thrilling as we gradually uncover its secrets and confro its mysteries. And we do so using the splendid intelligence our species has evolved. What could b more uplifting than that?

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

THROUGH A MICROSCOPE DARKLY

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

If stretched out for display, every cell in your body contains about six feet of DNA. Every nin hundred cells therefore produce over a mile of DNA. Because the human body contains as many 100 trillion cells, our bodies house over a billion miles of DNA. That's a pretty large number. Th 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 chimpanze genomes side by side, the degree of similarity has grown. Other than making glib statements lik "Humans and chimps are more related than mice and rats," what do we really know? As I write this 2008, it seems the less I say about this area of research, the better. Almost anything is likely become obsolete in short order. Craig Venter has decoded the human genome and made his ow diploid genome available on the Web (www.jcvi.org).

We have watched estimates of the "degree of overlap" between human and chimpanzee increas from 97 percent to nearly 99 percent in the span of less than ten years. At the same time, estimates the number of base pairs in the human genome seem to be dropping at a steady rate. Prior to mappin the human genome in 2000, estimates of the number of human genes were fixed at about 100,00 Shortly thereafter, that number fell to about 25,000, a dramatic drop by any reckoning. Had I writte this book a year ago, that number would have stood at about 22,000. By the time you read this, it ma lie below 20,000. The estimate keeps shrinking, yet the human genome remains firmly in plac 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 an express themselves, thus turning a genotype into a phenotype. The switches that turn genes on and o are not well understood. Some of them lie within the genes themselves. Others are thought to l

within the so-called “junk DNA,” poorly understood matter that comprises the large majority of th genome. The picture is even more complicated. In 2006, it was reported that individual differenc may result from previously undetected variations in the number of times that certain key genes a copied in the genome. Preliminary findings suggest that entire sequences may be repeated as many ten times, differing widely between individuals and yielding differences in the overall “copy numbe of genes. Perhaps we have ignored material such as this or “junk DNA” for too long, focusing instea on the more obvious proteins that were easier to measure and investigate.[3] In any case, high scho genetics books (often called molecular biology texts in universities) are losing their resale valu 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 tw hundred thousand years ago) lived in small nomadic bands. A lot of inbreeding occurred and most o the persons within the band were genetically related. They made a living by hunting together an gathering nuts and fruit that grew locally. These activities were fraught with peril. Animals that wer being hunted for food had no interest in being eaten. They had their own concerns about survival an reproduction and vigorously resisted our attempts to turn them into table scraps. Even nuts and berri that were available locally presented difficulties for our ancestors. “Nuts and fruit” may sound like healthy diet today, but much of that locally grown produce had an agenda of its own that probably d not include traveling through a human digestive system.

In short, food sources were, to quote a vivid description, “scarce and antagonistic.” Food acquisitio and storage were only a few of the daily problems facing our hominin ancestors. *Hominin* is the ter we want here, since we’re concerned with only humans and chimps, not with the other great ape Their survival was also threatened by environmental predators. Some of them were other human 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 o 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 Miami have nothing on so-called primitive cultures and, presumably, the Pleistocene world in whic our ancestors lived.

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

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

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

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

For well over 3 million years after splitting away from the apes, our species remained large unchanged socially, cognitively, or physically. These early hominins were not very impressive b 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 conjecture. The results were a series of dramatic changes to our ancestors that led to a near doubli in the size of their brains and an exodus from the African continent by *Homo erectus*. Compressing million years of hominin history into a paragraph or two can only trivialize or omit important event but the bottom line is this: over this period, our species grew in stature, dispersion, and intelligence. is the last of these that mattered most. Competition for finite resources on the planet has alwa included species and individuals who were stronger or more numerous than our ancestors. But t competition was never smarter.

By 500,000 years ago, our ancestors were busy defining their dominance. When we think ourselves as a species, we are usually picturing the anatomically modern version known as *Hom sapiens*. But there is a direct line between the modern *H. sapiens* and earlier hominins li *Australopithecus*, *Homo habilis*, and *Homo erectus*. The physical changes, most notably in stature a 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 ma crucial changes in our species. Probably the two most important changes, in terms of what our liv have become today, were language and domestication. It is virtually impossible to overstate t importance of language in defining who we are or our range of accomplishments. Communication widespread within the animal kingdom; language is not. Using labor-intensive procedures, we m train a chimpanzee or a parrot or a gorilla to ask for a tickle or tell us the number of items on computer screen. But as we know and employ it every day, language remains the sole domain of o species. Indeed, getting a human *not* to learn language is quite a feat. How important is language other aspects of human accomplishment? Make your own "Top 10" list and try to imagine any those feats emerging without written or spoken language.

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

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

We were not always the only human species on the planet. Most people know that other human came *before* us but are surprised to learn that different species of humans lived at the same time. Th most conspicuous example is *Homo neanderthalensis*.[4] Neanderthals, who have become figures almost cartoonlike proportions in popular culture, were actually successful competitors who lived recently as 28,000 years ago. *H. sapiens* and Neanderthals diverged from a common ancestor abo 370,000 years ago, and Neanderthals lived successfully in Eurasia for nearly 200,000 years. They we not mere brutes or scavengers, as occasionally portrayed. Evidence from 60,000 years ago indicat that Neanderthals buried their dead ceremonially with medicinal plants or flowers. Even mo important, they carried a version of the FOXP2 gene associated with human language ability. Short and stockier than *H. sapiens*, Neanderthals eventually disappeared along with *Cro-Magnons*, o ancestors in western Europe. When we hear stories of elaborate cave paintings and burial sites France and Spain, it is the Cro-Magnons who were responsible. In their book, *Biology, Evolution an Human Nature*, Timothy Goldsmith and William Zimmerman describe Cro-Magnons a "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 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 a shared by you, me, *and* George Washington. We're talking about our *species'* ancestors. Whether w like it or not, the solutions to their numerous struggles are reflected in our genome today. For better worse, their successes are translated into the mental and physical equipment we carry with us in th modern world. We're talking about far more than eye color or hair texture. These are about basi species-wide human qualities and predispositions. They are there whether your hair is curly straight, blond, brunette, or receding fast.

And there you have it. A journey that began its final leg about 6 million years ago, simmerin without much change for much of that time, suddenly coming to a boil in the last half a million yea and then reaching a frenzy of activity during the past 50,000 to 100,000 years—an era called th Pleistocene. This "history" is plainly very different from the images conveyed by Julius Caesa Abraham Lincoln, or World War II. It is also ancient and lengthy. And through it all, our species wa undergoing physical and mental changes that best adapted it to life under conditions that bare resemble our present world. The genetics that underlie these adaptations were carried forward eve after they ceased to be particularly useful. As the expression goes, "Evolutionary wisdom is pa 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 probab 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 perceptual system that is so geared to wrestling patterns out of complex arrays of stimuli is bound produce some false positives. From time to time we are going to see or hear what is not there, an

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 th information those organs provide. That's where your mind comes in. Strictly speaking, we are talkin about your brain, which is a modular organ. Our focus here is with the *interpreter function*—the pa of your brain that takes all those raw sensory impulses just forwarded by your eyes or ears and does i 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 yo left foot, and so on. All of those things and a lot more are beyond the scope of this book. It is th 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 tha took millions of years to evolve. But they are incomplete: they are not responsive to all the sights an sounds out there. In fact, they are responsive to a very narrow range of what exists around us. Imagin a line stretching for over a mile. It represents all the stimuli, the physical waveforms if you prefe that you might see or hear. Now imagine going up to that very long line and sticking a pin into it. Th head of that pin represents the range of stimuli you can actually see and hear. All the rest in bot directions is beyond your capability. For some people, that news alone is startling. They've alway assumed they can see and hear everything there is to see and hear. It's true that older folks may nee eyeglasses or a hearing aid, but prior to that all the sensory information in the world must have bee 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 raw sensory information that we manage to glean. For example, wavelengths longer than those for th color "red" are called "infrared." We cannot see them. Similarly, wavelengths shorter than those fo the color "violet" are called "ultraviolet." Again, we are blind to such energy, although it measurably present all around us. Our ears are similarly insensitive to sound waves that lie above below the audible part of the spectrum (roughly between 20 and 20,000 Hz or cycles per second). Th energy is there. Some of it we might have heard when we were younger or before we attended to many rock concerts. But, even then, we were relatively impoverished. Those other wave frequenci 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 giv us the illusion of a complete world. We may be vaguely aware that other animals see and hea different things than we do. Dogs (and rats and many other mammals) can hear high-frequency soun we can only imagine. Bees can see polarized light; hawks can see accurately at distances we ca 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. W don't *need* to see and hear everything out there. We are getting more than enough raw senso information to function at a very high level. It is what we make of those raw sensations that creat problems. Those cognitive and perceptual problems are the subject matter of this book. The science psychology makes the distinction between sensation and perception. Sensation refers to the structu and activity of our sense organs. Again, that is not the focus of this book. Perception, on the oth hand, is. How we perceive the world is the story of what our minds do with those raw sensory input 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 watchi magic tricks, they provide some excitement. They violate your expectations and create experienc that you *know* can't be happening in the real world. But even optical illusions are just a hint of t mental distortions that are part of our everyday lives.

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

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

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

This is not simply ancient history. It has everything to do with issues facing us today. Ask yourse why flat earth and center of the solar system beliefs were so widely held a thousand years ago. Th answer quite simply is that the human mind did the best job it could with the available evidence of i senses, and that the conclusions it reached, however wrong, were socially supported. The person on th street in the year 1242 had essentially the same mind you do. He had far less information than yo have, but he was subject to the same perceptual illusions, needs, and social pressures that you ar Arguing about Earth's place in the universe made no sense because, as far as he could tell, the statu quo seemed right. Moreover, it felt good, even comforting, to think that he and his family we important enough to be living at the center of the universe. And, speaking of his family, they a seemed to share this view, as did his closest friends and associates. Challenging this view, even if h 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 popular belief. Don't make the mistake of believing that such ignorance or defensiveness wa confined to the Middle Ages. Transitional times, as far as ideas are concerned, are often ugly period 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 today. There has never been as much scientific understanding of the world around us as there is rig at this moment. We have put many faulty beliefs behind us. Yet, because our minds are no mor evolved than they were a thousand years ago, we are just as vulnerable to illusion, comfort, and soci pressure as our ancestors were. Faced with incomplete sensory evidence, we are just as likely to con to wrong conclusions and then fight passionately to maintain those views because of the comfort stability they provide. We may be less ignorant than our ancestors, but all the hard-won addition 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 se something that is there, or you can see something that isn't there. Neither is good, but as errors g these two mistakes may not be equally costly. Imagine that you're in charge of designing the justi system for a new society. If your citizens decide the worst thing that can happen is to let a murder go free, then you will require a fairly low standard of evidence. In this way, you'll probably cat every murderer in sight. Nobody will escape detection. The problem is, you'll probably also prosecu a few people who weren't actually murderers. Think of these as *Type I errors*. By allowing a few Typ I errors (i.e., "false positives") to occur, you worry a lot less about real murderers going free. Thos 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 prima concern is to never execute an innocent man. In other words, Type I errors are absolutely intolerabl And so you raise the threshold for a conviction so high that you can virtually guarantee that n innocent person will be wrongly executed. Of course, in doing so, it's likely that a few real murdere will get away.

This simple lesson in statistical decision theory makes an important point. The probability of Type 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 incomple information. You simply have to decide which of the two kinds of mistakes will be better tolerated. have many middle-aged male friends who debate the merits of a PSA test for prostate cancer. The te almost never misses an actual case of the disease, but it is notorious for false positives. As a potenti victim of the disease, would you want to be sure that nothing life threatening has slipped b undetected, even if it means worrying needlessly after being told about a condition you actually didn have?

Natural selection of the human perceptual system faced these issues quite some time ago, and it clear which approach to the Type I versus Type II errors it took. Imagine the following scenario. On of your ancestors is walking through the forest and sees something on the path ahead. It might be predator. Then again, it might be a random array of shapes and textures amounting to nothing. If h believes it to be dangerous, he takes the appropriate defensive steps. Perhaps he freezes or arm himself or flees. What's the best that can happen? He survives a lethal encounter and gets to live an function another day. What's the worst? A false positive. He finds himself with heart pounding, pul racing, hiding behind a tree with a spear drawn for no good reason. It was only a pile of twigs on th path. He's wasted some effort and experienced a baseless fear. But he gets to go home, eat dinner, an

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

Now consider an alternative scenario. The same individual sees something ahead that might might not constitute a threat. Rather than assume the worst and squander some autonomic arousal, h perceptual system does not integrate the shapes and register the pattern as a threat. The best that ca happen? He saves some calories, does not flee or freeze needlessly, and can boast a perceptual syste more finely attuned to physical realities around him. The worst that can happen? A false negative, Type II error. By not interpreting those stimuli as a threat, he fails to flee. Type II errors in th 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 wer The worldview of this less successful hominin may have been more realistic than that of his neighb who scampered away from nearly everything and also saw faces in the clouds. But, again, accurac wasn't the real concern. Survival and reproduction were. Over time, natural selection probably favore perceptual systems and pattern detectors that were hyperreactive enough to make their share of Type errors. In a perilous world, Type I errors tend to be less costly. And one of natural selection's motto has always been, "Better deluded than dead."

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