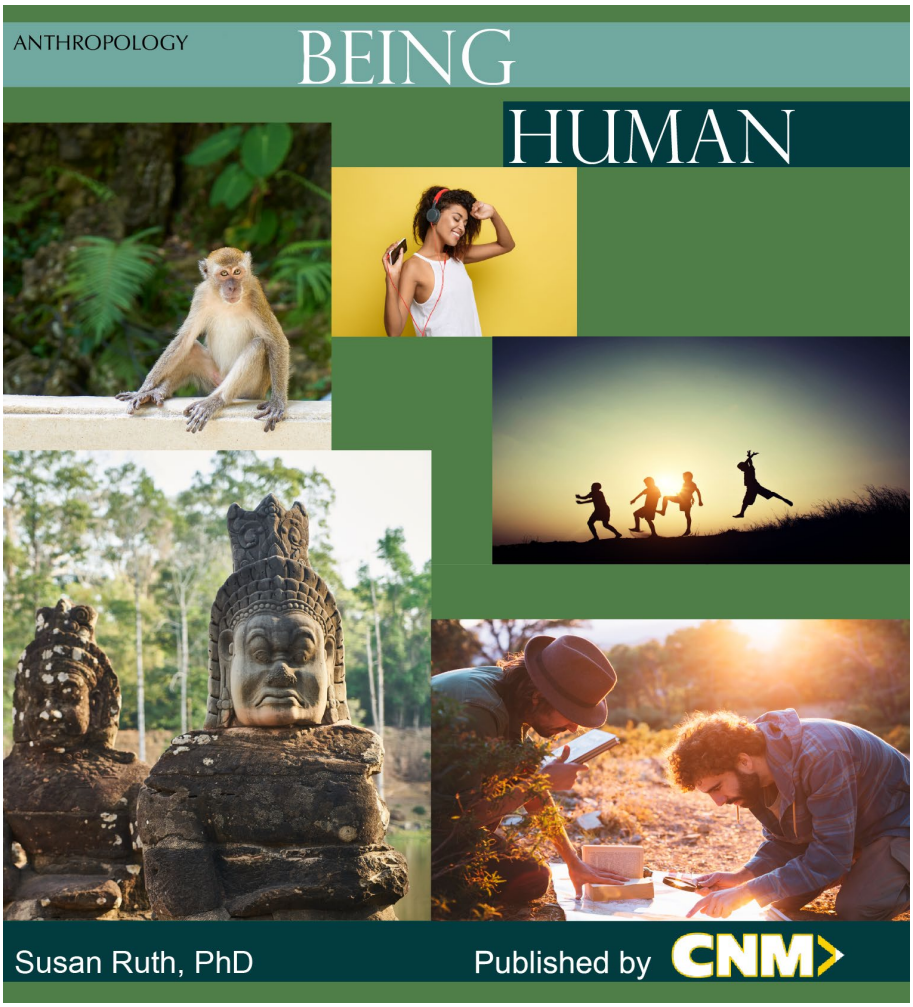
Anthropology: Being Human



Register

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Chapter 1: What Is Anthropology?

Happy people in PNG by eGuide Travel is licensed under CC BY 2.0

Every individual matters. Every individual has a role to play. Every individual makes a difference. The members themselves decide what they can do, individually or as a group, to make the world a better place."

—Jane Goodall, *With Love, 1994*

Men are born soft and supple; dead they are stiff and hard. Plants are born tender and pliant; dead, they are brittle and dry. Thus whoever is stiff and inflexible is a disciple of death. Whoever is soft and yielding is a disciple of life. The hard and stiff will be broken. The soft and supple will prevail.

— Lao Tzu

How I became an anthropologist.

In college, I took a sociology class, and the only thing I remembered from it was the Milgram study where people gave other people electrical shocks just because a man in a white lab coat said to. We learned that on the first day. Unfortunately, I didn't perform very well in that class, so, on a whim, I decided to take anthropology the next semester. I thought about what I could do to improve my academic performance and this "easy A" anthropology class would be my testing ground. "What would an academic advisor tell me to do?" I wondered, trying to get an outsider's perspective, without actually bothering to get an actual outsider's perspective. "Well," I thought, "I should probably read the book and take notes on each paragraph as I go. I should come to class, pay attention, and take lots of notes there too." My simple plan worked like a charm and that was a revelation for me. It didn't hurt that the information was fascinating, shocking, and even sometimes revolting (people tend to remember emotional stuff). The guy who sat next to me who got Bs and Cs asked me what my secret was, and I told him, "I read the book, take notes on everything, and come to class." He seemed disappointed.

But that wasn't everything. My next plan of action was to think about the information as it was presented. For instance, I would intentionally think, "Is that true?" "How does that relate to my history class?" "How did they test that?" This strategy also paid off and slowly things began to make more sense and I saw overlaps between different disciplines.

And so, even though I was an English major, I accidentally earned a dual degree in anthropology because I had taken so many anthropology electives. I didn't realize then that what I was doing was very anthropological. I got some distance from my issue by thinking of myself from an outside perspective. That is exactly what anthropologists do! They get try to distance themselves from their own cultural biases and automatic assumptions to see things differently. When I was thinking about how different subjects connected to anthropology I was thinking holistically. Anthropology is a holistic discipline, making connections between different parts of a culture, to understand how the whole system works. As it turns out, thinking like an anthropologist is not just helpful for understanding exotic peoples in strange, mysterious lands or discovering lost civilizations, but is a valuable tool for understanding oneself and for learning in general.

What is Anthropology?

Anthropology is the study of being human. While there are many different definitions of anthropology, I like this one, which comes from a student who took this class, for its elegant conciseness. The term "anthropology" literally means the study of humans (*Anthropos* is Greek for humanity). We are often fascinated with other people and even fascinated with ourselves, and why shouldn't we be? After all, within each human skull lies the human brain, which neuroscientist Christof Koch calls the most complex thing in the known universe (Flatow 2013). With our incredible brains, we can strive to know the world around us as well as ourselves. Knowing ourselves is the central challenge of anthropology.

Anthropology is not about a single aspect of humanity, such as our economic systems, political organization, religion, or biology. Rather, it is about all of these topics and how they intersect with each other. The discipline of anthropology covers all of human history, all the peoples of the world today, all the languages, all the technology, and our biology. Anthropology even extends its reach to other primates like apes and monkeys to understand how we are similar and different from those species. By keeping the perspective broad,

anthropology addresses some of the biggest questions of our day: Who are we? How did we get here? Where might we be headed?

How does one discipline even begin to address all these varied topics? To make things more manageable, anthropology is divided into four subfields, namely cultural anthropology, linguistic anthropology, biological anthropology, and archaeology. Cultural anthropology is interested in human culture and the diversity of human social life. Linguistic anthropology explores human languages and how they connect with culture. Biological anthropology studies human biology, especially physical variation in humans, fossil ancestors, genetics, and how biology intersects with human culture. Archaeology investigates the human past through material remains. There is also a fifth subfield that crosscuts the other four subfields called applied anthropology. This subfield uses anthropological techniques and concepts to help solve modern-day problems. Anthropology is considered a **holistic** discipline because it is interested in all aspects of humanity and takes a multitude of approaches to understanding the human condition. The Hmong of Laos have a saying, *hais cuaj txub kaum txub*, which means to speak of all kinds of things (Fadiman, 1997: 33). The Hmong recognize that many things are connected in some way, even if superficially they appear to be unrelated. And so it is with anthropology.

"Dog Sledding in Uummannaq, Greenland" is licensed under CC BY-NC-ND 2.0

Humans adapt both biologically and culturally to physical and social environments. Adaptation refers to how organisms cope with their environment. Himalayan sherpas of Nepal can climb Mount Everest far more easily than a New Yorker in part because they are biologically adapted to high altitudes by making more energy for the same amount of oxygen (Senthilingam 2016). Similarly, the Bajau "sea nomads" of Southeast Asia, known for their ability to hold their breath for long periods, may have a genetic adaptation to breath-hold diving.

Bajau children. Torben Venning, CC BY 2.0 <https://creativecommons.org/licenses/by/2.0>, via Wikimedia Commons

We also learn to adapt to our environments culturally. To live in extreme arctic conditions, we do not need a biological adaptation like a thick pelt of fur; we simply learn to sew a coat, build a shelter, and make fire. Because of the flexibility of culture, more than any other organism, we humans can occupy all environments of the planet from deserts to polar regions to the oceans and beyond the Earth itself. What's more, culture and biology are not separate and distinct systems but are rather intertwined (Sapolsky 2017). All traits are both genetic and environmental. We'll discuss how this can be in Chapter 8.

The Culture We Swim In

In Pulitzer Prize finalist David Foster Wallace's "What is water?" commencement address (Sullivan 2013) he tells a simple story: "There are these two young fish swimming along and they happen to meet an older fish swimming the other way who nods at them and says, 'Morning boys, how's the water?' The two young fish swim on for a bit, and then eventually one of them looks over at the other and goes, 'What the hell is water?'" What's true for fish in the water is also true for human culture. Culture is so pervasive, we don't even recognize that we are "swimming" in it all the time. Take a look around you. How many things do you see that weren't made, modified, or influenced by humans? What's more, we can become so accustomed to our own culture that when we see a different way of doing something, even something simple like counting or snapping, we can be taken by surprise because it never occurred to us that there was a different way to go about these simple, everyday actions. Anthropology also considers more fundamental features of cultures like marriage, rituals, and ways of getting food, that can seem radically different from the way we do things and what we think is normal.

Two important concepts in anthropology are cultural relativism and ethnocentrism. Cultural relativism means trying to suspend moral judgment to understand why people have certain practices and beliefs. That is, anthropologists try to suspend cultural assumptions about what is normal. Anthropologists don't condone practices simply because they exist but rather seek to understand the underlying causes. After all, few people would give the thumbs up to human sacrifice or torture simply because they are part of someone's culture or associated with someone's heritage. There is a kind of spiritual benefit to suspending judgment that allows us to gain perspective. This idea was captured 800 years ago by the Persian poet Jalāl al-Dīn Muḥammad Rūmī, better known as Rumi (1207–1273), in the lines:

Out beyond ideas of wrongdoing and rightdoing,
there is a field. I'll meet you there.

Cultural relativism not only provides a starting point for understanding other cultures but also allows a window into our own cultural biases. As anthropologist Michael F. Brown (2014:6) writes in his book *Upriver on* Amazonian cultures, "We become aware of the arbitrariness of deep-seated practices and beliefs only when forced to confront other societies whose customs differ from our own." Sometimes we need to look outside our own culture, the water in which we swim, to see it more clearly.

Huri Duna Dancers [PNG] WOMAD 11" by Peter Tea is licensed under CC BY-ND 2.0

The flip side of cultural relativism is ethnocentrism, which means using your own culture to pass judgment on another. Ethnocentrism is the idea that your own beliefs, values, and behaviors are the correct ones. You have probably heard the word "egocentric" used to refer to someone who considers a situation only from their viewpoint. Ethnocentrism is similar but from the perspective of an entire culture. Anthropology reveals that there are many ways of being human. Insights into the varieties of being human can reset how central and important we think we are. Sometimes this way of thinking can be threatening,

but it can also be intriguing, thought-provoking, and even inspiring.

The anthropological perspective not only helps us understand the world around us, but also can help us be better scientists, artists, and human beings. Steve Jobs once said, “Creativity is just connecting things…the broader one’s understand of the human experience, the better design we will have.” Though anthropologists are not in the business of creating new technologies, the idea behind the value of diverse experiences is the same. When we limit who we interact with or automatically reject certain ways of doing things, we limit our creative potential and ability to solve problems. By keeping our minds open to new ways of doing things and different people, we can understand other people better, understand ourselves better, and increase our ability to solve serious problems facing our world.

The WEIRD Problem

Anthropology is comparative, studying a broad range of human groups from hunter-gatherers to corporate culture. This comparative approach is important because if we only consider Western cultures, we would have a very skewed view of who humans are. The term “Western” refers to beliefs and values that have an origin in the European Renaissance and Age of Enlightenment. A well-known problem in psychology is that much research in that discipline has been based on people living in Westernized nations. This is largely because they are the most convenient subjects to study. American undergraduate students are common psychology research subjects—but are not a very representative cross-section of the world’s mental life. Psychologists recognize this problem and have labeled these subjects WEIRD—Western, educated, industrialized, rich, and democratic (Henrich et al. 2010). The acronym WEIRD is apt because most cultures have decidedly different beliefs and values than American college students as well as different life experiences. Anthropology casts its net beyond Western societies to try to circumvent the WEIRD problem and understand the human condition as a whole.

“WEIRD” CNM students. College students are typical subjects of psychology research. Photo: Sue Ruth

Quantitative vs. Qualitative

Anthropology is usually classified as a social science because it seeks explanations about human societies through careful observation and systematic analysis. Social scientists often look for general explanations and use quantitative methods, which means that some kind of measuring is involved. Anthropology also has elements of the humanities, in that it is interested in the diversity of human societies. This approach tends to be more qualitative, which involves explaining or describing a particular society or practice. Imagine an anthropologist is interested in recycling on campus. They might document how people feel about recycling, which would be a more qualitative approach. Another anthropologist studying recycling might take a quantitative approach by recording the items in the bin. The two approaches would provide different, but equally useful insights into recycling behavior and both are valuable in anthropology.

CNM Recycles! We have single-stream recycling, meaning all recyclables can go in the same bin. Click here to see what can go in the blue bins and rectangular bins

Cultural Anthropology

Cultural anthropology, or sociocultural anthropology, is the study of human culture. In everyday conversations, we might say someone who has excellent taste in art, music, and literature is "cultured." This, however, is not the definition of culture that anthropologists use. Everyone, no matter how uncouth, has culture. Culture has been defined in several ways. Nineteenth-century anthropologist E.B. Tylor defined culture as "that complex whole which includes knowledge, belief, art, law, morals, customs, and any other capabilities and habits acquired by man as a member of society." Anthropologist Conrad Kottak defines culture as shared traditions and customs that are transmitted through learning. Common to both these definitions is the idea that humans learn the traditions, laws, values, beliefs, and customs of their society. Perhaps more than any other species, humans rely on learning. The process of learning how to be a member of a society is called enculturation. Experiments show that human children have a strong expectation to be taught, to be enculturated. To paraphrase developmental psychologist Michael Tomasello, fish are born expecting water, and humans are born expecting culture (Roberts and Tomasello 2014).

Cultural anthropology is interested in how people are different and why they are different. People are often fascinated by what they consider exotic practices of other societies, whether it's dining on grubs or diving from a rickety tower to ensure a good yam harvest. But cultural anthropologists also study how all humans are alike. Features that are common to all human societies are known as cultural universals. Cultural universals include things like language, marriage practices, rituals, and kinship systems. There are no societies, for instance, that lack language or have no way of identifying relatives. Though cultural universals are common to all societies, their particular forms can vary tremendously. Cultural universals can be as interesting as human diversity because they get to the heart of what it means to be human, *Homo sapiens*.

Traditionally, cultural anthropologists do fieldwork, living with the people under study and engaging in participant observation. Cultural anthropologist Eduardo Kohn (Worrall 2014) calls participant observation "a kind of deep hanging out….spending huge amounts of time with people allowing oneself to be immersed in their world." Participant observation allows the anthropologist to experience what others are experiencing and to understand a culture from the inside. Needless to say, this is a difficult task and it often takes a year or more to learn the language and become accepted enough to ask questions about kinship, marriage, health, religion, and personal histories. As Michael Brown

(2014:41) writes of these difficulties during his fieldwork among the Awajún of the Peruvian Amazon, “What the devil am I supposed to do with myself in the months before I can ask a grammatically correct question?” Only when genuine and meaningful connections are made with people, can the anthropologist begin to ask meaningful questions.

Culture shock, anxiety as a result of being immersed in a foreign culture, is a common experience for anthropologists. Not knowing the language or appropriate behavior and being constantly misunderstood tend to make people, even anthropologists, seriously uneasy and isolated. Culture shock can produce a sense of “loss of self” and depression. Cultural anthropologist Michael Wesch describes the isolation and depression he felt during his first field experience in Papua New Guinea. It was only when he broke down and displayed his grief outwardly that people realized how devastated he felt. After that, he was able to make real connections with people and begin to learn from them.

Wesch also found that people rejected his money when he wanted to pay for something. Rather, they wanted to have a friendly relationship with him—someone they could rely on when they needed help, not just an anthropologist-visitor. What’s more, because of their social ambiguity, anthropologists often must be connected to people through a kinship term. It is not uncommon for an anthropologist to be adopted as someone’s son or daughter, and given a new name. This alleviates some of the social tension and uncertainty anthropologists cause when they enter village life. But the relationship with the anthropologist is also taken very seriously by the people themselves. A Kichwa man of Ecuador explained the problem with anthropologists, “They don’t realize how attached indigenous people become to them and how seriously we take it when we make them a part of our families” (Uzendoski 2005:13). As a result of becoming part of the fabric of village life, anthropologists need to commit to the people they are studying from the outset.

Linguistic Anthropology

Linguistic anthropology is related to cultural anthropology since much of

enculturation occurs through language. Linguistic anthropologists are interested in the diversity of human languages and the relationship between language and culture. As linguists Bruce Rowe and Diane Levine explain in *A Concise Introduction to Linguistics* (2006), "Speech, sign language, and writing is the way that linguistic knowledge gets out of your head and into the heads of others." With language, we can tell stories that encapsulate and perpetuate the values perspective of a culture. Language, and the stories it enables, is a powerful method of creating and transferring culture.

Language is a cultural universal, meaning that every culture has language. Today, there are more than 7,000 internationally recognized languages, representing a wide array of sounds and ways of constructing words and sentences. Unfortunately, more than half of these languages are in danger and are likely to go extinct in the current century (Kraus 1992). Linguists Nettle and Romaine (2000) point out that regions with the most biological diversity also tend to be those with the most linguistic diversity. As developed nations destroy the biological habit of these diverse zones, so too go the languages. As one Cofan chief Randy Borman of the Ecuadorian Amazon puts it, "Over half of our language describes the Forest; we cannot even speak without it" (Cepek 2012:107). In this sense, languages themselves are adapted to particular environments (Nettle and Romaine 2000).

Khoisan click language

Khoisan click language

Biological Anthropology

Biological anthropology is the study of human biology, culture, and human ancestry. Biological anthropology is a very diverse subfield. Some biological anthropologists are interested in the question of human physical and genetic variation. Nina Jablonski, for instance, has examined how skin color is an adaptation to differing amounts of solar radiation. Another field of biological anthropology, primatology, studies the primate order. Jane Goodall is a primatologist, someone who studies apes and monkeys (and other primate species) often in comparison to our own species. Another area of biological anthropology is paleoanthropology. Paleoanthropologists are interested in the fossil record and genetics of human ancestors. Forensic anthropology, made popular by television programs like *Bones* and *CSI*, is another kind of biological anthropology.

Archaeology

Just as we would get a skewed view of humanity if we only looked at Westerners, we would have a limited understanding of ourselves if we only looked at our current time period. Archaeology takes the long view by examining the human past. Unlike the related field of history, archaeology focuses on understanding past behavior through the study of material remains, or material culture. Material culture is essential for archaeologists because for most of human history there are no written records. What's more, when there are written records to rely upon, they very often concern only a small population of people, usually the ruling class, and are typically not about everyday life. Material culture allows archaeologists to study everyday people, not just the kings and queens and generals of history, and give us a wider sense of who we are.

Applied Anthropology

Today, many cultural anthropologists practice applied anthropology. Applied anthropology cuts across all four subfields and uses the techniques and concepts of those subfields to help solve modern problems. This approach often takes the shape of advocating for a group, whether it's helping to regain aboriginal land rights, advocating for water rights, or helping to foster communication between medical workers and villagers. Attorney Kimberly Motley takes an anthropological approach in litigating in Afghan courts. Motley used the Afghan tribal laws rather than Western laws, to argue against child marriage. In another case, during the ebola outbreaks in West Africa, anthropologists acted as liaisons between medical workers from the World Health Organization and *Medecins Sans Frontieres* (Doctors without Borders). It turned out that providing ebola medicine to African villagers was a

complicated matter. Rites of passage for the dead included close contact with infected corpses, resulting in the further spread of the disease. Many local villages were suspicious of the medical workers, thinking they were the cause of the disease or just more government interference. Anthropologists were able to reach a successful compromise involving rituals that were satisfactory to the villagers, but that did not involve close contact with the infected corpses.

Anthropologists worked as liaisons between medical workers and vulnerable Africans during the ebola crisis. "Staff at Island Clinic wash clothes of health workers after they have gone into the Ebola Treatment Unit" by Morgana Wingard for U.S. AID is licensed under CC BY-NC 2.0

Forensic anthropology is another example of applied anthropology because its main job is to help solve criminal homicides. Both forensic anthropologists and archaeologists are employed in investigating war crimes, unearthing mass graves, and attempting to identify the human remains. In his TED talk, Fredy Peccerelli (2015) talks about using forensic anthropology to identify the *Desaparecidos*, the civilian who disappeared, during the Guatemalan Civil War.

He and other anthropologists gave testimony in the genocide trial of General Ríos Montt. Forensic anthropologists also work to identify the remains of disaster victims. Forensic anthropologists are also employed by the U.S. military to help to identify the remains of soldiers.

Some anthropological linguists use their expertise to identify terrorists or criminals using dialect analysis. This type of work is called forensic linguistics. FBI forensic linguist James Fitzpatrick used his skill in linguistics to provide evidence to arrest Unabomber Ted Kaczynski. Other examples of applied anthropology include preserving archaeological sites, helping to maintain and revitalize indigenous languages, collecting knowledge of native medicinal plants, legal advocacy, humanitarian work, and working towards the conservation of threatened and endangered primates.

One of my favorite examples of applied anthropology is Daniel Lieberman's work on exercise among hunter-gatherers. He makes the point that exercise, an activity with no real purpose, is unusual in foragers and all species. The Tarahumara, traditional farmers in Mexico known for their running abilities, would laugh at Lieberman when he would go for a morning jog. The Tarahumara, as it turns out, doesn't run all the time, but only during special community events that are spiritual in nature. Expending calories for no good reason is not a good use of one's energy stores after all. And so, being "lazy" is just normal from an evolutionary perspective. And yet, with our current lifestyle and excess of calories, exercise is good for us. Lieberman uses the evolutionary understanding of why we don't generally like to exercise to help motivate us into doing something we are programmed not to do.

Sometimes anthropologists are employed in the business sector as well. These are called corporate anthropologists. The vodka seller *Absolut* employed anthropologists to infiltrate house parties to understand American drinking behavior. They wanted to know how it was being used: In what drinks? What kind? And by whom? They found that the story behind the bottle of vodka was

more important than the quality of the vodka. Behind the research, of course, was the intention to improve vodka sales (Wood 2013). According to author Graham Wood, "Microsoft is said to be the second-largest employer of anthropologists in the world behind the U.S. government." Anthropology in business goes beyond selling things. A landmark study by Baron and Hannon (2002) found that start-up tech companies that emphasized a commitment to the culture of a company were more likely to succeed than other types of employment blueprints like autocracy, bureaucracy, star, and engineering models. That is, a sense of culture and belonging, were bigger factors in success than strong leadership, highly talented people, or attention to documentation.

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Chapter 2: Are Humans Unique?

"All species are unique, but we are unique in some pretty unique ways." —Robert Sapolsky, *Behave: The Biology of Humans at Our Best and Worst* (p. 11)

"The human brain is special. Just not that special." —Peter Aldhous

"The only thing that separates us from the animals is our ability to accessorize."

—Clairee Belcher in *Steel Magnolias*

James Wide or "Jumper," was a South African railman who had the habit of jumping between railway cars. One day things didn't go as planned and he lost his legs. Jumper decided to look for a service animal to push his wheelchair and to help with his job as a signalman. That's when he discovered Jack, a male chacma baboon (*Papio ursinus*). Jumper taught Jack to operate the railway signals, and the baboon performed his duties admirably until one day a passenger looked out the train window and saw a baboon operating the switches. An investigation ensued, and Jack was temporarily relieved of his duties. Desperate, Jumper managed to arrange a demonstration of Jack's abilities to railway officials. After watching Jack operate the signals, the railway authorities hired him and put him on the payroll. It is said that he was paid in beer and food, and he never made an error.

A chacma baboon running the railway signals. "James Wide with Jack" by unknown is licensed under public domain.

Compared to other species, humans stand out as being a highly successful in terms of our technology, our ability to communicate, and our propensity to adapt to all sorts of environments. Philosophers and scholars have long discussed and debated exactly how our species is different. Sometimes though, there is a hidden assumption that humans are better than other species, given our particular suite of talents. This point of view where all species are judged based on a human standard is called anthropocentrism. Rather than focus on who is better, a completely subjective endeavor, anthropologists are more interested in figuring out how we came to be such a successful species.

Anthropology, with its holistic approach and emphasis on biology and culture, past and present, is well-suited to investigating the question of human uniqueness. We know that humans share the same basic building blocks of life with other organisms, namely the DNA molecule (and RNA). Within DNA are genes that code for amino acids, which in turn combine to build proteins, which instruct cells on what to do. Very different species share many genes in common. Homo sapiens and the fruit fly, for instance (National Human Genome Research Institute 2012). For this reason, genetic research on the "lowly" fruit fly (*Drosophila melanogaster*) is shedding light on a wide variety of human diseases—from neurological disorders to cancer to drug abuse. In this sense, the fundamental chemistry of life is not at all unique to humans. On the contrary, our genetic code serves as the basis for all plant and animal life on Earth. The question then becomes what other features might have given humans the upper hand?

We have about 60 percent of our genes in common with the fruit fly (*Drosophila melanogaster*).

"Drosophila melanogaster" by André Karwath is licensed under CC BY SA 2.5.

Tool Use

One early feature that anthropologists pointed to as uniquely human is tool use. Archaeologist Kenneth Oakley's 1959 book *Man the Toolmaker* was influential in characterizing tool use as being quintessentially human. Though there are gray areas, a tool can be generally defined as an object used to modify the shape, condition, or location of another object. The term tool typically refers to an object that is not permanently attached, so a monkey using its tail to grab an object does not qualify. There is also debate about whether bird nests and

hermit crab shells are tools. There are other nebulous examples: When an ape throws its own feces at unsuspecting zoo-goers, is that tool use? Despite some ambiguity in definition, a tool doesn't have to be something as complex as an electric drill or a sewing machine, and tools don't even require hands.

Jane Goodall's famous work in Gombe Stream National Park in Tanzania disproved the notion that tools were uniquely human. Goodall discovered that chimpanzees (*Pan troglodytes*) modified plant stems and inserted them into termite nests to extract the insects, a source of protein for the chimps. Termite fishing, as it is sometimes called, qualifies as tool use. Following Goodall's discovery, paleoanthropologist Louis Leakey famously quipped, "Now we must redefine tool, redefine Man, or accept chimpanzees as humans."

Since Goodall's groundbreaking work, numerous examples of animal tool use have come to light. Chimpanzees use several different tools in addition to termite sticks: logs and anvils to crack nuts, leaf sponges, and more recently a kind of spear, which are large modified sticks used to hunt smaller primates. Gorillas use tools in captive contexts, and recently one wild female gorilla used a stick to test the depth of a watering hole. Kanzi, a captive bonobo chimpanzee, the subject of study by psychologist Sue Savage-Rumbaugh, has been taught to create sharp stone flakes to cut a rope and retrieve a hidden snack. Capuchin monkeys in Brazil and macaques in Thailand use rocks to crack open nuts. Otters use rocks to open shellfish, dolphins use sea sponges to scrounge for food on the seafloor, and crows have been shown to

Chimpanzees are tool users. "Pan troglodytes 'ant-dipping' for tree-ants" by David Bygott is licensed under CC BY-NC-SA

use sticks to access difficult-to-reach food and even make wire hooks. All of these examples qualify as tools.

Chimpanzees use simple tools to get food. "Chimp Smarts" by s.yume is licensed under CC BY-NC-ND

While other animals use simple tools, human tools are astonishingly complex. We can, for example, make tools to make other tools. Our capacity for tool innovation lies in our ability to put together old ideas in new ways. As Steve Jobs famously said in his Stanford commencement speech, "Creativity is just connecting things. When you ask creative people how they did something, they feel a little guilty because they didn't really do it, they just saw something. It seemed obvious to them after a while." Plus, human technology is cumulative, in that we can build on previous innovations. As one CNM student eloquently put it, "Humans have the ability to build on the strengths of others." Thomas Edison is credited for inventing the light bulb, but as Steven Johnson's book and PBS series *How We Got to Now* makes clear, there were many patented versions of the light bulb before Edison perfected it. Edison thought of himself as a "sponge" of ideas more than an inventor. All sorts of discoveries and

innovations had to be made before the lightbulb or smartphone was possible—mining, metallurgy, batteries, plastics, glass-making, and countless others. In this light, the invention of the iPhone started when someone sparked the first fire hundreds of thousands of years ago. Because technology is cumulative and many people make small contributions over time, there's probably no single person alive today that can make an iPhone from raw materials from start to finish. one. This concept of cumulative technology is captured in Thomas Thwaites' TED talk where he describes how he attempted to build a toaster from scratch. The capacity to build upon prior discoveries, combine tools, and pass along knowledge to the next generation is an incredibly useful and powerful characteristic of humans.

Ted Talk - Thomas Thwaites: *How I Built a Toaster-- From Scratch*

Culture

Culture is very typically thought of as inherently human and only human. After all, anthropologist E.B. Tylor defined culture as that complex whole acquired by "Man." The definition of culture as shared traditions, beliefs, and values that

are transmitted through learning allows us to ask whether humans are the only cultural species. With this definition of culture, we can ask whether non-human animals have anything that resembles learned behaviors.

The story of animal culture begins with monkeys. In the 1950s on the Japanese island of Koshima, researchers were studying Japanese macaques (*Macaca fuscata*). Sweet potatoes were put out to entice the macaques into the study area. One day a female monkey named Imo ("Potato" in Japanese) got fed up with all the sand on her potatoes and began washing them in the salty sea. The water not only cleaned off the annoying sandy grit but also seasoned them with salt. Thus, a monkey "life hack" was born. Other monkeys soon followed suit until virtually all the macaques were washing the potatoes; the youngest were the "early adopters" and adult males were the last to adopt the practice. Even in the next generation of macaques, the practice of potato washing continued, indicating that the practice was transmitted through learning. While it might not seem much of a feat compared to the complexity of making a toaster, it can be considered a form of culture nonetheless.

Chimpanzees also have learned tool traditions. Young chimpanzees observe their mothers using termite sticks and other tools, and over time become adept at making and using the tools themselves. What's more, different populations of chimps have different tool traditions that are passed down and maintained. Primatologists like Martin Muller of the University of New Mexico and co-director of the Kibale Chimpanzee Project study chimpanzee tool traditions or "cultures."

Robert Sapolsky, a primatologist and

"Monkey Biscuit Contemplation" by Mark Dumont is licensed under CC BY-NC 2.0

neuroscientist who studies baboons in east Africa, experienced a sad but interesting case of culture among olive baboons (*Papio anubis*). Male baboons in his study group were visiting a garbage dump at an African tourist lodge in Kenya called Olemelepo. Parts of cattle sick with tuberculosis were discarded in the dump where the baboons fed. As a result of feeding patterns, the more aggressive males in the troop died from the disease, leaving behind male baboons that were less aggressive. The deaths also left far more adult females than adult males overall. This led to what Sapolsky (2004) describes as a "pacific culture" or peaceful culture among the baboons. There was more grooming, the dominant males were more tolerant of lower-ranking males, and there were lower stress levels as measured by cortisol in lower-ranking baboons. Even when new males immigrated into the troop, the "culture of peace" persisted, indicating that this "hippie" baboon culture was learned. Rescued orangutans released in Borneo learned to use soap from local villagers and have been known to steal soap to wash up. More surprising is that this tradition was spread to wild orangutans who have been known to steak soap to

wash up, creating a culture of cleanliness.

Wild Orangutans Learn to Wash with Soap

Other traditions in the animal world seem more bizarre than functional, and in that regard even more like human culture. Anthropologist Susan Perry, director of the Lomas Barbudal Monkey Project in Costa Rica, has studied an interesting cultural tradition in white-faced capuchin monkeys. One group of capuchins has developed a propensity for probing the eyeballs of other monkeys with their fingers up to the first knuckle. These odd eye-poking sessions can last up to an hour. The practice appears to be uncomfortable for the recipient, but the monkey makes no attempt to remove their buddy's finger. Perry suggests the behavior may be a kind of test of friendship, like a monkey "trust-fall." The reason for this bizarre cultural tradition, however, remains an open question.

Monkeys Bond in the Most Awkward Way

For many anthropologists, culture is not just about learned traditions, but rather the assignment of meaning and value to those traditions. We pass along beliefs, values, stories, and social traditions that are loaded with meaning. Our beliefs are connected to how we interpret things or how we assign meaning to objects and behaviors. An enormous amount of importance, for instance, is placed on how people dress, speak, eat, act, and pray because we assign these things meaning. Even small things that we do are loaded with meaning, like whether we greet with a handshake, a hug, two kisses on the cheek, or a bow. And sometimes we even things with meaning where there really is none. There's a old story about a family cutting the ends off the pot roast because that's how it was always done. When the family finally asked great-grandma, she explained that the old stovepipe oven she used just wasn't big enough, so she cut off the ends. Cultural meanings are inter-connected such that they form a kind of web that we become entangled in as we are enculturated. The famous cellist, Yo Yo Ma studied anthropology and got some insight into both music and meaning. He explains (Marchese 2020),

The bushmen of the Kalahari desert — I actually studied them, and I loved that group. I spent time there. And the thing — I'll give you the fast takeaway — is that they did trance dancing. They did this dance for hours. Women in a circle clapping; they got into trance. The next day, I interviewed the women and said, "Why do you do this?" They gave me the answer, "Because it gives us meaning." Their answer has been my answer for culture since that time.

Other species don't seem to have these deeply held values and meaning embedded in actions and objects. As one CNM student put it, "I doubt that

monkeys have strong feelings about abortion and helicopter parenting." Looking cross-culturally, beliefs and values are incredibly varied. As Robert Sapolsky puts it, "Human nature is extraordinarily malleable, and I think that's the most defining thing about our nature" (Illing 2017). It is a primary goal of cultural anthropology to recognize and understand these incredibly diverse cultural webs of meaning.

Human belief is quite powerful and often hard to change. The placebo effect demonstrates this nicely. In one study, 13 boys who reported being highly allergic to Japanese lacquer trees were told that their arms were being brushed by the poison-ivy-like leaves. In reality, those leaves were from a harmless plant. And yet all 13 boys experienced a reaction to the harmless plant. What's more, the irritating lacquer leaves were rubbed on the other arm, and only two boys experienced a reaction. Such is the power of human belief. Our cultural beliefs are even stronger and are reinforced daily. Think about your own beliefs about subjects like wearing clothes, gun control, or how children should be raised. People can live their entire lives without recognizing that their unshakeable beliefs come from their culture, and are continuously reinforced by stories, rituals, and interacting with like-minded people. Even businesses have their own mini-cultures. As management consultant and author Peter Drucker Cultural puts it, "Culture eats strategy for breakfast," meaning businesspeople ignore their company's culture at their own peril. Beliefs are so strong that people sometimes kill or are willing to die for them, and sometimes they are willing to put their own children in jeopardy for them. It is only when you look outside your own culture that you see outside the small box of belief and meaning that is your culture. Indeed, many people never step foot outside the box.

Cooperation and Reciprocity

An African proverb says that if you want to go quickly, go alone, if you want to go far, go with others. All of us are familiar with reciprocity, the equal exchange of favors, in our daily lives. If you help a friend move, you expect that friend to come help you if your car suddenly breaks down and you can't get to your

anthropology class. this ability to cooperate with others is extremely important for humans and other primates.

Primatologist Frans de Waal explains that reciprocity makes cooperation possible in monkey and ape species. Experiments with captive primates have shown that a pair of chimpanzees can coordinate efforts to pull in a heavy object with a treat on top. Elephants are able to perform a similar task. In another experiment, capuchin monkeys are shown to reject unequal pay. When one is paid in cucumbers and another is paid in grapes for the same task, the cucumber monkey rejects the cucumber payment.

Chimpanzee life in the wild is likewise full of reciprocal favors and cooperation. Chimpanzee grooming is not purely for hygiene but is a means to create bonds and alliances with other chimpanzees. In the chimpanzee world, there is a pecking order or social hierarchy for both male and female chimpanzees, but males tend to be dominant overall. For males to rise through the ranks, they need to make friends and have social backing. Male chimps groom each other and return the favor—reciprocate—by backing each other up in male-male contests. No matter how strong a chimp you are, you need influential friends to get to the top. The politically savvy chimps, not necessarily the strongest chimps, get promoted. Moreover, when fights do break out between friends, chimps will come together and hug to reconcile, highlighting the importance of maintaining the reciprocal partnership. Because cooperation is based on reciprocity, chimps tend to cooperate with other chimps that they know and see regularly. This cooperation extends to perhaps 60 to 100 individuals—the size of a chimpanzee troop. Non-primates are also known to cooperate, sometimes on huge scales. Ants for instance cooperate to the point where a colony is considered a single organism. They can be remarkably inflexible though by human standards. Biologist E.O. Wilson famously painted oleic acid onto the bodies of select ants. Oleic acid signals that an ant is dead. Thus, perfectly healthy ants would be carted off to the dead ant pile, despite the kicking and thrashing of the unfortunate pheromone-coated ant. This rigid cooperation is quite different than the cooperation based on reciprocity common in primates.

So very often we hear news stories about humans not cooperating. But compared with many other animals, we are a remarkably cooperative species. Psychologist and co-founder of the Max Planck Institute for Evolutionary Anthropology, Michael Tomasello points out that humans have what he calls "shared intentionality," understanding each other's intentions and working toward a common goal. Humans can "put our heads together" and solve problems that alone we could not solve. Even babies want to share their experiences by pointing to objects before they can talk. Small children will help out adults when they appear to be struggling. Tomasello notes that children also want to know the right way of doing something, and once learned, will enforce those social norms, also known as "tattling."

Humans can be remarkably violent as our World Wars have shown. And yet, we can be remarkably social in the most unexpected of circumstances. During World War I, British and German troops were in a standoff, dug into trenches along the Western Front. During the day, the soldiers would be trying to kill each other. In the evening, informal truces arose such that the enemy could retrieve the dead from the "No Man's land" between the military positions. During Christmas of 1914, enemy soldiers shouted Christmas greetings to each other, sang carols together, and even exchanged small gifts of food and tobacco.

The extent of human cooperation is vast. People cooperate in sports teams, churches, classrooms, workplaces, and millions of humans can come together for a common political cause or raise money for people they have never met. Instead of cooperating with the expectation of return, we often cooperate under a common cultural value or practice. A classroom full of strange chimps would be utter chaos, not to mention incredibly dangerous. But every semester, perfect strangers come together at CNM to take a course in anthropology or Spanish, or psychology without a problem. We can do this because we share common goals, shared values about how to treat each other, and shared ideas about what to do in a classroom setting. Yes, humans can be nasty, but we can also cooperate on a grand scale based on culture alone. Today, the Internet allows us to form virtual cooperative communities with millions of people we

rarely see or have never even met. Chimps, on the other hand, don't cooperate based on culture—either they know you personally or you are an outsider and therefore a potential threat.

Pointing is an example of shared intentionality.DSC_1387 by Josh Ward is licensed under CC BY 2.0

Chimpanzees groom each other to form alliances, an example of reciprocal behavior. "EMGhi-3468" by elaine is licensed under CC BY-NC-ND 2.0

Intelligences

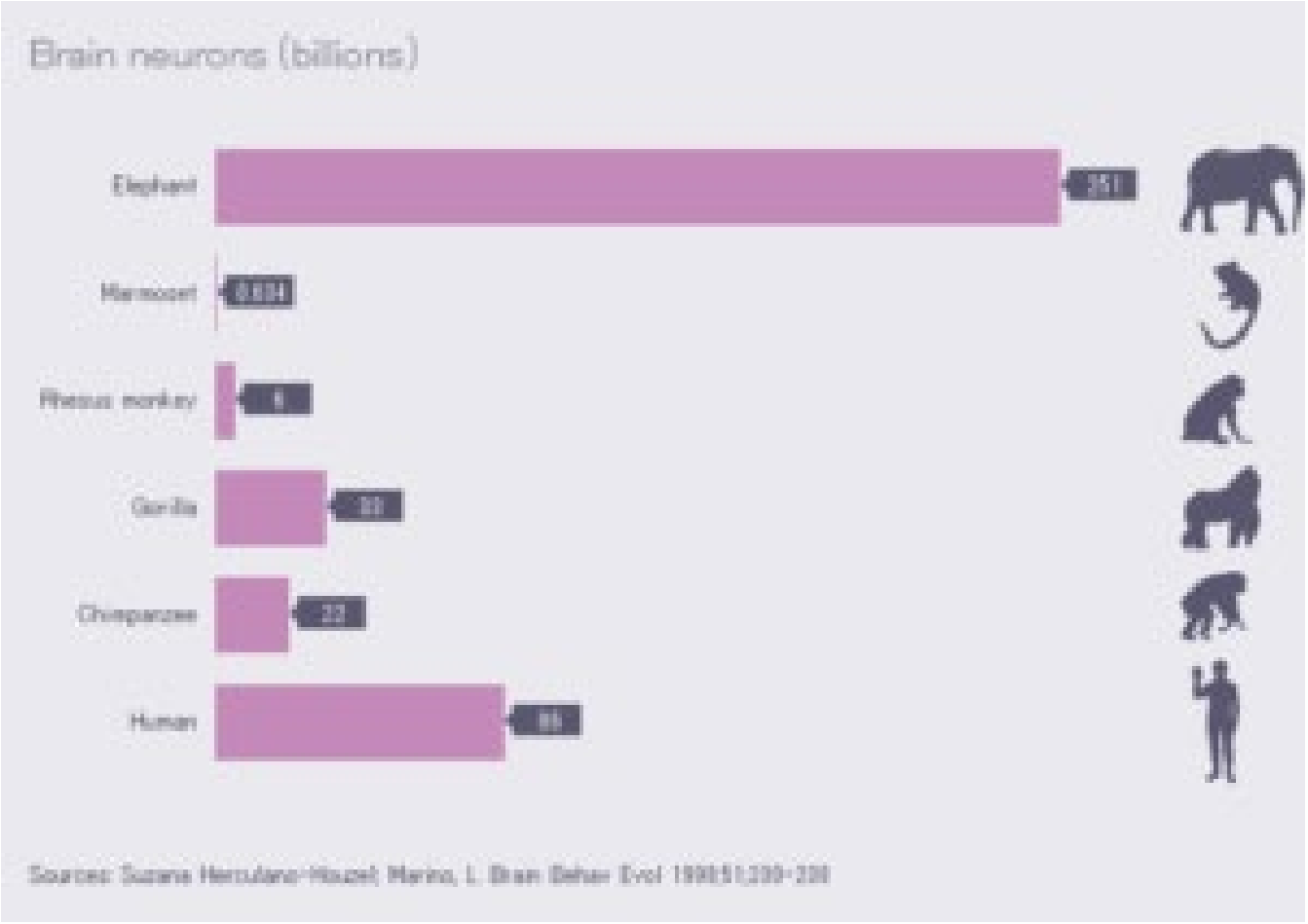
"Intelligence" is a term people use daily, but they don't always have a good working definition. In *Are We Smart Enough to Know How Smart Animals Are?* Primatologist Frans de Waal defines "cognition" as the ability to take sensory input from the environment, convert that input into knowledge, and then apply that knowledge. The ability to complete this process successfully can be thought of as intelligence. Co-founder of the Future of Life Institute, Max Tegmark (2017), defines intelligence simply as "the ability to achieve complex goals". French philosopher and scientist Rene Descartes (1629–1649) thought that while humans were governed by reason, animals were more like "flesh machines" responding to stimuli in a mechanistic way. Today, we know that chimpanzees excel at solving certain types of problems, sometimes even out-competing humans. In one test, chimpanzees were given a clear tube with a peanut at the bottom. Some chimpanzees figured out that if you add water, the peanut will float to the top. Try this test on your favorite human and see how long it takes them to figure it out.

In another interesting case, Ayumu, a chimpanzee raised in captivity at Japan's Primate Research Institute. Ayumu's study involved remembering a sequence of numbers to get a treat. Ayumu was able to perform this task with lightning speed, whereas human subjects failed miserably even after training. You can try a version of this game here: https://scratch.mit.edu/projects/213935354/ As primatologist Nick Newton-Fisher sensibly explains, "the apes are better at doing chimps things, and we're are better at doing human things." It is also possible that Ayumu simply has practiced all his life and has little else to worry about. This can happen in humans as well. László Polgár thought that children could be taught anything if they started young and focused on it completely. He immersed his three daughters in chess–Zsuzsa, Zsófia, and Judit–and they all three became Grandmasters or International Masters in chess. Judit is considered the best female player ever. And yet, when it comes to intelligence, it is very hard to compare different species because they all apply knowledge to solve problems in their environments but do so differently. Because of this dilemma, Frans de Waal argues that it is not useful to compare species on a single scale, but rather to speak of intelligences.

Frans de Waal writes: "Many people think that animals are trapped in the present, but there is increasing evidence that they think ahead and plan for the future. Not just in an instinctive manner, the way squirrels do when they collect nuts for the winter (the squirrels do not know about winter, certainly not the first-year juveniles, but still show the behavior)." Ravens have been shown to select a token from a series of objects that they can barter with for a treat (Cabadayi and Osvath 2017). Even if the treat is delayed by a day, the ravens will go for the token and not other distracting objects. A captive chimpanzee at the Furuvik Zoo in Sweden stockpiled stones that he would later hurl at unsuspecting zoo-goers. He even took straw from his bedding to hide the stones for future attacks.

But maybe there is something special about the human brain. After all, our ability to solve technical problems is unparalleled, and we can plan years in the future, even long after we are gone. For example, The Long Now 10,000 Year Clock, currently under construction, is intended to last 10,000 years. If we look

at sheer brain size, humans are not even close to the top of the heap. Sperm whales have the largest brains overall and elephants have the largest brains of terrestrial animals. But we humans have a larger than expected brain given our body size—about seven times bigger than expected compared to other mammals, and three times bigger compared to other primates. This measure is called the encephalization quotient. But comparing humans to other mammals in terms of expected brain size is not straightforward, as brain size and number of neurons is not always linear. According to Brazilian neuroscientist Suzana Herculano-Houzel, the number of neurons and where they are in the brain are more significant than overall size. Humans have, by Herculano-Houzel's (2012) estimate, 86 billion neurons, and we have a large number of neurons in our expanded cerebral cortex (16 billion), the wrinkled outer rind of the brain and the seat of complex cognition. Humans rank second for neurons in the cerebral cortex, sandwiched between different species of whales. Even though we are not in the lead for cerebral cortex neurons, Herculano-Houzel thinks these brain cells may be a significant contributing factor in our flexible intelligence.



Brief comparisons of number of whole brain neurons (top) and cerebral cortex neurons (bottom) among five mammals by Peter Aldhous is licensed under CC BY 4.0

How many neurons there are and where they are in the brain are more important than brain size. This video contains closed captions.

Long-finned right whales have more neural connections in their cerebral cortex than humans, though humans have denser connections because our brains are smaller. Public domain.

Mirror, Mirror: Self Recognition

Visual anthropologist Edmund Carpenter introduced mirrors to remote Papua

New Guineans in the 1960s. This was the first time the Papua New Guineans had ever seen their own image. He writes in *Oh What a Blow that Phantom Gave Me!* "They were paralyzed. After their first started response— covering their mouths and ducking their heads—they stood transfixed, staring at their images, only their stomach muscles betraying great tension. In a matter of days, however, they groomed themselves openly before mirrors" (1976:112). Carpenter also took Polaroid photos of Papua New Guineans. Initially, people did not recognize the photos for what they were, but when Carpenter pointed out features of human faces, they realized what was happening. Men would slip away to study it alone. In no time though, villagers were taking photos of each other and men began to wear their photos on their foreheads. Carpenter later wondered if bringing these items to the Papua New Guineans was a mistake, wondering if he had helped to create a new sense of "the private individual" and social alienation (1976:120).

Humans can recognize themselves and spend an extraordinary amount of time and energy embellishing their bodies with makeup, tattoos, clothing, and hats. Clairee Belcher in *Steel Magnolias* advised, "What separates us from the beasts is our ability to accessorize." She has a point, given our obsession with outward appearances and the amount of money we spend on clothing, cosmetics, tattoos, jewelry, and braces. And yet, some animals can recognize themselves in mirrors as well. This is demonstrated through the mark test or the mirror test. First, a colored mark is secretly placed on the animal's face. When the animal sees itself in the mirror, it touches the mark. Chimpanzees, orangutans, some

"Nuba – body painting" by Rita Willaert is licensed under CC BY-NC 2.0

gorillas, Eurasian magpies, dolphins,
and an Asian elephant have been shown to pass the mark test, while monkeys, dogs, and cats all fail. This ability is called bodily self-recognition and indicates that those animals are aware that the image in the mirror represents them. The mark test, however, has been criticized because it is geared toward animals that rely heavily on vision as opposed to other senses like hearing or smell. As Ed Yong points out in *Immense World*, other species' perceptual worlds are vastly different from our own. Birds can sense the earth's magnetic field. bees see ultraviolet light, pit vipers can sense infrared radiation, and mosquitos can detect carbon dioxide which they use to locate you and suck your blood. Also, bodily recognition is not the same as mental self-awareness—understanding oneself as an "I." Any casual familiarity with social media makes it clear that humans are interested and sometimes even obsessed with their identity, the values and beliefs they project to the world.

Magpies

Cats, unlike chimps, don't seem to recognize themselves in mirrors. "Izzy Loves Mirrors" by Alison Elizabeth is licensed under CC BY-NC 2.0

Chimps have been known to do something akin to human bodily adornment, for no obvious reason. At the Chimfunshi Wildlife Reserve in Zambia, a chimpanzee named Julie one day stuck a piece of grass in her ear and kept it there (Main 2014). She continued with this strange behavior until one day other chimps began to do the same. This "fashion statement" is interesting because it doesn't have an obvious function.

Human bodily decoration appears to be a bit different from chimp fashion or bower bird nesting building, in that our embellishments are also loaded with meaning. Engagement and wedding rings are a symbol, as are tattoos and clothing styles. They send signals about the identity of the person, and people form communities very often with people sending similar signals. Researcher Michelle Langley (2018) writes "Some choices are conscious, others not so much – but everything we wear is telling a story…This process of agreeing amongst ourselves that a certain thing can stand for something completely different is what makes us human." Langley argues that early humans used these external symbols, bodily decoration, to expand their communities beyond the people they saw daily.

Art

Art is all around us every day poetry, literature, music, paintings, murals,

television, films, dance, and even something as simple as a tattoo. Some animals do create images that are symmetrical or aesthetically pleasing from a color point of view. Satin bower birds famously create bowers decorated with bright blue objects to allure female bower birds. Pufferfish create symmetrical designs with their fins on the sea floor to attract females. He even decorates his creation with shells. Some chimps even paint and appear to enjoy the process. Birds sing beautiful melodies to attract mates and defend territories.

Humans though, take art to another level to provoke an emotional or mental response. We decorate our bodies with meaningful designs and images as well as our environment. We create patterned sounds that evoke emotion and often tell a story, which we call music. Sometimes our art is representational, depicting things in our environment or even imaginary beings and settings. In many ways, we create our own reality, new worlds using art—in how we present ourselves, in how we craft our environment, and in the music we immerse ourselves in. And art is intimately tied to the web of meaning that is human culture. As Nathan Letts (2017) writes, “Without culture, there really can’t be art, as we know it, because art cannot exist separate from culture. Art reflects culture, transmits culture, shapes culture, and comments on culture.” Human art does more than attract a mate, it creates and transmits worlds.

Emotion

One of the most interesting lines of inquiry in recent years into the question of animal cognition is their emotional lives. But it was once thought that animals had no emotion. Philosopher Nicolas Malebranche (1638–1713) put it this way: "animals eat without pleasure, cry without pain, grow without knowing it: they desire nothing, fear nothing, know nothing." By the mid-1900s, anthropomorphizing, meaning assigning human qualities to an entity, was seen as unscientific among the behaviorist school (which focused on behavior rather than the mind), because animal emotion was impossible to measure quantitatively. All that could be documented unquestioningly was behavior. In the 1960s, Jane Goodall's work paved the way for a reconsideration of animal emotion. Unaware of the prevailing behaviorist paradigm (a paradigm is a school of thought) in animal studies, she happily assigned all the chimpanzees she encountered personalized names like Flo, David Graybeard, and Mike, completely unaware that other researchers were labeling their animal subjects with numbers. Likewise, Goodall did not hesitate to use words like "jealous" and "angry" to describe chimpanzee emotional states and wrote about chimpanzees as if they had individual personalities. Goodall had no idea that these practices were viewed as unscientific among behaviorists and she was vilified for her methods.

Behaviorists were especially skeptical about whether animals could experience emotions more complex than fear or anger. One area that was off-limits to research was compassion or empathy. Today, empathy in animals is being actively studied. We know, for example, that mammals share the neural seat of emotion—the brain's limbic system—with humans. And the Internet is full of anecdotal stories and video evidence of animals saving other animals from harm. Controlled experiments by psychologist Russell Church show similar results. In a laboratory experiment, a rat would inadvertently deliver an electric shock to another rat in a separate cage when they pressed the lever to get a treat. Once the lever-pressing rats learned of this correspondence, they denied

themselves the treat. Church's article entitled "Emotional Reactions of Rats to the Pain of Others" met the same skepticism from behaviorists as Jane Goodall's work with chimpanzees. More recently, rats have been shown to free other rats even in the presence of a chocolate treat. In this case, rats free the other rat as often as they go straight for the chocolate (Ferber 2011).

The tide has turned on animal emotion. Jane Goodall writes in "Life and Death at Gombe", "Those who have worked closely with chimpanzees agree that their emotions—pleasure, sadness, curiosity, alarm, rage—seem very similar to our own, though this is difficult to prove." In his article "Animal Spirits" philosopher Stephen T. Asma points out that fear, lust, and care are what allow animals to flee predators, mate, and care for their young. He writes, "We share a rich emotional life with our animal brethren because emotions helped us all survive in a hostile world. Indeed, the more we understand what mammals have in common, the more we have to rethink everything about even our specifically human intelligence."

Other more subtle emotions, like grief, are becoming of interest to animal researchers and anthropologists alike. *How Animals Grieve* by Barbara King describes how cats and dogs will alter their routines, refuse to eat, and undergo a change in personality after a companion dies. Animals in the wild also alter their behavior following the death of a family member. There are numerous examples of elephants returning to the site of a deceased family member or even returning bones that have been removed by humans to their original location. There is anecdotal evidence (unconfirmed stories) of elephants covering their dead with dirt. Kaeli Swift has documented numerous crows converging upon a dead crow, then launching into a series of caws followed by silence (Marshall-Chalmers 2020). These are sometimes referred to as "crow funerals." Swift has even evoked "crow funerals" with taxidermied crows.

Recently, researchers at the Max Planck Institute in Leipzig witnessed unusual chimpanzee behavior when one chimp died. The chimps gathered around the body and one chimp appeared to test the response of the body by pounding on it. A male friend of the dead chimp seemed especially interested in the corpse.

While this behavior was billed as “chimp mourning” in the popular media, the researchers understandably were reluctant to use the term, though they acknowledged the behavior as highly unusual. In another case concerning bonobos, a group of captive bonobos refused to allow workers to remove the body of a dead bonobo, displaying, screeching, and pulling the body away from the humans.

“Sad Elephant” by Mark Bridge is licensed under CC BY-NC-ND 2.0

Language

Language in animals is a source of fierce debate, and like so many other terms, it depends on how you define it. Scholars like Jane Goodall, Frans de Waal, and Noam Chomsky do not think animals have language in the way that humans have language. Language seems to be a specialization of humans. At the same time, some features of language can be seen in animal species in both captive

environments and in the wild. Apes like Washoe the chimpanzee, Kanzi the bonobo, and Koko the gorilla have been taught to use words in American Sign Language or symbols called lexigrams to communicate with humans. Their ability to use signs to refer to things in their environment is remarkable. Yet other key aspects of language, like grammar, are not well developed in animal communication. We will look at this subject and the signing apes in more detail in a later chapter.

Awe and Spirituality and Meaning

Of all the comparisons between non-human animals and humans, spirituality seems the most uniquely human. Psychologist Jonathan Haidt likes to refer to humans, not as *Homo sapiens* (thinking man), but *Homo spiritualis* (spiritual man). For Haidt, it is our spiritual life and not our rational, calculating minds that make us stand out in the animal crowd. In many ways, we are decidedly non-rational.

Recently, Jane Goodall has expressed the idea that chimps can feel, but not analyze, a sense of awe and wonder (Jane Goodall Institute 2011). She defines awe as amazement at things outside ourselves and says that chimpanzees experience awe and wonder during something called a waterfall display. At Gombe National Park, waterfall displays consist of tossing in stones, rhythmically swaying, and swinging from nearby branches over the falls while vocalizing. Goodall suggests that the display is a kind of dance or an emotional state that the chimps can't analyze. I experienced something similar when studying mantled howler monkeys (*Alouatta palliata*) in Costa Rica. Not only would the monkeys howl when threatened by other male monkeys, but they would howl at the sound of thunder and an oncoming rain storm. Low-pitched frequencies in general seemed to elicit a howling response.

In West Africa, chimps throw stones at certain trees, leaving behind numerous caches of stones around the tree (Kuhl et al. 2016). The chimps who throw

stones tend to be males, (though some females do as well) and also exhibit behavior seen during aggressive displays—hair erect, pant hooting, and bipedal stance. It is not clear why chimpanzees would engage in this behavior around a particular tree, but it could be an extension of the foot drumming which is a normal part of a male dominance display. The rock throwing may serve to amplify the sound and heighten the effect of the display. The behavior may also be learned, as it only appears in West African populations. Some news reports enthusiastically labeled the behavior as "chimpanzee religion," "chimp temples," or, perhaps worst of all, "sacred monkey trees." While there is still much debate about what the rock-throwing behavior and waterfall displays mean, the arena of religion, ritual, and spirituality seems if not unique to humans, then the least well-represented feature in non-human animals. But, as we will see in Chapter 10, there are other species in the fossil record, like *Homo naledi*, that quite possibly had a sense of spirituality and may have even deliberately deposited their dead in caves for ritual purposes.

Discussion

By comparing humans and their behavior to other species, we can get a better

idea of what it means to be human. Though we share the basic ingredients of all life on earth, DNA, we can see that humans overlap in many features with other organisms including tool use, emotion, cooperation, reciprocity, bodily self-recognition, reasoning and intelligence, and perhaps even some aspects of culture, language and the spiritual. We now turn to a fundamental activity of all species, getting food.

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Chapter 3: Pursuit of Food

“My father is Awa. He is a great warrior, he defended the Waorani territory with spears. Now I must defend our territory and the forest with documents and law, speaking Spanish, and traveling far away like the harpy eagle”.

—Baihua, Waorani man of Ecuador (Korn 2018)

In 2018, I was in the Ecuadorian Amazon near the Napo River, traveling as a tourist. We were in a canoe headed towards an indigenous Kichwa community situated along the river. The last tour group to visit the community was offered live grubs. As an anthropologist that covers insect eating in my class, I knew I'd have to eat one of those live grubs as a point of honor. Palm larvae are large, plump white grubs with a dark head, and are eaten by many Amazonian peoples. On the long canoe trip to the village, I was going back and forth between visualizing eating a live palm larva and shutting it out of my mind completely. Finally, the moment came. We were seated in a communal hut, and the smiling Kichwa women passed around a basket of wiggling white grubs. But to my relief, they decided to *cook* them over a fire on sticks! They only vaguely resembled grubs once they were grilled and that made all the difference. It was no problem to scarf down a palm larva or two, and as it turned out, they tasted vaguely like bacon.

Every organism needs to get energy from its environment, which ultimately comes from the sun. Those ancient people who built monuments to the sun, at Stonehenge and Machu Picchu, were on to something. Gorillas get their energy almost entirely from plant leaves, with with an occasional insect here and there. Humans, being omnivores, can and do eat just about anything. Deciding what to eat has been called the "omnivore's dilemma", a term popularized by writer Michael Pollan. Today, about half of the world's population lives in urban areas and buys food rather than produces food. Pollan illuminates just how W.E.I.R.D. our relationship with food is, by pointing out that we need investigative journalists to track down where it comes from and what's in it. Pollan calls these "industrial foods." Today during the age of coronavirus, more people are turning to urban foraging eating things like pigeons, wild fruits, and even the mustard weeds that can be seen all over Albuquerque. One concern is that these foods might be contaminated with pesticides or other chemicals. For some, urban foraging is more than a food source. It's a way to spiritually connect with nature. Gabrielle Ceberville posts regular foraging videos on TikTok and has a following of more than 800,000. Ceberville (2021) explains, "Foraging is a way to make the natural world feel real and valuable to people. When you're foraging for food or even just for fun, you're recognizing that there

is an entire ecosystem growing around you, and you start to take part in a carbon exchange with the natural world. I think it's important to treat nature like a neighbor. Foraging is an important first step." Another foraging sensation is Alexis Nikole Nelson, also known as the Black Forager, a Columbus-based social media influencer, who has over 800,000 followers on Instagram and 1.7 million followers on TikTok.

TikTok's Black Forager Shows You How to Make Violet Syrup Pink Lemonade

For most of human history, humans have been foragers. For millennia, societies foraged for food or produced their food and continue to do so. Anthropologists use the term subsistence to refer to how we go about getting food. Societies that produce or forage for their food are called subsistence economies.

Anthropologists use a classification system of different modes of subsistence. These include:

- **Foraging** (also known as hunting and gathering): reliance on wild resources
- Pastoralism: reliance on herding animals
- Horticulture: gardening using mostly human power and simple tools
- Intensive Agriculture: farming with the use of animal labor, plow, fertilizers,

irrigation, or terracing
- Industrialized Food Production and **Wage Labor**: work for wages to buy food from others

These subsistence modes can overlap. For example, people can practice horticulture much of the year but supplement with hunted and gathered foods at other times. Or foragers can exchange foods with neighboring agriculturalists. Or people who work for wages can have a garden. While these categories are not mutually exclusive, they are useful to anthropologists because subsistence predicts other aspects of culture, including things like mobility, population size, how labor is organized, and social and political systems. Also of interest to anthropologists are how subsistence is changing and the consequences of those changes.

Foraging

Foraging or hunting and gathering simply means reliance on wild food resources. Foragers rely on human power to get energy from their environments and foraging is the oldest form of human subsistence. Foraging has been around for hundreds of thousands of years, whereas other modes of subsistence like pastoralism, horticulture, and intensive agriculture have only been around a few thousand years. Reliance on fossil fuels (petroleum, oil, and natural gas) as a source of energy is only a few hundred years old. Psychologists, biologists, and anthropologists believe this deep history of hunting and gathering has shaped our species both physically and psychologically. Historian Yuval Harari argues that we are foragers in body and mind, but industrialists in practice, which he blames for many of our modern problems. For that reason, the study of foragers has always been a cornerstone of anthropology. Of course, foragers are not living fossils stuck in the stone age, but modern humans living as complex dynamic lives as we do.

Foraging has continued into the 20th century, especially in those areas ill-suited or difficult to exploit for

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farming. Most foragers live in Arctic regions, deserts, and tropical rainforests. Today, however, very few people subsist by foraging alone. In *The Foraging Spectrum*, archaeologist Robert Kelly points out that nearly all forager societies today rely at least in part on non-forager economies such as agriculturalists, pastoralists, and industrialized nations. In short, foraging is a way of life that is dying. Traditional foragers or forager/gardeners of today and the recent past include the "forest people" (formerly called pygmies) of Uganda and the Congo, the Inuit of the Arctic (the Eskimo), the Hadza of Tanzania, the Huaorani of Ecuador, the Batek of Malaysia, and aboriginals of Australia to name a few.

The Hadza are hunter-gatherers of Tanzania. "Hadza archery" by Woodlouse is licensed under CC BY-SA 2.0

The Batwa and other forest people were traditional foragers. “Future of the Batwa” by Brian Harries is licensed under CC BY 2.0

"Inuit man, Salamonie, working on a model kayak for the Canadian Handicrafts Guild, with his daughter, Annie, at his side, Cape Dorset [Kinngait], Nunavut" by unknown is licensed under CC BY 2.0

A few groups of people remain virtually uncontacted by modern societies and resist encroachment by outsiders. To the south of the Amazon, the Ayoreo people of Paraguay avoid contact with outsiders but are pushed out by encroaching settlers. In remote areas of the Amazon Basin, foragers are being pushed out of their traditional lands by illegal logging, mining, agribusiness,

and other industrialized operations. Some Waorani foragers of Ecuador have moved deeper into the Amazon and avoid contact with outsiders. Some fight oil companies with lawyers and legal documents. But with a shrinking land base, the Waorani find it more difficult to avoid each other, and violent clashes are thought by some Waorani to be inevitable. Though the rights of people to practice traditional ways are protected in Ecuador's Constitution, other clauses stipulate that oil and mining operations cannot be obstructed. In addition, the fierce egalitarianism among the Waorani make it difficult for them to name people as their representatives under a unified tribal entity (Korn 2018).

The Sentinelese, who live on North Sentinel Island in the Andaman Islands located in the Bay of Bengal are some of the most isolated people in the world. The island is officially administered by India in 1996. Because of previous deadly encounters and because the Sentinelese could be devastated by mainland diseases, all attempts at contact are now illegal. Recently, an American man who intended to bring Christianity to the islanders was killed by bows and arrows (Schultz et al. 2018). Following the devastating tsunami of 2004 in the region, there was concern that the Sentinelese were wiped out. When a reconnaissance helicopter expedition flew over the island, a Sentinelese man emerged from the woods and aimed a bow and arrow at the helicopter. Though the Sentinelese had managed to survive the tsunami, their numbers remain uncertain.

Foragers often have certain features in common. For example, except those who live along the coast, foragers tend to be highly mobile; that is, they tend to move often to where they can find food. This is called an extensive use of land. That is, foragers tend to need a large area in which to forage. Because a lot of land is needed, mobile forager band size is rather small. Depending on the environment and season,

North Sentinel Island in the Bay of Bengal. Map data ©2016. Google Maps.

mobile foragers might stay just a few weeks at a camp and houses tend to be temporary structures.

Mobile foraging societies also tend to be more egalitarian than societies associated with other modes of subsistence. There are not different classes or full-time political leaders. The term egalitarian means that a society has relatively few differences in status, wealth, and power between people. Lying in stark contrast to foragers are industrialized societies like the United States. The top one percent of people in the U.S., for example, control forty percent of the wealth. The distribution is far less egalitarian than people assume. In *The Last of the Cuiva*, colonial settlers view the Cuiva (now called the Hiwi) foragers as wild animals because they wear no clothes and hunt and gather food. The Hiwi whose society is based on sharing, view the settlers as uncivilized because they refuse to share their food. Sometimes people in industrialized nations feel sorry for foragers, not so much because of their dwindling land problem, but because they're not consumers–they don't have much in the way of clothes, cars, phones, money, and so forth. And yet all their work goes directly to meet their needs or is shared with friends and family. In wage economies, as Vicki Robin and Joe Dominguez write in *Your Money or Your Life*, you trade your life energy for money. Happiness and satisfaction tend to be very high among foragers (if they have their original lands), while anxiety, drug addiction, and depression are common problems in societies where people trade their lives for

money. When foragers become part of wage economies, often against their will, the resulting depression and alcohol addiction are disastrous.

Even though mobile foragers tend to be egalitarian, this does not mean that they are somehow naturally or biologically more generous than other groups of people. The English poet John Dryden (1631–1670) thought of hunter-gatherers as "noble savages," a term he coined. A century later, Jean-Jacques Rousseau (1712–1778) saw hunter-gatherers as being in harmony with nature, unsullied by civilization. The noble savage idea is still with us today, but it fails to acknowledge the humanity and complexity of foraging people. A closer look at forager societies shows that they are not "naturally" egalitarian nor are they always generous. Foraging societies are based on egalitarianism and reciprocity, and have been known to work hard to ensure that no person gets too much power. Anthropologist Richard Lee learned that among the !Kung of the Kalahari (now called the Ju/hoansi), there is a practice called "insulting the meat." As a Ju/hoansi man explained in the ethnography *The Dobe !Kung*:

When a young man kills much meat, he comes to think of himself as a chief or a big man, and he thinks the rest of us as his servants or inferiors. We can't accept this. We refuse one who boasts, for someday his pride will make him kill somebody. So we always speak of his meat as worthless. In this way, we cool his heart and make him gentle.

Likewise, Robert Kelly (1995) explains that foragers ensure food is shared through accusations of stinginess, verbal abuse, and demanding a share of food. Among the Hadza foragers of Tanzania, men who make a claim to be chief are similarly mocked and humiliated. Rather than being inherently and nobly generous, Kelly describes foragers as "aggressively egalitarian." Foragers will also avoid appearing stingy. In her classic work *The Harmless People*, Elizabeth Marshall Thomas writes, "A Bushman will go to any lengths to avoid making other Bushmen jealous of him, and for this reason, the possessions that Bushmen have are constantly circling among the members of their groups." Other non-state societies are stress sharing in part to keep social tensions down. Children's games in Western societies often result in a single winner. As

Lightning McQueen states, “One winner. Forty-two losers. I eat losers for breakfast.” Jane Goodale describes a very different game among the Kaulong of New Britain in the book *To Sing with Pigs is Human* (1995:119). Children are each given a banana. Instead of one children working to get the most bananas. The children each divide their banana in half, then give it to another child. Then the half-banana is divided again, and half given to another child. The processes is repeated until children are passing around tiny portions of a banana. The important thing in the game is not to get the most most bananas, but to form as many friendly relationships as possible.

One incentive to sharing is called tolerated theft. Tolerated theft occurs when the cost of defending a resource, like meat, is more than the benefit of keeping it. An example illustrates this simple concept. In a recent crime in Santa Fe, a man danced around another man who was eating a green chile cheeseburger (Resisen 2017). The dancing man then slapped the burger out of the other man’s hands and ran off with it. In that situation, the cost of defending the half-eaten burger, by running after the strange man, was greater than the value of the burger itself. One student in this class brilliantly explained tolerated theft at the Dollar Store:

The concept of tolerated theft can be seen in the modern world in the Dollar Store’s loss prevention measures. Unlike retailers like Walmart or Target, the Dollar Store does not invest in loss prevention measures like security guards or cameras, because the cost of defending their low-price items is not worth the price of defending them from shoplifters.

In forager societies, it is not easy to defend access to food or other resources. If someone tries to claim more than others, the group can ostracize the person, physically abuse him, or refuse to share later. Anthropologist Lorna Marshall suggested that !Kung women intentionally restrict their foraging to avoid being subjected to an onslaught of demands. Similarly, the Hiwi of Colombia will hide their belongings when another group visits, so as not to appear stingy (*Last of the Cuiva* 1970). While freeloading in mainstream American culture is frowned upon, among foragers being stingy is worse.

Another reason for sharing among foragers is reciprocity. Reciprocity entails the equal exchange of resources like food. In this type of exchange, there is an expectation of future sharing. This type of reciprocal food sharing often occurs when large game is brought in on a sporadic basis. Sharing then is not a benevolent gesture on the part of the hunter, but a strategy to offset his future shortfalls in food and also to form cooperative bonds with other people. Cultural anthropologist Bruce Knauft describes the importance of reciprocity among the Gebusi people of Papua New Guinea. The Gebusi have "exchange names" such that a person is referred to as "my bird egg," "my fishing line," or "your salt" depending on the item given or received. In this way, a person is constantly reminded of their reciprocal relationships and their social identity is tightly bound to reciprocity. Likewise, among the Napo Runa of Ecuador, the complex web of relationships is likened to a net bag or shigra, where everyone is connected in some way to someone else (Uzendoski 2005:5).

Television programs that feature one or two people trying to make it in the wild, don't capture the essence of being a forager, because foraging is a group effort. When one person experiences a shortfall, he can count on others to share, and later reciprocate in kind. Reciprocity is not just a forager thing, but of course, is found in many traditional (non-industrialized) and industrialized societies. In this cultural anthropology course "The Art of Being Human", cultural anthropologist Michael Wesch explains how gift giving in Papua New Guinea creates a web of relationships that bind people to each other. People feel a strong sense of interdependence through sharing and story-telling. In the United States, we simply pay someone for our coffee or cable installation, and the relationship is over. Trying to pay for a service in Papua New Guinea, where reciprocity and human relationships form the foundation of society, is offensive. As Wesch explains, it "ends a relationship."

The Art of Seeing

The Art of Seeing: Understanding Witchcraft in New Guinea

A third reason for sharing is that men who share meat (men are more likely to hunt large game, though there are many exceptions) stand to gain prestige. Even when the meat is "insulted"—when the hunter's success is minimized—everyone is still aware of who the best hunters are (Kelly 1995). Good hunters tend to have higher status than others. This type of status is called achieved status because it derives from a person's accomplishments during his or her lifetime. Achieved status provides one with influence rather than control. This contrasts with ascribed status in which status is inherited. Most Americans also have achieved status, unless you are a Kennedy or a Kardashian. Foragers are not able to accumulate much wealth, and thus inheritance of wealth and status is limited.

Forager Diet

Every culture has deep-seated notions about what is food and what is not food. Humans are omnivores capable of eating a wide range of plant and animal foods. Foragers eat a variety of foods and have remarkable knowledge of how to find food in even the most meager of environments. People living in industrialized nations often have no idea where their food comes from beyond the grocery store. Foragers, on the other hand, are food experts. A wonderful example of this ingenuity is how Australian aboriginals track a striped honey ant back to its nest. People dig out the honey ants, as they are called, and suck out the sweet liquid stored in their abdomens. In Australia, large moth larvae called a witchetty grub is eaten both raw and cooked and is a good source of protein. In the Amazon Basin, palm larvae are eaten both cooked and raw. In the American, Southwest people have traditionally eaten cicadas (Davis 1915:191). In places like Colombia and Ecuador leaf-cutter ant queens (hormigas colunas) are collected during their nuptial flight, and deep-fried. Westerners are often repulsed by insect-eating, but as one bee-keeping student succinctly put it, "honey is basically bee barf."

"Honey Ants" by avilasal is licensed under CC BY 2.0

Foragers have discovered ingenious methods of getting food. The blowpipe, used by foragers in the Amazon Basin and the forests of Southeast Asia, is especially good for hunting animals high in the forest canopy, like monkeys. Poison is obtained from trees, like *curare* of the Amazon, and poison dart frogs tip the darts and immobilize prey. Foragers of the Kalahari also use poison derived from a beetle to tip their arrows.

Anthropologists have pointed out that our forager forebears have shaped our preferences for food today. It makes energetic sense to go for calorie-dense foods like fatty meat, roots and tubers, and even sugar rather than leafy greens, even though they are good for use. That is, we have been shaped by our past to not want to eat salad unless it is covered in salad dressing, cheese, and nuts. Foragers also consider processing and handling time. If it takes more energy to crack a nut than the nut itself provides, it's better to go for something else. Likewise, if it takes more energy to chase down a rabbit, skin it, butcher it and cook it, then it just isn't worth it to hunt rabbits. We make these same decisions

all the time as well, and is part of the reason fast food, with no handling or processing time and lots of fat and calories, is so hard to pass up.

How Humans Evolved from Foraging to Food Shopping - Big History Project

Division of Labor

Forager society is often divided up not by class, but by age and sex. The sexual division of labor means that economic tasks are divided by sex or perceived sex. Hunting with weapons like arrows or spears is often a man's task, though there are many exceptions. Agta women of the Philippines, for example, traditionally hunted large game like deer with bows and arrows, sometimes while carrying infants on their backs. Anthropologists Michael Gurven and Kim Hill explain in their article "Why Do Men Hunt?" that Agta women of the Philippines would traditionally hunt with dogs and target areas where men did not hunt, closer to their village. More commonly, women in forager societies tend to gather food, watch children, prepare meals, construct shelters and clothes, get fuel and water, transport items between camps, and hunt smaller game. Women's gathered food resources often tend to be more predictable, while men's hunting often provides more food, but on a less predictable basis. However, there is quite a bit of variation in the availability and importance of different food items among foragers.

Mothers and Others

A look at forager childcare is enlightening. Children in the Kalahari do little to no work, do not forage for food in any significant sense, and are treated gently. Children are a distraction on foraging trips, and there are few foods available for children to forage easily. In addition, the high temperatures of the Kalahari and the need for water make taking children on longer forays inefficient. Mothers and fathers supply children with most of their food well into their teens. In other forager cultures, children contribute more. For instance, anthropologists Kristin Hawkes, James O'Connell, and Nicholas Blurton-Jones have found that among the Hadza of Tanzania, older children can forage more effectively.

Many foragers practice alloparenting (a.k.a. babysitting) "Batwas women and children resting after their harvesting, Mututu forest reserve, Burundi" by IUCN is licensed under CC BY-NC 2.0

Childcare is not a solitary endeavor among foragers. In all known hunter-gatherer societies, mothers let others hold their babies, not so different from Westernized childcare. Alloparenting means that someone other than the mother provides help in caring for infants. Human foragers and industrialized nations lie in stark contrast to chimpanzees who diligently guard their babies against others. "Hadza mothers," writes Frank Marlowe (2005), "are quite willing to hand their children off to anyone willing to take them." Hadza grandmothers and fathers provide a considerable amount of childcare. Anthropologist Sarah Hrdy argues that in a species with high child mortality and offspring that are extremely costly to raise, namely *Homo sapiens*, this kind of cooperation makes sense. She goes on to argue that alloparenting in our human past shaped our emotional lives, honing our ability to read emotions and see motivations in others. This need for alloparenting may have contributed to us being such a highly social and cooperative species. Indeed, babysitting likely played a significant role in making us human.

Nasty, Brutish, and Short?

The political philosopher, Thomas Hobbes (1588–1679) in contrast to Rousseau, famously wrote that foragers represented primeval life in the state of nature and was "solitary, poor, nasty, brutish, and short." It was once widely held that hunter-gatherers just didn't have any spare time to elaborate their culture because they were so busy searching for food all the time. Agriculture, it was thought, released people from these time-consuming subsistence efforts and freed up time for other, more leisurely, artistic pursuits. Since the 1960s, anthropologists have known that some hunter-gatherers don't put in the same long work days that agriculturalists or even industrialists do. African G/we hunters, for example, will hunt for about 5 hours a day, and some days people don't forage at all. This apparent forager free time led anthropologist Marshall Sahlins to describe hunter-gatherers as "the original affluent society." The calculation of work and leisure in any society is quite complicated, however, because abundance varies seasonally and other problems make work and leisure difficult to quantify. Also, different foragers live in different environments with different productive potential, and many have been pushed

into areas where food is more scarce. Despite these difficulties, it is nonetheless clear that forager life isn't always just about searching for food.

Another misconception about foragers is that they die young, rarely living past 40. This misconception is based on a misleading statistic called the average age at death, or average life expectancy at birth. The average age at death is exactly what it sounds like: you record all the deaths in a population over a period of time and take the average age at death. This statistic will be heavily influenced by infant and childhood deaths—these early deaths push the average age at death down into early middle age, even though many or most people are living into their 60s and 70s. This is especially true of populations living before the medical advances made in the 20th century. Among hunter-gatherers and, for that matter, all pre-20th century populations, the period between birth and 5 years of age is particularly fraught with risk. Among the pre-contact forest Aché foragers of Paraguay, former UNM anthropologists Kim Hill and Magdalena Hurtado estimated that 25 percent of the population died by age 5, while anthropologist Nancy Howell found that 33 percent of Dobe !Kung (Ju/'hoansi) children died by their fifth year. In some societies, early life is so precarious that infants are not even named until they are a year old or more.

The average modal age at death—that is the age at which most people in a given population die tells a different story. In 2007, UNM anthropologists Michael Gurven and Hillard "Hilly" Kaplan carried out a survey of 50 hunter-gatherer populations from around the world for which there was detailed census data collected. They found that the average modal age of death for these forager populations was 72, plus or minus about six years (ranging from about 66 to 78). These results suggest that foragers that survive the precarious time of childhood live to a fairly ripe old age.

Foragers in a Modern World

In a case famously described by Theodora Kroeber in her book *Ishi in Two Worlds*, an emaciated man stumbled out of the woods in northern California. His village was massacred by California settlers in 1865, he and his family

survived by hiding in the woods for more than 40 years. When he finally emerged in 1911, he was nearly dead. Ishi, as he is known, was taken in by University of Berkeley anthropologist Alfred Kroeber. He was the last of the Yahi people and spoke a dialect of the Yana, an extinct native language of northern California. Ishi lived at the university, providing arrowhead-making demonstrations until his death from tuberculosis in 1916. Astonishingly, this process of removing foragers from their traditional lands continues today in the face of settlers, oil drilling, logging, mining, and building of hydroelectric dams. Foragers find themselves between two worlds as they try to maintain their traditional ways and advocate for their rights.

Ishi, the last Yahi, died in 1916. Ishi is licensed under public domain.

Mobile foragers require large areas of land to meet their subsistence needs—extensive use of land. Loss of land due to colonization, mining, logging, and the establishment of game preserves have all but eliminated the forager way of life. In 1961 Botswana, the Central Kalahari Game Reserve was created to protect wildlife, and the forager San people (Bushmen) were relocated to an area within the reserve. After time, the Botswana government said it wanted to integrate the San into a more developed life and stopped government support, plugged wells, and banned hunting and gathering, forcing the San out of the Reserve into settlement camps. The Botswana government said the San presence in the Reserve was inconsistent with the mission, but others suspected the government wanted to clear the area for diamond mining. Later in 2014, diamond mining began in the reserve. In 2006 the evictions were ruled unconstitutional, but only a limited number of foragers were allowed to return.

From the Kalahari to Court

The extraordinary story of how the Bushmen of the Kalahari took their government to court and won.

In a similar narrative, the former forest dwellers such as the Batwa of Uganda have been displaced by the encroachment of farmers and the establishment of Mgahinga Gorilla National Park and the Bwindi Impenetrable National Park. The Ugandan government held that the Batwa had no claim to land because they never settled permanently, overlooking the fact that mobile foragers do not establish permanent settlements. The Bwindi Impenetrable National Park became a World Heritage Site for the protection of endangered mountain gorillas (*Gorilla beringei beringei*). Gorilla tourism brings in money for the government of Uganda, but the Batwa have suffered as a result. The Batwa are not permitted to forage in the park, are not employed by the park, and cannot teach their children their traditional subsistence practices. Today the Batwa live on the margins of their ancestral lands or in slums as "conservation refugees". Conservation refugees are people who have been removed from their traditional lands in the process of creating parks and refugees for animals and plants.

In another case, where animal conservation and foragers collide is the case of the Makah of Neah Bay, Washington. The Makah have an 1855 Treaty of Neah Bay with the United States that ceded some of their land but permitted the right to whale in "common with all citizens of the United States." The Makah ceased whaling in the 1920s when the numbers of gray whales dwindled due to over-hunting by the whaling industry. More recently, the gray whale was removed from the endangered species list and in 1999 the Makah were allowed to hunt a gray whale. The hunt was denounced by some conservation groups. Since the hunt was not conducted for subsistence purposes, but rather for cultural reasons, the Sea Shepherd Conservation Society claimed the hunt an invalid and dangerous exemption to the Marine Mammal Protection Act.

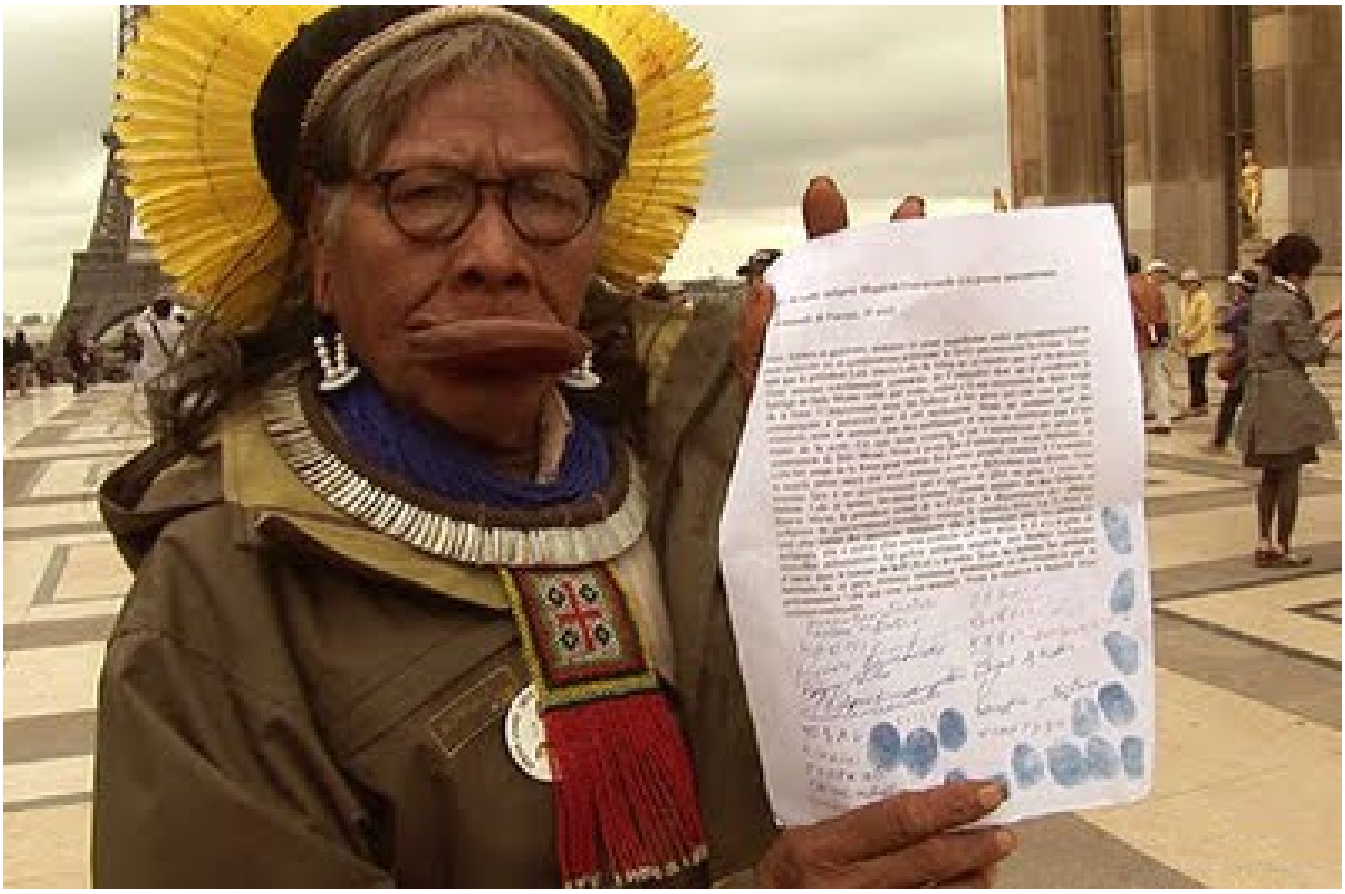
Cofán man of Ecuador. "Chevron's Toxic Legacy in Ecuador's Amazon" by Rainforest Action Network is licensed under CC BY-NC 2.0

A case where an indigenous people have successfully combined cultural and biological conservation is the Cofán of Ecuador. The Cofán are traditional forager-gardeners of the Ecuadorian Amazon. In the 1970s, Cofán territory was devastated by oil drilling, and some Cofán responded by establishing a new

settlement and defending themselves against the illegal encroachment of oil companies. Instrumental in this process is American-Ecuadorian Randy Borman, the “gringo-chief” of the Cofán. Borman was born to American missionaries in Ecuador, is fluent in A’Ingae ,and is married to a Cofán woman. Borman has been able to both live the traditional life of a Cofan person and argue the case of the Cofan with governmental agencies, oil companies, and non-profit organizations. Borman and other Cofán created the FSC (Foundation for the Survival of the Cofán People) which helped to triple the size of Cofán territory, conduct scientific and conservation projects, and educate future leaders (Cepek 2012: 103). Today Cofán people manage and protect the biologically diverse Cayambe-Coca Ecological Reserve. The Cofan also provide community-based ecotours in which Cofán people act as ecological guides.

Foragers have also been faced with protecting their intellectual property. Foragers have a vast understanding of the plants and animals in their environments and have identified plant medicines, pesticides, preservatives, perfumes, sweeteners, and of course new foods. Intellectual property rights extend to indigenous knowledge of plants. And yet, “gene hunters” are subcontracted by large firms to acquire this knowledge from traditional societies to patent the gene or chemical and make a profit (Vishnu Dev 2016).

In Brazil, indigenous Kapaó leader Raoni Metuktire has fought for decades for the preservation of the rainforest, threatened by dams, logging, and cultivation. Although he and his people only became acquainted with Western culture in the mid-1950s, Metuktire has met with international leaders and has become a symbol of the effort to preserve the Amazon. In response to the recent Amazon fires, Metuktire (2019) wrote an opinion piece in the *Guardian* stating “For many years we, the indigenous leaders and peoples of the Amazon, have been warning you, our brothers who have brought so much damage to our forests. What you are doing will change the whole world and will destroy our home – and it will destroy your home too.” In 2019 Metuktire was nominated for the Nobel Peace Prize.



"Raoni holding his international petition against the Belo Monte Dam in Paris." by Gert Peter-Bruch is licensed under CC BY-SA 3.0

Food Production

In contrast to the foraging lifestyle are the food producers. Food production, which relies on domesticated plants and animals, began around 10,000 years ago. Today, most people in the world rely on some form of domesticated food, a stark departure from our forager ancestors. Anthropologists divide up food producers into categories of pastoralism, horticulture, and intensive agriculture.

Pastoralism

Pastoralism means herding and raising animals. Pastoralists have domesticated herbivores including cattle, horses, reindeer, sheep, and goats, depending on

the region. Traditional pastoralists include the Masai, Dinka, and Nuer of Africa, the reindeer herders of far northern Scandinavia (Sami) and Siberia (Eveny), and nomadic pastoralists of Tibet. Mobility varies with different animals and in different environments. Pastoral nomads move with herds from sources of water and food and lead a highly mobile existence. Transhumance pastoralists move animals between seasonal camps and often supplement with crops. Pastoralism often occurs in open semi-arid region where farming is difficult.

"Saami man with Lavvo and reindeer Lyngen Troms 1909" by saamiblog is licensed under CC BY-NC-SA 2.0

Typically, pastoralists do not kill their animals very often for food, but rather rely on their milk and blood. In one practice, animals are "bled" without killing them and the blood is mixed with milk. When an animal is killed, it is often shared during a feast usually accompanied by a ritual. As with foragers, sharing

among pastoralists confers prestige as well as sets up reciprocal obligations.

"Masai herding cattle outside the Mara" by Clive Moss is licensed under CC BY-NC-ND 2.0

Horticulture

Horticulture is farming with the use of simple hand tools and human labor on temporary farm plots. Horticulture first began more than 10,000 years ago around the end of the last ice age. In addition to simple farming, horticulturalists often supplement their diet with some hunting, raising domesticated animals, and selling goods. Horticulturalists move their semi-permanent farm plots to another area as soil fertility in the original plot decreases. This practice is called shifting cultivation, or swidden, and allows farmland to rejuvenate over time. To improve the soil, horticulturalists will often practice slash and burn, clearing and burning vegetation except for the largest trees before farming a plot of land. In general, areas that are conducive to slash and burn horticulture are ill-suited for long-term use of farm plots,

which require large amounts of fertilizer and pesticides to sustain the soil. Because they produce more food in a given area, horticulturalists use the land more intensively than foragers. As a result, horticulturalists tend to live in more dense communities than foragers, whose populations tend to be small.

Swidden, or slash and burn, is practiced by horticulturalists. "Citemene (Slash and Burn) Chinsali District, NE Zambia, 1988" by Simon Berry is licensed under CC BY-SA 2.0

Horticulture has recently been practiced in the Amazon Basin, Papua New Guinea, central Africa, Samoa, and Southeast Asia. Farmers in the American Southwest practiced horticulture as well, relying on floodplain water for their fields. Because horticulturalists maintain fields for several years before moving to a new plot, architecture tends to be more permanent than mobile foragers. Horticulturalists often use techniques like multi-cropping and planting certain crops together to boost productivity and minimize erosion and soil depletion.

Intensive agriculture

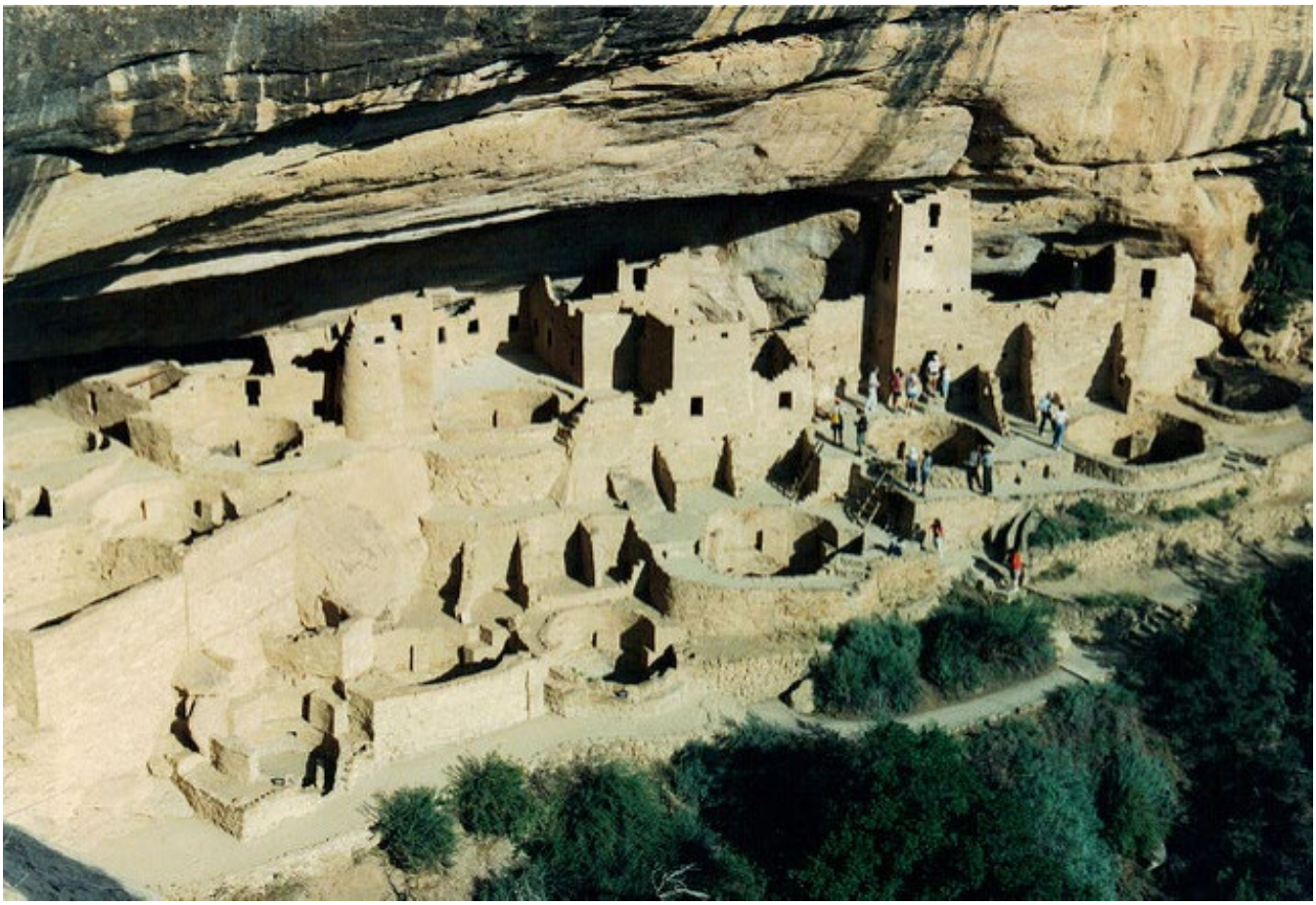
Early intensive agriculture began in Mesopotamia (modern-day Iraq), Egypt, India, and China. Intensive agriculture differs from horticulture in that it continues to use the same plot of land rather than periodically shifting plots. Intensive agriculture produces more food per unit of land than does horticulture. It accomplishes this by people working harder, adding animal labor, and applying farming innovations to keep up soil fertility. Innovations to improve soil productivity include fertilizers, plows, irrigation, and terracing (creating steps out of a hillside for gardens). All these inputs require a great deal of time and energy to build and maintain. Fields must be weeded and pests like mice, rabbits, and grasshoppers driven out. Domesticated animals must be fed, housed, bred, and cared for. Irrigation ditches and terraces must be engineered, excavated, and maintained. Fertilizers must be collected and spread on the fields and farming equipment must be made and maintained. The plow is an important innovation, allowing farmers to reach nutrients below the topsoil. Rather than moving periodically to rejuvenate the soil, efforts are increased to ensure soil productivity over the long run.

What's more, intensive agriculturalists tend to grow storable grains. Storage units have to be created, maintained, and kept free from vermin. In addition, the grains must be processed on a grinding stone to get the most food value from them. This can entail grinding grains for many hours a day. That said, it is clear that agriculture did not free people from heavy labor, quite the contrary. In *Homo Deus*, Yuval Harari likens the expulsion of Adam and Eve from Eden to work "by the sweat of your brow"—forever leaving behind a forager lifestyle. In this light, agriculture hardly liberated people from the hard labor of farming, allowing them more leisure time to pursue their passions and develop the arts and sciences. Quite the contrary, people were working harder than ever, investing more time and energy as intensive agriculturalists compared with foragers and horticulturalists. On the other hand, more people could be supported per unit of land, and food could be more easily stored and defended, providing some food security during shortfalls and lean seasons.

Terraces make use of otherwise unusable land for agriculture. "Along the Inca Trail to Machu Picchu" by Lee Coursey is licensed under CC BY 2.0

Consequences of Intensive Agriculture

There are consequences of intensifying production, even before the introduction of fossil fuels, pesticides, and monocropping. Because intensive agriculturalists do not move, investment in architecture tends to increase and more permanent settlements emerge. Staying in one place is called sedentism. Instead of the movable tents or simple brush structures, mobile foragers have, intensive agriculturalists often build houses from clay bricks, stones, or other more permanent materials. This can be seen very clearly in the archaeological record. When maize began to be relied upon in the American Southwest, people started building more permanent structures living in and storing food that we call pueblos. Differences in wealth and power also emerge with intensive agriculturalists in contrast to the egalitarian pattern of foragers.



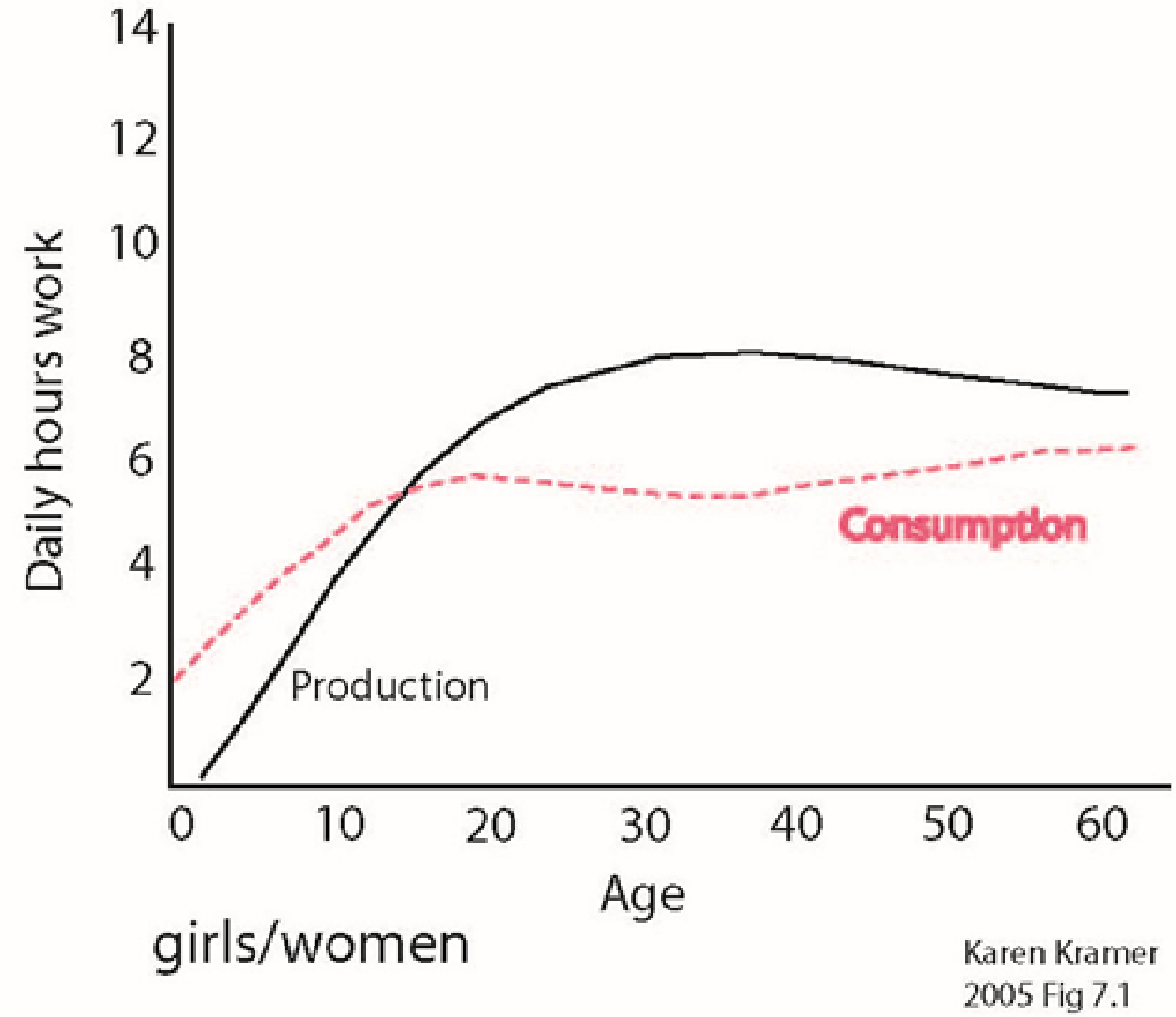
A consequence of agriculture is sedentism. Photo by Sue Ruth.

Populations tend to increase with the onset of pre-industrialized intensive agriculture as well. Not only can more people be supported per unit of land, but anthropologist Karen Kramer argues that children of intensive agriculturalists can do many tasks that offset the costs of raising children. Girls in agricultural societies process grain, fetch water and fuel, care for children, cook, wash clothes, and other tasks. In her book *Maya Girls*, Kramers shows that around age 13, Maya girls begin to produce more than they consume. When electricity came to a Maya village, grinding maize, a task that girls performed for hours a day, became mechanized. As a result, the age of menstruation, which is a direct result of food intake and energy expenditure, dropped by 1.5 years. This drop reveals the considerable amount of energy that Maya girls were spending on household tasks. Kramer argues that Maya girls were underwriting the cost of their parents having more children, resulting in population growth.

Forager children in contrast typically do not contribute to the household

economy until relatively late in life. For instance, Ache boys of Paraguay don't produce more than they consume until around the age of 17. Ache women and girls never produce more food than they consume. In essence, Kramer argues that intensive agriculturalists can afford more children than foragers. This idea remains the subject of some debate because Hadza hunter-gatherer children have been shown to forage for a considerable amount of their daily intake and so environment likely plays a key role in children's production in both forager and agricultural societies. While there is a tendency for mobile forager children to do little work and for children of agriculturalists to do a lot of work, different environments will affect the nature of children's labor.

Maya girls carrying fuelwood. Photo by Karen Kramer.



Maya girls begin to produce more than they consume around the age of 13. Karen Kramer.

Zoonotic Diseases

Intensive agriculturalists often use animal labor in addition to human labor, coming into contact with animal meat, blood, and feces. These close quarters with animals have the consequence of increasing the occurrence of zoonotic diseases. Zoonotic diseases are those that can be transferred between humans and animals. The diseases typically start in animal populations but shift when a genetic mutation allows them to jump to humans. Zoonotic diseases are very

common and can be disastrous for human populations. The infecting agents can be parasites, fungi, and viruses. Examples include bubonic plague, Lyme disease, hantavirus, ebola, zika, HIV/AIDS, polio, malaria, yellow fever, mad cow disease, rabies, smallpox, swine flu, bird flu, toxoplasmosis, and chicken pox. Related, the build-up of garbage is a problem for pre-industrial intensive agriculturalists and urban dwellers alike. Garbage dumps called middens can be found in the archaeological record, the physical remains of the past, adjacent to settlements. Middens are a treasure trove of information for archaeologists. For people living near these dumps, however, they can become vectors of disease, containing animal and human waste and attracting vermin like cockroaches, rats, and mice. Cats, who prey on these vermin, began living in human settlements 9,500 years ago, around the time that humans began farming and storing food (Ault 2015).

Today, with more than 7 billion people on the planet, we live in more densely packed urban centers than ever and are connected globally. When epidemics start, like the 1918 Spanish flu epidemic that killed more people than World War I, the results can be difficult to contain. Given the unprecedented connection between people today, there is a call for a global system of response to deal with potential epidemics. Economist Jeffrey D. Sachs, Professor of Sustainable Development, Professor of Health Policy and Management, and Director of the Earth Institute at Columbia University calls for a system of global readiness and response, which includes funding for the production and distribution of vaccines.

Other Effects of Agriculture

As agriculture intensified, people began to store foods, especially grains. Populations grew denser, and people could defend those resources from outsiders. Note this contrasts with the tolerated theft of foragers who can't easily defend their hunted foods. Differences in wealth and status begin to emerge (as evidenced by the archaeological record) as some people had better land and higher production than others. Craft specialists including scribes, soldiers, priests, and bureaucrats emerge; these people do not produce food for

themselves, but rather produce a service or product in exchange. Ruling, merchant, and peasant classes eventually arise along with the concept of personal property. For the ruling class, status and prestige become at least partially ascribed, inherited at birth.

Unilineal Evolution

As European nations came into contact with and began to colonize North and South America, Africa, and India, they encountered people who were physically and culturally unlike themselves. This led to the question, why do people in different parts of the world look and behave differently? The concept of unilineal evolution developed out of this question. Unilineal evolution is based on the late 17th and 18th century Enlightenment idea of progressivism—that humans are advancing toward intellectual and moral perfection. One version of this framework was that humans progressed through different stages from "savagery" to "barbarism" to "civilization," with civilized society at the top of the pinnacle. In this ranking system, the more you controlled nature, the more civilized you were, and the more you represented a model of social and moral perfection.

The idea of unilineal evolution was espoused by anthropologist Lewis Henry Morgan and others in the late 1800s, in part based on archaeological discoveries of a progression from stone tools to metal ones in Europe. Not surprisingly, the adherents of this idea considered themselves members of the most intellectually and morally advanced group—the civilized sort. Under this mindset, early anthropologists decided that foragers of their day were still languishing in the stone age with all the supposed mental and moral deficits that went with it. Unilineal evolution bears no resemblance to Charles Darwin's (1809–1882) ideas about evolution through natural selection. Quite the contrary, Darwin, who encountered many different peoples on his travels aboard the Beagle, pointed out the remarkable similarities in humans that he encountered.

Unilineal evolution was not just an ivory tower idea but had real-world

consequences. In the 1904 Louisiana Purchase Exposition in St. Louis Missouri, there was an exhibition of living cultures which including Apaches from the Southwest, the Tlingit of southeast Alaska, and a man named Ota Benga a Mbuti native (formally called “pygmies” for their short stature) of the African Congo. Ota Benga was a personable man with a set of sharpened pointed teeth, a result of a coming-of-age rite of passage among the Mbuti. More than 19 million people attended the event. Geronimo was also part of the Exposition, and it is said that he liked Ota Benga so much that he gave him one of his arrowheads.

Ota Benga from the Congo was placed in a zoo exhibit. Ota Benga is licensed under public domain.

After the Exposition, Ota Benga went to the Bronx Zoo where he did odd jobs.

Unfortunately, Ota Benga was harassed by tourists and had taken to targeting bullying children with tiny arrows shot from a miniature bow he had made. As a result, Ota Benga ended up as an exhibit in the "Monkey House" at the Bronx zoo as part of a publicity stunt. One editorial in the New York Times called to mind unilineal evolution by stating that "The pygmies … are very low in the human scale" (*The Guardian* 2015). According to the *New York Times*, an African-American clergyman wrote in protest, "We think we are worthy of being considered human beings, with souls". Following public protest, Ota Benga was released and went to live with a family in Virginia. By that time, he wanted to return to Africa, but travel became impossible once World War I broke out. Distraught, Ota Benga removed the caps that had been put on his pointed teeth, built a fire, and shot himself. No one knows where his remains are today.

Anthropologist Franz Boas (1858–1942) rejected unilineal evolution and the false distinction between "primitive" and "civilized" people. Boas had worked with Inuit and Northwest Coast societies and wrote descriptions of those cultures called ethnographies. He appreciated their intricate worldviews and histories, comprehensive knowledge of their environments, and complex social and political systems. In short, he knew people were people and could not objectively be ranked on scales of intelligence or morality, and that traditional societies weren't somehow less than human.

Through his first-hand experiences, Boas created the term "cultural relativism." Cultural relativism is the idea that cultures need to be understood within the context of that culture. The flip-side of cultural relativism is ethnocentrism, passing moral judgment on a culture based on one's own culture. Cultural relativism is not about passing moral judgment or giving cultural practices the unexamined stamp of approval but rather is intended as a tool to understand why people do what they do. Franz Boas' insistence that human cultures be understood on their own terms earned him the title "father of American anthropology." Boas also championed what was called salvage anthropology, working to record cultural practices that were quickly disappearing in North America and elsewhere with European colonization, removal of people from aboriginal lands, language decline, the decimation of populations by infectious

diseases, and in some cases, outright genocide.

While the idea of unilineal evolution may seem like a relic of the past, the notion continues today. Jair Bolsonaro, the president of Brasil stated in 2020 that “The Indian has changed, he is evolving and becoming more and more, a human being like us.” Bolsonaro believes the land allotment of the indigenous people in Brazil is too large and hopes to open it up to mining logging, and other industrial ventures.

Franz Boas is often called the father of American anthropology. Franz Boas by unknown is licensed under public domain.

The Anthropocene

The Industrial Revolution truly revolutionized how we get food. For most of human existence, human power and relatively simple technology has sustained our species. Increasing human labor, animal domestication, and technological innovations like the plow increased production per unit of land and allowed populations to grow. Today, reliance of fossil fuels to power machinery to clear land, and produce food has changed our lives entirely. What's more, industrialization is changing the face of the planet in unprecedented ways. Most dramatically, humans have altered the ratio of animal species to favor our lifestyle and dietary habits. Worldwide there are 780 million pigs, approaching a billion cattle, and 21 billion chickens making them the most common bird in the world. The wild ancestor of domesticated cattle, the auroch, went extinct in the forests of Poland in 1627. The wild ancestors of camel, sheep and house cat are on the brink of extinction (Francis 2015). Animals that we enjoy as companions far outnumber their wild counterparts. For instance, in recent years there have been about 95 million cats in the United States alone. Globally, there are around 200,000 wild wolves, but 400,000,000 domesticated dogs. Humans themselves numbered around 1.6 billion in 1900, but number around 7 billion today.

Wildlife accounts for 3 percent of land animals. There are around 200,000 wild wolves, but 400,000,000 domesticated dogs. Photo: Katy Ruth

Other species that do not contribute as immediately to human appetites, like Sumatran tigers (~500, *Panthera tigris* sumatrae), mountain gorillas (1000 *Gorilla beringei beringei*), and northern white rhinos (3 in captivity, *Ceratotherium simum cottoni*) are on the brink of extinction. Przewalski's horse (*Equus ferus przewalskii*, 250 in the wild), the only horse that has never been domesticated and is strikingly similar to horses in early European cave paintings, is also close to extinction. In a recent article in the *Atlantic*, science writer Peter Brannen (2017) points out, "today wildlife accounts for only 3 percent of earth's land animals; human beings, our livestock, and our pets take up the remaining 97 percent of the biomass." Human populations are expected to reach 9 or 10 billion by 2050, increasing the pressure on non-domesticated animals through encroaching settlements, mining, logging, poaching, the illegal pet trade, and other pressures, creating further homogenization of biological life. For more information on threatened species see the IUCN's (International Union for Conservation of Nature) redlist.

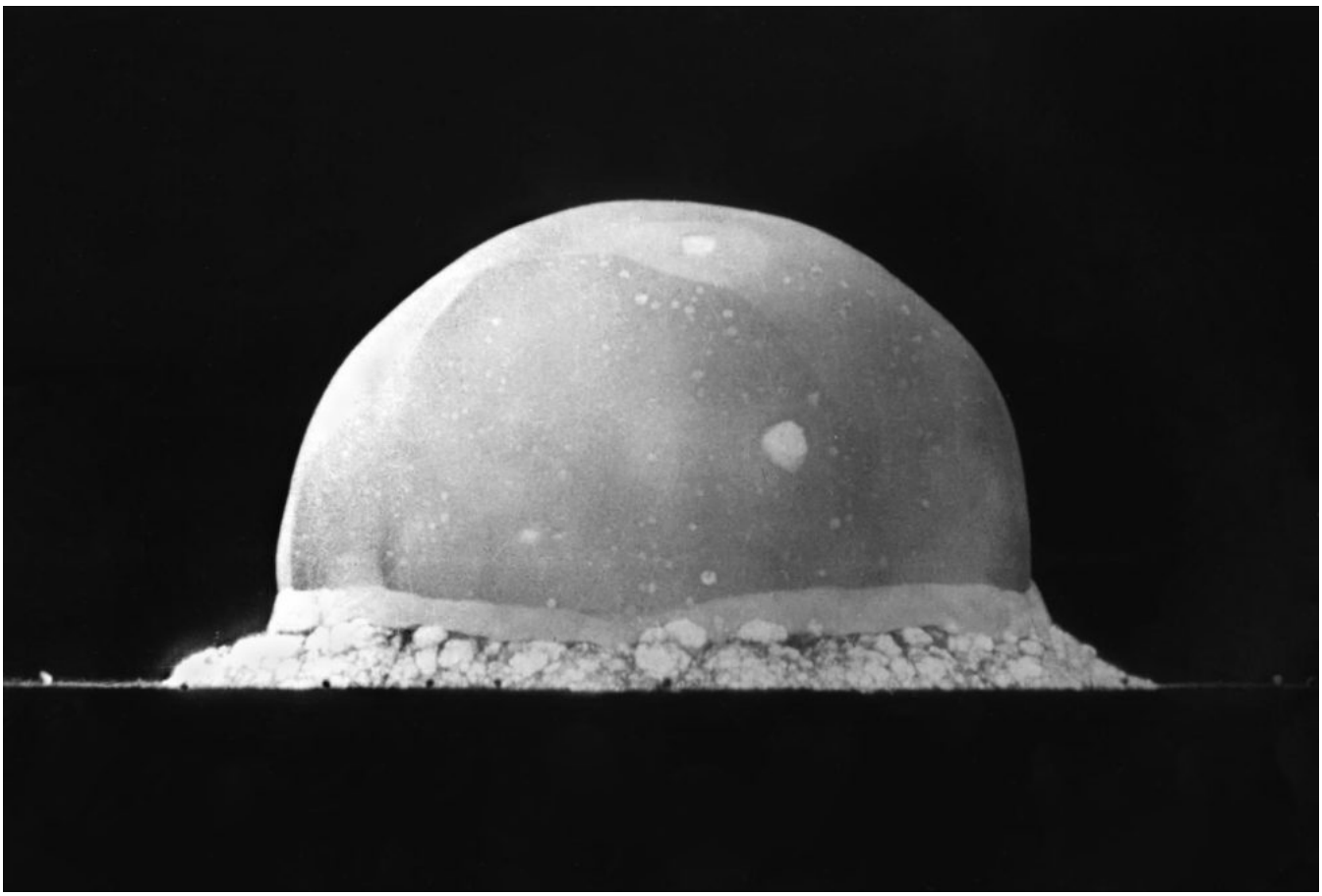
Mountain gorillas (Gorilla beringei beringei) number about 1000 individuals. "Baby Mountain Gorilla" by Bradford Duplisea is licensed under CC BY-NC-ND

Other changes are taking place as a result of human intelligence and cooperation like the rise of cities, massive dams, huge mining operations, irrigated farms, ocean acidification, surface temperature increases, ocean dead zones, deforestation, the composition of the atmosphere, and ozone depletion. Ice cores from Antarctica indicate higher levels of greenhouse gases today than in the last 500,000 years. If we reach an increase of 4 degrees Celsius, the use of the planet will change dramatically resulting in extinctions, crop failures, starvation, and huge migrations of people would also follow. It is not just scientists who worry about the human impact on the earth's systems, but foragers as well. As Henry Rosas a Mastigenka (hunter-gardeners) man of the Peruvian Amazon puts it, "We ourselves have to realize that it is we human beings ourselves that are poisoning everything or else we will ourselves. We will kill ourselves unless we wake up" (Proyecto EBA Amazonía 2016).

Humans have become the most important agent of ecological and climatological change (Harari 2017). We may be a speck in the galactic sense, but we have transformed our speck. Geologists divide time into epochs based on changes in rock layers (also called strata) that correspond to changes in climate and environment. Technically speaking, we live in the Holocene. Yet observing how we have transformed our planet, scientists are now proposing that we are living in a new age called the Anthropocene— the age of humans. Never before has a single species been responsible for altering its ecosystem on such as massive scale. We have become a geophysical force on par with volcanoes and asteroid impacts.

Geologists use fossils and chemical signatures to identify different geological periods. What might be the signs that future geologists will use to define the Anthropocene—the future fossils? Three contenders include fossilized chicken bones, increased radiation levels, and possibly plastics. The Working Group on the Anthropocene is currently debating which signatures will likely prevail. This is a difficult prospect since our lifetimes are so minuscule compared to geologic time. The start date of the Anthropocene is also currently being debated. Some suggest that European contact with the Americas and the resulting exchange of agricultural products and death of an estimated 50 million people from disease

should mark the official start. Others think the beginning of the Industrial Revolution in 1710 is more appropriate. Still, others think 1950 is a solid starting date with the onset of nuclear testing, increased use of plastics, fertilizers, and concrete, along with deforestation, rising carbon dioxide emissions, and increases in domesticated animals like chickens. Wherever you place the starting point, it is clear that humans have had an outsized impact on the planet.



Sign of the Anthropocene. "Trinity Site Explosion" by Berlyn Brixner is licensed under public domain.

Sign of the Anthropocene. "Broiler chickens raised for slaughter" by Farm Sanctuary is licensed under CC BY-NC-ND 2.0

Sign of the Anthropocene. "Marine Litter" by Bo Eide is licensed under CC BY-NC-ND 2.0

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Chapter 4: Ritual and Rites …→

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Chapter 4: Ritual and Rites of Passage (Preview)

You Are Not a Human Being Having a Spiritual Experience. You Are a Spiritual Being Having a Human Experience. **–attributed to Pierre Teilhard de Chardin (popularized by Wayne Dyer)**

In 1999 I was in Rome, Italy, for an excavation at the Villa of Livia in Prima Porta. One day, some Swedes and I were walking around Rome and decided to go to the Vatican. We simply walked into Saint Peter's Square and suddenly I was swept up in a huge roar of a crowd. Thousands of people were crammed into the square, people had signs, and piñata-like things on sticks. Their glowing faces were looking up at a balcony.

"What's happening?" I asked the Swedes, who looked bored.

"Oh, it's the Pope," they shrugged.

"WHAT?!?" I immediately worked my way to the center of the square, surrounded by sweaty ecstatic people. As I turned my head toward the balcony I caught sight of an arm waving and some white cloth flapping in the breeze.

"IT'S THE POPE!!" I shouted.

The Pope vanished and another huge wave of sound enveloped me and reverberated throughout the square. Only later did I question what happened at the moment and my reaction to seeing Pope John Paul was so moving. I mean, my parents forced me to go to the Catholic school on Saturday and I hated it so much that one day I just decided to get on my bike and ride as far and fast as I could. I kept this up for weeks until my brother snitched on me. Why then was I so caught up in this moment? Looking back, I think it was something called "collective effervescence"–a moment of spiritual ecstasy when a group is in perfect synchrony and solidarity. It is a feeling of oneness with other people that is irresistible to people. Well, except for the Swedes.

Spiritual Beings

A central irony of being human is that our spiritual nature is as notable as our ability to solve physical problems—we live in and excel in both realms. Humans invest huge amounts of time, energy, and money in planning and participating in religious activities, often preparing for weddings, funerals, and

coming-of-age ceremonies years in advance. Monuments like Angkor Wat in Cambodia, Karnak in Egypt, the Parthenon in Greece, Tikal in Guatemala, and Stonehenge in England, to name a few, illustrate the lengths to which humans will go for the sake of spiritual beliefs. Plans are currently underway in India to build Viraat Ramayan Mandir, a religious complex even larger than Angkor Wat, the world's largest. While chimpanzees display at waterfalls and throw rocks at particular trees, spirituality, religion, and sacred values take center stage in human societies. For many, spiritual or religious beliefs are at the core of a person's life and identity.

There are dozens of major religions and around 4,000–5,000 in total. By some estimates, there are as many as 10,000 religions today, counting numerous sects or sub-religions (Dietrich 2015). Our devotion and industry toward matters of religion and ritual are so strong, that psychologist Jonathan Haidt suggests *Homo spiritualis* (spiritual human) is a better description of our species than *Homo sapiens* (thinking or wise man).

Temple of Angkor Wat, Cambodia, is the largest religious monument in the world. "Angkor Wat Colour 2" by Claire Bates is licensed under CC BY-NC-ND 2.0

The Sarsen stones of Stonehenge weigh about 25 tons each. "Stones" by vgv8383 is licensed under CC BY-ND 2.0

Supernatural and Religion

We can define supernatural as powers or phenomena that are not subject to the laws of nature. What qualifies as supernatural varies from culture to culture. Disease, for example, in Western societies is often considered a natural occurrence, caused by small organisms that invade the body or other biological processes. In other cultures, diseases are thought to be the result of supernatural forces. Among the Gebusi of Papua New Guinea, all adult deaths are considered to be caused by sorcery (Knauft 2013). The same was true for the Huaorani of Ecuador. As Anthropologist Steve Beckerman puts it, "There was no concept of accidental death or injury. If I'm out hunting and a tree branch falls and almost hits me, that's witchcraft. Somebody caused that to happen" (Beckerman et al. 2009). Similarly, stars and planets are thought by some to personally affect lives, but for others, celestial objects are irrelevant to personal welfare. This contrast in supernatural beliefs can be seen in the ebola outbreak mentioned in Chapter 1. For the medical workers, ebola was a purely natural problem, but for some African villagers it was a kind of supernatural curse and medical workers were suspect (Bloch 2014).

"tarots card" by Yamanaka Tamaki is licensed under CC BY-NC-ND 2.0

All cultures have some form of religion, and thus religion is considered a cultural universal. Religion, like culture, has been defined in various ways. For many non-Western societies, there is no distinct and separate concept of religion at all. In *Genealogies of Religion* Talal Asad argues that the term "religion" is a modern European construction and can't easily be applied to non-Western religions. Religion is simply the way the universe is organized—the "cosmic order" of things. Laws, rituals, and social norms, in turn, reflect this cosmic order. Religion is so embedded in daily life, that it doesn't require a special name.

Anthropologist Sir Edmund B. Tylor (1832–1937) defined religion as simply belief in spiritual beings. His ideas about religion were based on progressivism. He thought that religions progressed over time as societies became more complex, from simple animistic beliefs to polytheism, to monotheism, and then finally to a scientific point of view. "Primitive" religions, in Tylor's view, arose from the idea that so-called "primitive" people had dreams and assumed those dreams were a kind of separate, spiritual reality. Souls of people, animals, and the dead could travel and meet in this dream state. From there, people ascribed souls, spirits, or consciousness to nature—rocks, trees, mountains—assigning a kind of "personhood" to the natural world. This type of belief system is called animism.

For philosopher and psychologist William James (1842–1910), who wrote *Varieties of Religious Experience*, religion meant belief in an unseen order. Anthropologist Clifford Geertz (1926–2006), one of the most influential cultural anthropologists of the twentieth century, refers to religion as an order of existence supported by symbols that make that order seem obvious, natural, and factual. Though religion is difficult and possibly impossible to universally

define, we can say that religion is widely shared in society, involves belief in a supernatural or cosmic order, and is supported by symbols and symbolic behavior.

Rituals

For Geertz, rituals support and confirm the "unseen order" of things. Rituals, like marriage, are cultural universals that vary widely from culture to culture. The features of rituals are the following:

(1) are symbolic

(2) create a sense of community or communitas

(3) create or prevent a transformation of some kind through the supernatural

(4) reflect ideologies or ideas about social correctness and the correct order of the universe

These are the defining characteristics of rituals. The idea of transformation is central to the concept of ritual. A Yanomami shaman, or part-time religious practitioner, might conduct a healing ceremony, contacting the spirit realm, to prevent someone from dying—preventing a transformation from life to death. Men of the island of Vanuatu in the South Pacific perform a land-diving ceremony, enjoining supernatural entities to provide a decent harvest and bring prosperity to the people—ensuring the transformation of a bountiful harvest. In parts of India a "baby dropping" ceremony, where infants are dropped from a building and caught below on a sheet, is intended to ensure that the infant will be strong and healthy and lead a long life—enacting a transformation from vulnerable to invulnerable. We simply don't see anything like this outside of human societies. In all these cases, the supernatural is mobilized through the

ritual to create or prevent some kind of change in the material world. The idea that rituals transform is not just a feature of non-Western societies. In one recent study, American young children assumed that the birthday celebration—the ritual itself—played a causal role in aging (Woolley and Rhodes 2017).

Rituals are often loaded with symbolic actions, words, and objects, such as placing a ring on a finger, blessing with water, wearing black clothing, or anointing the sick. Rituals, both secular and sacred, also reinforce ideologies, pointing out correct behavior and values in that culture. Ideologies are beliefs about how things should be—how people should think and behave. Marriage vows, for example, might highlight values like fidelity, loyalty, honor, and sometimes even obedience. Wedding rings symbolize fidelity and loyalty and identify a person as married. Graduation ceremonies highlight values like hard work, persistence, and dedication. Moving the tassel from right to left symbolizes your transformation into a college graduate.

Rituals that ensure a transformation from one life stage to another life stage have a special name—rites of passage. A rite of passage can be very simple. In some cultures, naming ceremonies transform an infant into a person. That is, the baby is not recognized as being a full-fledged person until given a name. Baptism transforms someone from a non-member to a member of the church. Marriage transforms a person from an unwed person to a spouse. In some cultures, people are not even considered dead until a rite of passage ritual is performed. In Sulawesi, in eastern Indonesia, people Westerners would consider dead are thought to be just sleeping or sick. The body is kept in the house, given food, talked to, and cared for until the funds for an appropriate funeral can be secured. This continues, sometimes for years, before the funeral. Only after a large and elaborate funeral and appropriate interment is the person considered to have passed on.

Perhaps the most dramatic rites of passage are coming-of-age ceremonies, those rituals that mark the transition from childhood to adulthood.

Baptism is a rite of passage that transforms a person into a member of the church. "Baby Baptism" by Mark Cariaga is licensed under CC BY NC ND 2.0

Everywhere, adults and children are treated differently, and rites of passage make it clear which category a person is in and how they are to be treated. Quinceañeras and debutante balls are examples of rites of passage from childhood to womanhood. In some traditional variants of the ritual, the quinceañeras (the initiates) are permitted to start tweezing their eyebrows and wearing makeup. The girl, now a woman, is often given high heels and gives away an item from her childhood like a doll to a younger sister, as a symbol of her transformation. It is not unusual for initiates to be identified through articles of clothing, hairstyles, jewelry, tattoos, or bodily decoration that children are not permitted to wear.

Quinceañeras are coming-of-age ceremonies with symbolic rituals. "Hispanic Heritage Celebration" by US Army Africa is licensed under CC BY 2.0

As part of the coming-of-age ceremony, girls are often instructed in the proper way to be a wife and mother. Among the Diné (Navajo) and Apache of the American Southwest, girls may undergo a Kinaalda ceremony, which transforms a girl into a strong and capable woman. In Nigeria, Efik girls who have started menstruation are secluded in a hut, fed to gain weight, and instructed in the proper behavior and beliefs for a wife and mother. Traditionally, the Masai of East Africa have coming-of-age ceremonies intended to transform a carefree

girl into a full-grown woman with the responsibilities of womanhood.

The traditional Masai of Tanzania and Kenya coming-of-age ceremony involves female circumcision—also called female genital cutting or female genital mutilation—in which the clitoris is removed with a knife (there are several variations of this practice). Infections and difficulty giving birth are complications of the practice. The practice has been outlawed in Kenya but continues to be practiced by some Masai and in other countries in Africa and the Middle East. Sarah Tenoi (2014), who has been circumcised and prefers the term female circumcision, explains, "the cultural roots of female genital cutting are so embedded in my community that parents believe it is the best thing for their daughters. Girls often want to be circumcised so that they will be fully accepted by their culture." An estimated half a million women and girls who had undergone genital cutting living in the United States (Wescott 2015). Like the Cofán of the Amazon, who are reconciling traditional and Western ideals and practices, the Masai are working to transform their society on their own terms. Sarah Tenoi proposes an alternate rite of passage that does not involve cutting, and instead pouring milk on the girl's thighs. In addition, Tenoi (2014) explains how it is important to involve everyone in the community and to encourage Masai warriors to publicly state that they would marry non-circumcised women.

Boys' coming-of-age ceremonies are often equally intense as girls'. Among the Sateré-Mawé peoples in the Brazilian Amazon rainforest, young men undergo a rigorous coming-of-age ritual. Venomous bullet ants (*Paraponera clavata*) are sewn into gloves which are then placed on the hands of the initiates. These large ants, around one inch long, inject a neurotoxic venom that has been compared to being shot. I have seen people bit by a single bullet ant in Costa Rica. There was a lot of swearing needless to say along with days of redness at the sting site. When asked about the ceremony, one Sateré-Mawé explains, "If you live your life without suffering anything, without any kind of effort, it won't be worth anything to you." And so, the ceremony, like so many things in human society, appears to be a way to create value and meaning for living. Remember in chapter 2, we discussed how meaning is something not seen in other species. In

this way, we can view rituals and rites of passage as ways of creating a structure that defines what is valued and meaningful.

Among the Masai, pastoralists of Kenya and Tanzania in east Africa, initiation into warrior-hood traditionally meant killing a lion with nothing but a spear. This proved their bravery and also rid the Masai of predators that kill their cattle. Ritual killing of lions was abolished in Kenya in the 1970s, but the practice persisted. Today, because of the dwindling lion population and economic opportunities that come from eco-tourism, the Masai have rites of passage. In one case, Masai warriors put on a kind of "Masai Olympics," where one's prowess is demonstrated by competitive spear throwing. Warriors have also become "wildlife warriors", finding ways to conserve wildlife while protecting the cattle, the lifeblood of Masai culture.

Western people truly are W.E.I.R.D. because they tend to have very little in the way of coming-of-age rituals. Western milestones tend to be linked to age– getting a driver's license, reaching the legal age for smoking, watching certain movies, or drinking. There is very little in the way of symbol, ideology, or transformation involved. Given this stark contrast with non-Western societies, the question arises whether we are missing something by lacking coming-of-age rituals. Parent Ron Fritz recognized this lack of ritual and decided to create his own coming-of-age rituals for his children based on ritual, community, values, and challenge. These rituals included running challenges, job interviews, and building an Ikea bookcase. Then adults shared their wisdom with the teens in a circle. Westerners also have personal rituals that are intended to transform through the supernatural. Personal rituals are not shared by an entire community but are particular to a person. Before going on stage, Stephen Colbert would slap his face twice, chew the right side of a Bic pen, and ring a little bell in a bathroom. Somehow these personal rituals provide a feeling of comfort and control for humans, especially before a big game, before a recital, or a big exam. Superstition also affects consumers. Lauren Block and Thomas Kramer found that Taiwanese consumers would pay more for fewer items because the lower number of items was considered lucky. They were also susceptible to buying an item at a higher, but luckier, price. The authors posed,

"How much more profit could Taco Bell have earned if they had altered their seven-layer Crunchwrap Supreme into an eight-layer one for Chinese consumers? Similarly, the current $4/$4/$4 (unlucky) promotion by Domino's Pizza may not be as well received by Chinese consumers as had been hoped by the company (Block and Kramer 2009)." So much for humans being different from other species because of our rationality.

Religious Forms

In forager societies, religious beliefs often take two related forms. Animism means that nature is "animated" or endowed by distinct spirits. Plants, animals, rocks, trees, mountains, the sun and moon, springs, and other geographical features are inhabited by a specific spirit or soul. No distinct line exists between humans, animals, and the environment—all are endowed with a spirit, soul, consciousness, or agency. The idea of an animated universe is quite common, even in non-forager societies. In Ireland, the Celts believed certain trees contained spirits and were central meeting places for tribes. Animistic behavior is also common in modern Western societies. We talk to our cars and computers, and some of us even talk to plants. Children's books and movies are filled with animistic images of talking trees, animals, and objects.

Sacred trees are an example of animism. churchyard yew, "Huxham, Devon" by bazzadarambler is licensed under CC BY 2.0

"The talking tree" by mykaul is licensed under CC BY-ND 2.0

A similar concept is animatism. In this case, spirits are impersonal, not tied to specific kinds of plants, animals, or objects, and are potentially everywhere. Animatism is a transferable force and is a kind of generalized spirits like luck, charm, spirit, or charisma. Mana of the islands of the South Pacific, a force or energy that inhabits everything to one degree or another, is an example of animatism. The massive shield volcano Haleakalā that forms most of the island of Maui is thought to possess concentrated mana. Some people or things have concentrated mana and can be dangerous to ordinary people. Mana can be inherited as well as acquired or lost through actions. Taboo is a kind of negative mana and can be contaminating. Taboo things, like weaponry or sacred objects, are to be touched only by certain people. Animism and animatism are not inconsistent with other types of religious beliefs. Most people in modern society believe in luck to a certain extent, and many of us carry crystals, amulets, or special heirlooms. If a Masai warrior heard us talking about good luck or bad luck, he might come away thinking we were quite animatistic.

“Penny from Heaven” by Caitlin Regan is licensed under CC BY-ND 2.0

Mana is a force that can be transferred, gained, or lost. "Chief Sielu Avea" by Extreme Medium is licensed under CC BY-NC-ND 2.0

Sometimes the term magic is used to refer to a system of causation that does not adhere to natural causes. Like rituals, magic transforms through the supernatural, but is not necessarily a repetitive practice. The desired outcome could vary greatly, from attracting a mate to causing harm. Usually, special incantations, behaviors, and treatment of objects accompany magic. The term sympathetic or imitative magic was outlined by anthropologist James Frazer (1854–1941) in *The Golden Bough*. One form of sympathetic or imitative magic imitates the desired outcome and works on the principle of similarity, essentially "like produces like." For example, during the ice age, hunters painted scenes of animals with spears flying at them. This is thought to be an example of hunting magic, where the image supernaturally ensures a successful hunt. This is not so different from modern-day manifesting, where visualizing an event happening produces the event. Another example comes from my childhood. If you gave a wallet or purse to someone, it had to include a coin in one of the pockets. This would ensure that the wallet or purse would always have money. On New Year's Eve in Ecuador, people run around the block with empty suitcases to ensure that they will travel a lot in the coming year. The burning of effigies at the New Year, like Zozobra in New Mexico or politicians in Latin America, ensures that the negativity associated with them won't affect the new year. In Bolivia, there is a festival called *Alacitas* where people buy replicas of the things they want for the New Year, such as houses, cars, baby dolls, chickens (to find a partner), miniature tiny cameras, computers, fake money, and passports. These are then offered to Ekeko, the god of abundance. A voodoo doll is another good example of sympathetic magic. The doll and the victim are connected through their similarity. Among the Hmong of Laos, women having difficulty getting pregnant will consult a healer, who ties a string from the door to marriage bed, such that the baby's soul can find their way to the mother's womb (Fadiman, 1997). For an especially difficult labor, a woman could drink water boiled with a key, so as to unlock the birth canal (Fadiman, 1997: 15).

Contemporary Voodoo Doll with 58 pins
by BeatrixBelibaste is licensed under CC BY SA 3.0

Another variety of magic introduced by Frazer is magical contagion. In this kind of magic if something comes in contact with another object it can leave behind some of its essence or can act on the object at a distance. This is not very different from the concept of animatism. For instance, one student described how after he shaved his head, his grandmother would make him collect his hair and burn it, just in case a witch might want to use it against him. This magic is also present in voodoo dolls, if the hair, for example, of the intended victim, is attached to the doll. In some cultures, personal items are endowed with the essence of people and are symbolically killed or destroyed upon death to release that essence. Sometimes the effect of magical contagion is positive. For instance, as a child, a student thought that putting glitter on pictures would make them come to life. Objects can have qualities of magical contagion, especially those touched by someone famous or infamous—a kind of real-life Horcrux. Autographs work like this–it's like celebrities and sports heroes leave

a little piece of themselves on the paper. Some people convert their deceased pet's collar, fur, or cremated bones into jewelry that they wear. It's a way of keeping the essence of their pet close to them. The same is true for objects closely associated with famous people. Psychologist Bruce Hood likes to ask audiences if anyone is willing to try on a serial killer's sweater for money. Very few people accept the offer to wear "the killer cardigan", demonstrating that many people have underlying magical or animistic/animatistic beliefs. In 2016, one of Marilyn Monroe's dresses (the "Happy Birthday Mr. President" one) sold for more than 4 million dollars (Juto 2016). It originally cost about $1500.

There are many examples of magical contagion in sports. In his book, *Alter Ego* performance coach Todd Herman describes how he would place trading cards of professional football players on his shoulder pads to improve his game. This is also a bit like imitative magic because the cards themselves are imitating the players! A student once did something similar by getting tattoos of the Icelandic staves Gapaldur and Ginfaxi; historically these symbols were placed in the shoes to ensure victory. One of the best examples of both magical contagion and imitative magic comes from a former student. The student explained that mixed martial arts champion would always wear a lucky sweater to insure a successful fight (magical contagion). Another fighter then imitated him by wearing the same sweater (imitative magic)!

Marilyn Monroe's dress selling for 4

million dollars is an example of magical contagion. "Marilyn Monroe" is licensed under CC BY-NC-ND 2.0

Shaman are typically part-time healers who communicate the needs of the living with the spirit world. Sometimes shaman help others make the journey. Shaman often accomplish this with rituals, trances, ritual drumming, singing, or sometimes hallucinogenic drugs. Ethnobotanist Terrance McKenna explains that "shamanism is about going into the realms of death, transcending the body, transcending space and time…What the psychedelics do is that they dissolve boundaries. They dissolve the illusion of separateness" (*Shamans of the Amazon* 2016). One well-known plant from the Amazon is ayahuasca which is called the "vine of the dead". When coupled with another plant, *Psychotria viridis,* which contains DMT (dimethyltryptamine), it produces powerful hallucinogenic effects.

In contrast to animism, theism means belief in supreme deities, where gods rank higher than humans. Polytheism means many powerful gods and goddesses or deities. Ancient Egyptians, Mayan, Hindus, Greeks, and Romans are all good examples. Very typically, the human ruler in polytheistic societies was also divine or semi-divine. In polytheistic religions, powerful gods and goddesses needed to be appeased through sacrifice and rituals to remain benevolent and to ensure a good harvest and health. Polytheism is associated with more complex, hierarchical societies. The ancient Hebrews were an exception, being monotheistic— with the single powerful god Yahweh.

Communitas and Collective Effervescence

When I was in Rome and saw the Pope, there was electricity in the air and I was swept up in the moment. French sociologist Emile Durkheim called the intense feeling of togetherness and ecstatic excitement that accompanies ritual "collective effervescence". Religious activity such as prayer, meditation, chanting, dancing, and singing has a measurable physiological effect on people. The field that studies this phenomenon is called Neurotheology. Brain scans

(FMRI) show decreased blood flow in certain areas (parietal lobe) of subjects engaged in spiritual practice, perhaps relating to a decreased sense of self. Long-term meditation results in thickening in the cortex of the brain associated with attention and sensory processing. Speaking in tongues results in decreased activity in the frontal lobe. This squares with what people say they experience, that is, being outside of themselves and overcome by some outside force. Some people might even have spiritual experiences in other non-religious endeavors like painting, singing, sporting events or other activities not related to the supernatural. We see this on social media in flash mobs. Where people start spontaneously singing and dancing, and everyone stops and participates in the moment as if time has time itself has stopped. Even if one does not feel "outside of themselves" or part of something larger, many people feel a senese of communitas when engaging in group activities like making music together, dancing, or playing a sport. One student provided a great example of this that they observed at the Waterpark Village Vacances Valcartier in Quebec. The park has a waterslide where a single person is locked in a chamber, then the floor suddenly drops away, and the person rockets straight downward into a waterslide tube. The intenseness of the experience has a pronounced effect on people. Strangers begin to chat and offer encouragement (You got this!) and offer advise (Fold your arms in front!") to the "initiate" who is about to disappear into the unknown before their eyes. The normal rules of social engagement are suspended and people who would normally ignore each other are comming together with a sense of communitas and oneness. It may be that human rituals tend to be intense precisely because they inspire intense feelings of unity and sometimes "effervescence."

When Did Belief in the Supernatural Begin?

Supernatural beliefs themselves cannot be discovered in the archaeological record, being by definition "beyond the natural". Archaeologists only have the material record to work with. Religious texts can be very informative, but the invention of writing only began around 5,500 years ago in Mesopotamia. What

then can archaeologists use to infer that people had a belief in an unseen order or rituals associated with religious belief?

The first evidence for supernatural beliefs are much older than religious texts, going back tens of thousands of years into the Pleistocene or the ice ages. At Lascaux Cave in France, there are some 2,000 paintings that are about 17,000 years old. The figures are depictions of ice-age animals, especially horses (very similar in form to the threatened Przewalski's Horse). There is little evidence that ice-age people lived in the interiors of these painted caves, but went to great lengths to paint them. This has led archaeologists to speculate that the images were not art for art's sake but rather related to shared religious beliefs and perhaps used in the course of religious rituals. Archaeologist and priest Abbe Henri Breuil (1877–1961) suggested that ancient paintings of animals on the walls of European caves were a form of sympathetic hunting magic, an attempt to increase animal numbers or aid in the hunt through the concept of "like produces like". In essence, depicting the animals with spears in them assists in the actual hunt.

"Cave painting of a dun horse (equine) at Lascaux" by Cro-Magnon peoples is licensed under public domain.

At the site of Dolní Věstonice in the Czech Republic (circa 27,000 years ago), archaeologists found a small structure located away from a village. The structure contained a specialized oven or kiln for firing ceramics. Approximately 2,300 loess (fine silt) figurines depicting lions, foxes, bears, horses, and rhinos were discovered, along with more than 2,000 loess balls. Most of the figurines were broken and archaeologists determined that they were intentionally destroyed during firing, perhaps as part of a ritual performance. Archaeologists speculate this was an early shaman's hut.

But perhaps the most obvious indicator of supernatural beliefs are burials, especially those burials that contain grave goods. An early example of a human burial comes from Sungir in Russia. At Sungir, burials include one adult male and two children, who are buried head-to-head. The site dates to ca. 24,000 years ago, and the three burials included more than ten thousand ivory beads,

mammoth ivory bracelets, beaded caps, decorated belts, ivory pendants, an ivory lance made from a straightened wooly mammoth tusk, and an animal pedant among other grave goods. The intentional burial of human bodies with objects suggests that people even tens of thousands of years ago had some concept of the afterlife.

Everyday Unseen Orders

Anthropologist Clifford Geertz was not happy with the definition of religion as being about the supernatural. Rather, he focused on ideas about the "order of existence"—how the world is and how it should be. For Geertz, these worldviews are supported by symbols, made to seem natural and obvious, and can be highly motivating. Geertz's definition of religion doesn't involve the supernatural at all.

Similarly, others have pointed out that humans have created their own "unseen orders" that we interact with daily. We live in a material world, but we also live in a world of our own making. Historian Yuval Harari points out that humans accept all sorts of ideas that cannot be measured or even seen, but rather are purely abstract concepts and values that we have invented that we take for granted as normal and obvious. For example, we accept the existence of nations and laws as if they truly existed in the material world and not concepts created by humans. The ideas of nations are supported by symbols like the Statue of Liberty and the American flag and rituals like saying the pledge of allegiance or singing the national anthem. Flags are not merely colorful pieces of cloth, and people have strong opinions about how the American flag should be treated. Indeed, the Flag Code embodies a supernatural and starkly animistic idea stating: "The flag represents a living country and is itself considered a living thing." When the symbols and rituals of these unseen orders are disrupted or questioned—by the tearing down of monuments or kneeling during the anthem—many people have very strong reactions. In this regard, everyday institutions like schools, companies, and nations, are not so different from religions having their own ideologies, rituals, symbols, and sometimes even supernatural beliefs.

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Chapter 5: Marriage →

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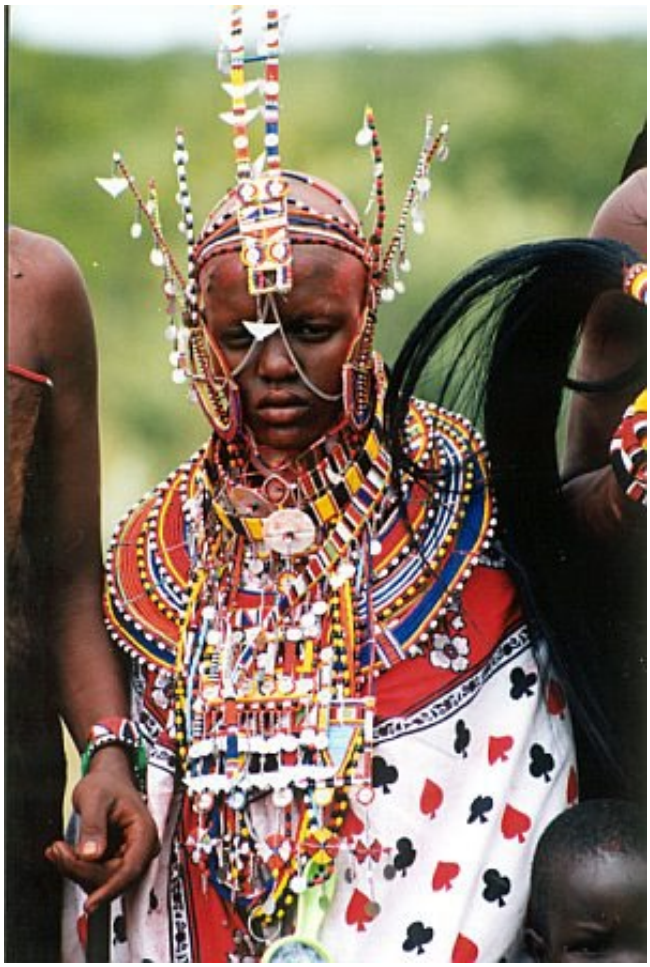
Chapter 5: Marriage (Preview)



"Maasai1" by medicalmission is licensed under CC BY 2.0

What does Santa Claus have to do with marriage? Saint Nicholas was a Greek bishop who lived in the 4th century. In those times, and in many places today, dowry was needed to marry a daughter to a suitor. Dowry is paid by the bride's family to the groom's family. A story goes that a man with three daughters could not afford a dowry for them, and they were likely to be forced into prostitution. Santa Claus decided to do something. In order not to shame the family he came at night and threw a bag of gold through the window for the first daughter's dowry. The next night, he threw another bag of gold through the window for the second daughter. The father wanted to know who was helping them and so stayed up all night at the window. On the third night, Santa threw the bag of gold down the chimney to avoid being noticed. It is said that in this way, Saint Nick became the patron saint of prostitutes (although he is admittedly the patron saint of a lot of professions). Saint Nicholas is often portrayed with three golden balls representing the bags of gold. So if you celebrate Christmas, this year, remember Saint Nick and his acts of kindness.

What is marriage?

Marriage consists of a publicly, socially, or legally recognized relationship between partners. What makes marriage different than other formally recognized relationships is that it organizes sex, child care, inheritance, economic tasks, and social ties. The marriage ritual—the wedding— is typically marked by exchange of goods and services between families. Like language, ritual, and kinship, marriage is a cultural universal—virtually all cultures have some kind of marriage. However, the form that marriage takes differs markedly from culture to culture.

There are several general kinds of marriage, though these don't cover the full range of possibilities that exist. Monogamy refers to having a single mate for life (and sometimes even beyond life), while serial monogamy means having one mate at a time. Serial monogamy is a pattern of marriage and divorce that many Westerners are familiar with. Polygamy is a general term meaning having more than one spouse at a time. Anthropologists usually refer to two varieties of polygamy called polygyny and polyandry. Polygyny occurs when males have more than one female spouse (*gyno* is the root for woman). Polyandry (*andro* means man) occurs when females have more than one male spouse. A particular form of polyandry is called fraternal polyandry, in which brothers share a wife.

The majority of traditional non-Western human societies permit polygyny, where men have multiple wives. This can be misleading, however, in that the majority of marriages in the world are monogamous, even where polygyny is socially and legally permitted. Polygynous marriage requires wealth to support multiple wives and their children, and not all men are wealthy enough to be able to support multiple wives and children.

As we will see, marriage can take many unexpected forms and vary greatly between cultures. In agricultural and pastoral societies, marriage is often a way to designate an heir to land, animals, or other property or rights. In forager

societies, where there is little property to inherit, relationships can function to improve survivorship. Marriages with multiple partners, same-sex marriages, arranged marriages, and marriage to deceased persons are well-known and have been historically documented. Changing economics and ideas about personal happiness borne out of the Age of Enlightenment resulted in marriages based more on affection and companionship than practical matters like inheritance and offspring survival.

Polygyny

Polygyny is a form of marriage most commonly found in Africa and some Muslim countries. For example, South African political leader Nelson Mandela's father had four wives. Politician Mitt Romney's great-grandfather had four wives and 30 children, fleeing to Mexico when the Mormon Church outlawed the practice in 1890. Likewise, Barack Obama's great-grandfather, Obama Opiyo of the Luo tribe of Kenya, had five wives.

Polygyny is more common when there are differences in wealth and status among men. In traditional Maasai society of Kenya and Tanzania, women are married to older men and cannot divorce except in extreme cases. The marriages are arranged not by the couple, but by the village male elders. A woman must marry because she relies entirely on her husband for sustenance. There is no option to remain single. When a woman marries, she is given cattle, a form of wealth, to watch over, but they are not owned by her. Indeed, women cannot own anything. Instead, a woman passes along rights over cattle to her sons when they are older. A woman must have a son to inherit the cattle because when she is older she will leave her husband's house and be taken care of by her son. If she fails to have sons, she will become reliant on the generosity of anyone who will help her.

Polyandry

Polyandry, where multiple men share a single wife, is a very rare form of

marriage and is illegal in most parts of the world. This form of marriage is most commonly practiced by Tibetans in Nepal where farmland is scarce. Brothers may marry a single woman, called fraternal polyandry, to limit the number of children they have—a form of birth control. This is important because if there are too many heirs (children that inherit), then the land will become divided and unable to support the family. The children are considered the offspring of all the brothers. In addition to preserving the estate, multiple husbands can increase the family's standard of living by providing more paternal care, by the fathers working in the city, taking care of domesticated herds, and tending to the farm (Goldstein 1987).

Another variation on polyandry is called partible paternity. Partible paternity is practiced in lowland South America. In these systems, it is thought that the fetus is formed from the semen of more than one man. According to anthropologist Steve Beckerman, women have sex with multiple male partners to ensure that their offspring will have the best qualities of those men. When the child is born, the men acknowledge that they are one of the fathers. The men are then obligated to provide gifts like fish and meat for the child as well as provisioning for the pregnant mother. Having a "backup dad" ensures that children will have better access to food and protection from violence (Beckerman and Valentine 2002). For instance, a secondary father improves child survivorship among the Barí of Venezuela, where child mortality is high. The odds of young Barí women being widowed were so high, that men who allowed their wives to take a lover were providing a kind of insurance policy for their children (Small 2003).

Three Araweté children in Brazil, 2005 by Avidd is licensed under CC BY 2.0

Monogamy and Serial Monogamy

Marriage patterns are influenced by subsistence and economy. Monogamy is practiced in societies where family alliances are important and establishing an heir, usually male, to inherit the wealth and land is paramount. In monogamous marriages, it is not just the couple that is brought together, but also the families of the bride and groom. In these societies, divorce and extramarital affairs are severely punished as they affect the alliance and the status of not just the couple, but the two affiliated families.

Male inheritance as regulated through marriage has been very common throughout history. Historically, in Western European society, the eldest male would typically inherit the estate and women generally could not inherit.

Having few other options, women had to marry, much like Maasai women, to survive. The premise of the PBS series Downton Abbey set in England in the early 1900s revolves around this very problem. Lady Mary cannot inherit her father's estate and so a marriage with her third cousin is arranged to pass along the wealth. Oftentimes, first or second cousin marriage was ideal because this allowed the estate to be kept within the family, and titles were retained. The television program prompted a bill, the "Downton Law", requiring equal inheritance for titles for males and females (it didn't pass). Because so much depends on the success of marriage, divorce, especially for the wife, is difficult.

Serial monogamy (one legal spouse at a time) is very common among foragers and industrialized nations. In both cases, people tend to move to resources whether it's a job or a mongongo nut grove in the Kalahari Desert. Less emphasis is placed on family alliances and inheritance, and so permanent marriage bonds become less important and carry fewer economic consequences. In mainstream American culture, once women entered the workforce in significant numbers, they were better able to provide for themselves and their children, and divorce, while still scandalous at the time, became increasingly possible. While some see divorce as a sign of moral decline, divorce is connected strongly to economic patterns. Divorce in general is correlated with women's economic security.

Other Forms of Marriage

In Sudan, there is a practice called Nuer woman-woman marriage. If a man has no son, and therefore no heir, his daughter may take a female bride. The bride then chooses a man to have sex with, like a sperm donor, and the children of that union are considered the offspring of the female husband and the female wife. The female wife can also help with household chores. This union, while not a sexual one, ensures the continuation of the family name, established a cooperative economic unit, and provides an heir for the family's wealth. Again, we see that marriage is an arrangement for purely practical reasons, in this case, the establishment of a suitable heir to the property. In this case, marriage does not regulate sex, but rather organizes family inheritance, economics, and

child care.

Another Nuer practice is ghost marriage. If a Nuer woman is widowed, her husband's brother may step in as a substitute. This system where the brother steps in and marries his brother's widow is called the levirate. The woman, however, is still officially married to her deceased husband (the "ghost"), and any children produced by her and her husband's brother are considered the offspring of her deceased husband. Nuer women traditionally have no significant wealth—it belongs solely to their husbands. By substituting her husband's brother for her deceased husband, she can hold onto her husband's wealth and pass it along to her sons when they mature. Again, we see that the marriage organizes child care and inheritance of wealth. The sororate is a similar system where the widower man marries his dead wife's sister. This system is not unknown in Western societies. For instance, surrealist artist Salvador Dali's father married his deceased wife's sister making his aunt his step-mother.

Walking Marriages are practiced in the Mosuo culture of southern China. The people raise crops and livestock and live in large extended families. The families are matrilineal, meaning that inheritance flows through the female line. And so, women do not move out of their birth family (natal family) as they often do in patrilineal societies. Instead, a young woman will invite a man to come to her bedroom at night. He then leaves in the morning and has little to do with supporting his children. Instead, it is the female's extended family, especially the woman's brothers support her children. These unions are often referred to as walking marriages because the man walks to the woman's house. Women may have multiple partners throughout their life, but often the couple forms a long-term relationship. Mosuo women also do much of the labor and the most important person in the household is the grandmother. One Mosuo woman describes Mosuo culture as "the most progressive in the world." This lies in stark contrast to other parts of China where a woman must marry before the age of thirty. Women not married by this time are called "leftover" and their Shanghai parents sometimes advertise their daughters on umbrellas at a place called the "matchmaking corner."

Arranged marriages

The system that mainstream Americans practice where we can choose our mates is unusual among the world's cultures. In traditional societies, marriages were arranged by parents, families, or male elders, with the bride and groom having little say in the matter. These marriages are of course called arranged marriages, a practice which continues today in many cultures and countries. This practice has roots in European as well, where the groom asks the woman's father for his consent.

Arranged marriages often affect not just the people in the marriage, but their families as well. This is because jobs, houses, and social circles are gained through family connections bonded through marriage. In her article "Arranging a Marriage in India," anthropologist Serena Nanda found that young women were largely accepting of the idea of arranged marriage. One young woman explained, "My marriage is too important to be arranged by such an inexperienced person as myself."

When marriages are arranged, it is also common practice for the bride to move into the house of the husband's family and leave her natal family. This is called patrilocal residence. In mainstream American culture, the newlyweds often live apart from their natal families in a practice called neolocal residence. Because of the wage labor economy, the couple often moves far away from their natal

families. Rather than rely on family alliances for jobs and social networks, the newlyweds form their own path.

In arranged marriages, a dowry is often transferred from the bride's family to the groom's family. Dowries can include things like cash, jewelry, appliances, and even furniture. Dowries typically occur in stratified societies in which women can marry above their status if their dowry is sufficient. The better the dowry, the better the match a woman can make, at least in economic terms. In theory, a dowry is a way to ensure that one's daughter is financially supported in her new home. In India, dowry can lead to harassment, burning, and dowry death. Because of patrilocal residence, brides are more vulnerable to abuse in the groom's house, not having the protection of her natal family. Brides have been harassed to extort more dowry from her family. "Bride burning" also occurs where the woman is intentionally burned by the groom's family and later is disguised as an accident. Sometimes the family claims that the bride committed suicide by poison or some other means, and sometimes the abuse leads to suicide. In addition, girls are sometimes seen as a financial burden that they are neglected or killed before birth. One study found that when gold prices increased, infant girls were less likely to survive (Ratcliffe 2018). As a result of the problem, compulsory dowries were outlawed in India by the Dowry Prohibition Act, 1961. And yet, the practice continues. In 2010, there were more than 8,000 cases of dowry death reported in India.

In other cultures, there are prenuptial agreements to protect brides financially in the case of death or divorce. The ketubah is a Jewish tradition that outlines the responsibilities of the groom toward his bride and includes financial contingencies in the case of divorce. Today, ketubah not only acts as a prenuptial agreement but is also a kind of decoration as well as a symbol of commitment (Sheinbaum 2019).

Illuminated ketubah, Sotheby's, public domain

Bridewealth is a gift or money from the groom's family or descent group to the bride's family. There are various forms of bridewealth. In one form, bridewealth is compensation for the work that women do for the household. That is, the bride's family demands payment for the work the bride would have done for the family as well as the children she would produce. Among the Igbo, bridewealth is seen as payment for the rights over children. If a woman is unable to have children the bridewealth must be returned. Alternatively, bridewealth is sometimes seen as compensation for the time and energy it took to raise the girl to a woman.

In another form of bridewealth, a groom's elders—fathers, uncles, and older brothers—help him assemble a standardized amount of wealth to obtain a bride. The groom must then devote time and energy to his seniors instead of his wife. The arrangers of the marriage then get benefits beyond marriage alliances or the organization of inheritance. In this gerontocratic society, where older males hold all the power, younger males become indebted to older males.

Brideservice involves the groom serving the wife's family for several years. In the Biblical story of Jacob and Rachel (his first cousin), Jacob works for several years for the right to marry Rachel. After seven years of service, a veiled Leah is substituted for Rachel at the wedding. The sisters' father, Laban, indicates that Jacob can marry Rachel for another seven years of brideservice. When Rachel cannot bear children, she has her handmaiden sleep with Jacob to act as a surrogate and produce children for her. This is similar to the Maasai women giving away their children so that women with none will be able to raise children.

“Rachel meets Jacob at the well”.
Licensed under public domain.

Child Marriage

Child marriage is a very common form of arranged marriage. Where the competition to find suitable mates is intense, child betrothals can take place. Child betrothals occur when young children are promised in marriage to be consummated when they mature. This practice ensures a match early in life. Mohandas “Mahatma” Gandhi, born in 1869, was married at the age of 13 in a match arranged by his parents. Child betrothals and child marriage, especially for girls, continue today in many parts of the world including Africa, Asia, and Central Asia.

Parents sometimes give away their daughters to older foreigners and sell their daughters to repay debts (Motley 2014). Activist Memory Banda describes in her TED talk how young Malawian girls are sent to initiation camps, where they are taught to please men and sometimes get pregnant. One initiate Grace Mwase explained, "They taught us only how you can handle a man. So you should be dancing for the man. The man should be on top of you and you should be dancing for him, making him happy" (Ahmed 2014). Sometimes men called "hyenas" are paid to have sex with the girls. Sexually transmitted diseases and complicated pregnancies can result. Often people are secretive about the initiation rites because they do not want outside interference or judgment from missionaries. Yet, there is a movement of change from within. The Girls Empowerment Network encourages girls not to have sex during the initiation and to stay in school. Memory Banda has worked to end these practices in her home country of Malawi and successfully lobbied to amend the constitution to raise the legal age of marriage to 18. In Zambia, girls produced a song called "We are Girls, Not Brides" to bring attention to the problem of child marriage.

Unfortunately, child marriage is sometimes used as a way to buy a person's labor for life–more like a form of slavery than marriage. As one Afghani girl bride explained (VOA 2018), "I kept telling them that I wanted to go to school. But my in-laws told me, 'If you go to school, who will do the house chores? We bought you.'" There are many examples where girls are married off young and abandoned by their natal families. If they escape their marriage and try to return home, they are sent back because of the shame they are bringing to the family name.

Child marriage also has health negative effects. The World Health Organization reports that childbirth and pregnancy complications are the leading cause of death for girls globally aged 15 to 19. In addition, babies of adolescents are more likely to suffer from neonatal conditions. Unfortunately, the pandemic has increased economic strain and school closures, causing an increase in the incidence of child marriage. As one sixteen-year-old girl from Cameroon recently explained (Funyuy 2020),

"My father complained [that] instead of me eating his food and occupying his space, I better get married," Inna told The New Humanitarian in April at her home near Ngaoundéré, in the Adamawa region. "My father told me that marriage is my ticket to heaven – not education."*

And the pressure to be married and to find a decent husband can be intense. To find a suitable husband Maasai girls are circumcised and Mauritanian girls are force-fed 9,000 calories or more a day because fat is a sign of beauty. And in the Western world, there is intense pressure for girls to be thin to be accepted and avoid fat shaming. The Universal Declaration of Humans Rights (1948) stands in opposition to child marriage, stating, "Marriage shall be entered into only with the free and full consent of the intending spouses." In the United States, teen marriage is associated with low education, lower wages, and higher unemployment (Dahl 2010). Teen girls who marry are 50% more likely to drop out of high school.

Traditional Marriage and Love, Actually

With the rise of industrialization, urbanization, and wage-labor economics, people became more and more independent from large extended families associated with intensive agriculture. Likewise, the significance of inheritance diminished. The concept of marriage as about companionship and love emerged from this development. With the eighteenth century's Age of Enlightenment's focus on individuality (captured in the Constitution's "life, liberty, and the pursuit of happiness), people began marrying for more individualistic reasons and choosing their own mates.

Sometimes people, especially, politicians, will bring up the idea of traditional marriage, with the intent to restore traditional marriage in American society. In these cases, traditional marriages mean monogamy between a man and a woman. For the anthropologist, as we have seen, traditional marriage means something quite different. For anthropologists, traditional marriage conjures up practices of cousin marriage, polygamy, polygyny, partible paternity, dowry, levirate, and so forth.

As discussed, marriage regulates several things—childcare, inheritance, procreation, sex, and labor. But we have also seen that marriage takes many forms around the world. What's more, is that definitions of what constitutes a legitimate marriage can change over time. Anthropologist Rosemary Joyce (2013) discusses Supreme arguments against same-sex marriages that took place in the United States in 2013. The counsel against same-sex marriage proposed that marriage is about producing children, and same-sex marriages should therefore not be considered valid in the eyes of the state. Joyce points out that marriage has no "singular, stable history", but rather takes a wide variety of forms. Ultimately, the argument against same-sex marriage failed, and it is today legal in all states in the U.S. According to the Pew Research Center (2019), 30 countries legally recognize same-sex unions including most countries in North and South America and western Europe.

Gay marriage around the world

Countries that allow gay marriage or where it is legal in some jurisdictions

Source: Pew Research Center analysis. Map classifications as of October 2019.

PEW RESEARCH CENTER

Polyamory has recently received much media attention. It is not technically a marriage arrangement, but rather refers to consensual romantic relationships with more than one person. Polyamorists stress that polyamory differs from cheating because the relationships are consensual. It also sometimes goes by the unwieldy name “consensual non-monogamy”. Polyamorists argue that it is not mere promiscuity, but rather a commitment to more than one person. Polyamory seems to focus more on Western ideals of love and companionship than do traditional marriages. Polyamorists point out that there are many

forms of love romantic, passionate, and companionate and they can be expressed toward different people. Philosopher Carrie Ichikawa Jenkins, who has both a husband and a boyfriend, thinks that a broader definition of love is needed (Weigel 2017). Anthropologist Barbara King suggests that polyamory is a good example of just how flexible human behavior can be (King 2017).

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Chapter 6: Language

"Language is an app for converting a web of thoughts into a string of words."

—Steven Pinker, Linguistics, Style and Writing in the 21st Century

My oldest son was two years old and he asked me,

"Where's the cheeser? I want the cheeser!"

You want cheese? I asked, heading for the refrigerator.

"No, the *cheeeeser*!"

Oh no. He wants the cheese grater, I thought. How can I distract him? A two-year-old with a cheese grater is just a bad idea. "Let's play a game!"

"Oh. There's the cheeser!" he said pointing to the smartphone on the counter.

"Aha!" A cheeser is an object that makes one say "cheese."

But how did my son come up with this word at two years of age? I never said cheeser in my life, and no one else did for that matter, so he could not just be imitating. I wondered, how can kids who can't eat, dress, sleep, or poop on their own, figure out something as complex as language? And do other species have language like humans? What even *is* language exactly?

Language is the principal way in which we convey information to others and how culture is transmitted. As linguists, Bruce Rowe and Diane Levine (2011) explain, "Speech, sign language, and writing is the way that linguistic knowledge gets out of your head and into the heads of others." Without language, "there would be no stories, there would be no books, there would be no Internet, there would be no computers, in fact, there would be no history" (Jeffrey Elman 2008). Language permits humans to cooperate on massive scales by allowing us to find common ground, pass on information, teach others, and negotiate relationships. Language makes us a powerfully adaptive species. It is no exaggeration to say that the puffs of air that we push out of our lungs and through our vocal tract have changed the world.

What is Language?

Language can be defined as a communication system consisting of words used in a structured and conventional way, but we will see that it is more enlightening to look closely at specific features of language to understand what it is. There is no human society that lacks language, and it is, therefore, a cultural universal. The 7,000 or so languages in the world are wonderfully diverse, with different sounds, words, and rules for making sentences. The !Kung language spoken by the San of the Kalahari, for instance, has one of the largest sound inventories in the world including distinctive click sounds. Different languages use different rules for ordering subjects (S), objects (O), and verbs (V). In English, we say "Sue sells salsa", an SVO sentence. In Tuareg-Berber, a VSO language, the sentence would be something like "Sells Sue salsa." There are 6 different possible arrangements for sentences, all of which are found in human languages. Though we often think of language as being spoken, it can have different delivery systems including speech, sign language, and

writing. While all cultures have some form of spoken language and accompanying oral traditions, not all have a written form of language. Writing itself had its beginnings around 6,000 years ago, the earliest known writing system, cuneiform, arising in Mesopotamia.

Xhosa Khaya

How to say “click” sounds.

It is easy to take language for granted; most of the time we don’t even think about it. We just do it. If we had to explain it to alien visitors or even to children, we’d probably have trouble even with the basics. Spoken language is communicated through sounds—air pushed up from our lungs through the vocal tract—the area that extends from the vocal cords to the lips where the sounds of language are generated. The shape of the tract affects the shape of the sound produced. Those sounds are combined in systematic ways to make words, which refer to things, ideas, and relationships. From there, words are combined in systematic ways into phrases, which are combined into sentences. Sound waves then travel through the air, enter the listener’s ear, and are

conveyed to the hair cells in the cochlea. From there the signal is transferred to the auditory nerve, then off to the primary auditory cortex in the brain for translation. From an alien perspective, it is a remarkable and complex way to pass along information, and yet even small children can do it.

Features of Language

In 1960, linguist Charles Hockett defined the features of language. He argued that if a communication system lacks even one feature, it is not language. Because language is so essential to human culture, peeling back the layers of language is useful for understanding the nature of being human.

Hockett outlined many design features, but we will consider only six in this chapter. These are:

- Cultural Transmission
- Arbitrariness
- Productivity
- Displacement
- Grammar
- Context-specific

Cultural transmission with regard to language means that humans learn the language of their environment. It is not too surprising that children raised hearing Swahili all around them will grow up to speak Swahili. This was not always so self-evident, however. Psammetichus I, king of Egypt from 664–610 BC, commanded a shepherd to raise two babies without them ever hearing language. Whatever language the babies spoke, Psammetichus reasoned, must be the mother tongue of all languages, from which all other languages descended. One baby allegedly said the word “bekos” which sounded like a

Phrygian word for bread, and Psammetichus concluded that Phrygian was the root of all languages. Today, depriving a child of language is called the "forbidden experiment." Based on the few cases where children are raised without language, it is clear that children do not spontaneously speak a "mother tongue" without ever getting any linguistic input.

Language is culturally transmitted.

Arbitrariness means that words that we assign to represent things don't resemble each other. In short, words are symbols that represent things or ideas. William Shakespeare's famous line from Romeo and Juliet "What's in a name? That which we call a rose by any other name would smell as sweet" has come to epitomize the arbitrariness of words. Here's how Mary Jane Scott, a CNM student explains arbitrariness:

Arbitrariness is the feature of language that says our words don't necessarily match the things they represent. We have all just decided that in the English

language that 'desk' represents a desk, but essentially that was just chance. 'Desk' could have easily meant something entirely different, but we decided those letters in that arrangement meant what it does, and we've just agreed on it.

The majority of words in all languages are arbitrary. Sometimes writing systems or signs in American Sign Language are not arbitrary. That is, they resemble the things they represent. Yet, ASL contains arbitrary signs as well. Some writing systems also have non-arbitrary symbols. For example, in the ancient Maya writing system, this is the word for jaguar, which somewhat resembles an actual jaguar. But the spoken word "door" doesn't resemble a door.

B'ALAM

Ancient Maya writing system, this is the word for jaguar

To take another example, "whale" is a small word for a big animal; and "microorganism" is just the reverse. Arbitrariness is what allows different languages to have words that sound nothing like each other—perro, hund, chien, dog. The exception to arbitrariness in spoken language is onomatopoeia in which the word sounds like what it represents. A classic example is "cock-a-doodle-doo", which resembles the sound a rooster makes. The word for the sound a rooster makes is remarkably similar across unrelated languages and is therefore not arbitrary.

Cock-A-Doodle-Doo–English

Kokekokko–Japanese

Quiquiriquí–Spanish

Cocorico–French

Ake-e-ake-ake–Thai

The word "cock-a-doodle-doo" is not arbitrary but most other words are. "Crowing Rooster" by Tony Alter is licensed under CC BY 2.0

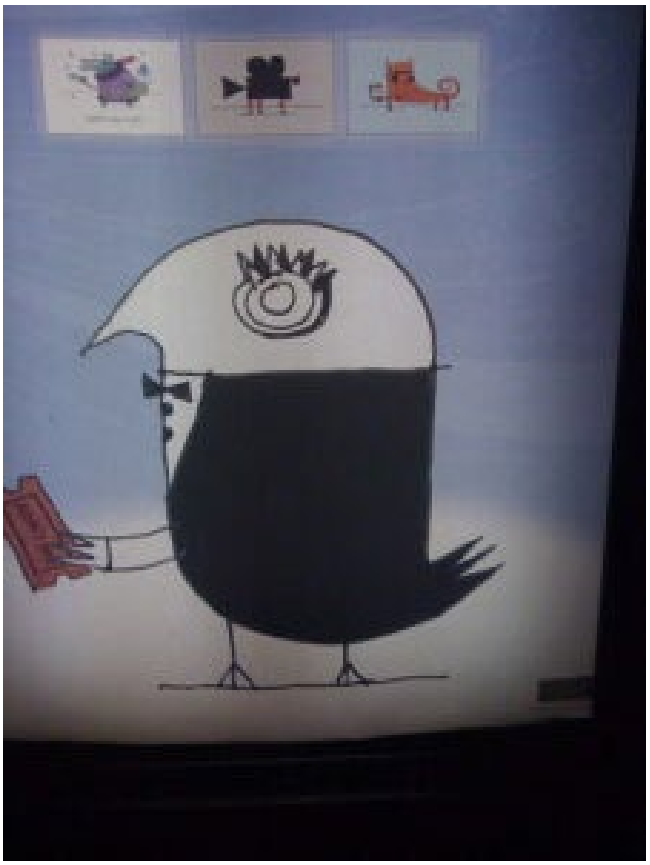
Productivity means that new words or sentences can be generated. We can always invent new ones. Once upon a time, the words "selfie", "blog", and "smartphone" simply didn't exist. We created them because we needed them to describe the ever-changing world. New sentences can also be created at will. For instance, I could say "Friendly aardvarks do back-flips in pajamas." Even if you never heard this sentence before, you can still understand it effortlessly. You don't need to have heard or read this particular combination of words before. You use your knowledge of sentence construction, grammar, and perhaps a little imagination, to figure it out.

Even little children know how to decode language. They don't just imitate, they

also actively construct language. One of the joys of children is that they effortlessly create new words or neologisms. Once my extended family stayed in a Florida condo with a kitchen, three bedrooms, a living room, and even a stash of toys. My five-year-old son decided that this new place wasn't just a hotel, it was a "home-tel", creating a totally new, but immediately understandable, word.

Grammar refers to the structural rules of human language. Grammar is essential for understanding and creating language, and is not the trivial rules of language or writing. There are grammatical rules for building words, like adding "ed" or "ing" to form different verbs. Add "er" to "farm" and suddenly you have someone who farms. It is grammar that allows for productivity, creating new words and sentences. Even young children know grammatical rules and do not simply imitate, for instance, when they say "peoples" or "I goed." Ironically, adults don't normally say "goed" or "peoples" unless they are imitating their children! We know that children create language from the "Wug Test," invented by Jean Gleason. Here is how it works:

This is a Wug:



"Wugish" by roseandsigil is licensed under CC BY 2.0 (Image has been altered).

Here are two _____. Obviously, the answer is wugs.

Here's another:

What would you call a very small wug?

You might have answered with, "wuglet," or "wugita," or "wuggie." If you did, then you are a grammar expert. In addition to systematic rules for organizing sounds into words, every language also has rules for organizing words into sentences. It makes a big difference in meaning whether you say "Bob lied to Mary" or "Mary lied to Bob." Without the grammar, it would be impossible or at least very hard to know what people were saying.

Displacement means we can communicate ideas that are not in our immediate

environment or that exist only in our imaginations. We can express ideas that haven't yet happened and that might never happen. We can speak of things as they might be, should be, or could be. Displacement allows us to create stories of journeying to the center of the earth or traveling back in time to a galaxy far, far away. Neuroscientist Dean Buonomano, the author of *Your Brain is a Time Machine*, says that this ability to create the past and future makes "*Homo sapiens*, sapiens, it makes *Homo sapiens* wise." Displacement also allows humans to do something we excel at, prevaricate, which is a fancy word for lie. Lies are after all hypothetical scenarios that exist only in our imaginations. And finally, displacement allows us to feel that most human of feelings, regret. Regret is about traveling mentally to the past, rewriting it, and traveling forward again to see what might have been. Daniel Pink in *The Power of Regret* goes as far as to say regret is what makes us human.

Another important aspect of language is that it is context-specific. Very often when you hear a sentence in isolation, it can be very ambiguous. We see this problem all the time when people are quoted "out-of-context" in the news. To illustrate, here are two actual sentences my son uttered this summer:

They beat the junior coaches with the orangutan.

My crocodile got diamonds, so there was a disco party.

The first sentence makes sense only if you know that the "orangutan" is a chess opening. The second only makes sense if you know something about the video game Disco Zoo (which I do not). Context, or the lack thereof, is also why headlines are sometimes so funny. Human language, as it turns out, is more complex than stringing together a series of words in the right order using the correct rules. Communicating effectively requires knowing something about the cultural context in which it is embedded.

Language is Context-Specific

Animal Call Systems

It is informative to compare how non-human animals communicate with how humans communicate. How much of what we do with language is unique to us? We know that all animals communicate and even plants communicate with chemicals, which ecologist Suzanne Simard (2016) calls a kind of intelligence. Some forms of communication are passive like the false eyes on the wings of a butterfly that make predators think twice before approaching. Other communication systems involve a signal. Ants, for instance, use chemical signals to communicate with each other. Still, other animal communication systems use sound produced from a vocal tract. These are referred to as call systems and include a repertoire of specific sounds, such as hoots, panting sounds, and grunts.

We know mammals, birds, and fish species share the gene FOXP2 with humans, the only gene yet known to affect language. The FOXP2 genes of these animals also influence communication. When FOXP2 is deleted in infant mice, they cannot make the certain vocalizations needed to communicate with their mothers (Shu et al. 2005). Animal FOXP2 genes, however, take a slightly different form than the human gene. In chimps, for example, there are only two changes in the FOXP2 protein, but those changes seem to add up to big differences. FOXP2 is the only gene we know of that influences language, but it is assumed there are many more yet to be discovered.

Are animal calls completely automatic like inadvertently screaming during a scary movie or yelping after stepping on a lego? Michael Wilson, who studies chimpanzee vocalizations, writes, “Like humans, chimpanzees scream when they are being chased, beaten, or otherwise attacked or threatened. These screams often sound disquietingly similar to human screams.” Primatologist Jane Goodall, who lived for years among the chimpanzees at Gombe National Park in Tanzania, records an instance of a chimpanzee who found a cache of bananas and wished to keep them for himself. He was unable to suppress the excited rough grunt call that signals the discovery of food and attempted as best he could to muffle the call by placing his hand over his mouth. The reverse seems to be generally true as well. Goodall (1986:125) writes, “The production of sound in the absence of the appropriate emotional state seems to be an almost impossible task for a chimpanzee.” Chimpanzee vocalizations then seem strongly tied to emotion.

Yet there are interesting exceptions. Goodall notes that chimpanzees will suppress calls while patrolling their territory. Recent evidence also suggests that chimpanzees communicate intentionally. In one study researchers placed a fake snake along a chimpanzee path. Chimps were more likely to make a call when their companion chimp had not already seen the snake (Schwartz 2017). It could be that chimp vocalizations are both automatic and under voluntary control in different situations, not so different from humans.

"Vervet Monkey" by Rod Waddington is licensed under CC BY NC 2.0

A Little Bit Like a Word

One of the most interesting cases of primate vocalization comes not from chimpanzees, but monkeys. Vervet monkeys of east Africa have specific calls for specific predators, specifically leopards, eagles, and snakes. When a monkey hears the alarm call for leopard, he climbs a tree. When he hears a signal for eagle, he finds cover. For the snake alarm, he rises and looks around for the predator. Robert Seyfarth (2014) points out that the calls are something like a word, a sound that represents something. The monkeys aren't automatically responding to the sight of a predator, but to the call itself. Monkeys also don't automatically respond to calls and can become habituated to a repeated call over time to the point where the call is ignored (Schwartz 2017). Other monkeys and even ring-tailed lemurs have similar systems. One thing the vervets are unable to do, however, is to combine the calls for snake and eagle into a new, imagined creature, like "sneagle". They also can't chat about leopards or reminisce about the day that Larry almost got picked off by an eagle. So, productivity and displacement don't seem to be present.

Cultural Transmission

Some animals, like humans, learn the language of their environment. Some sparrow calls are both hard-wired and learned. If a fledgling sparrow is removed from its local environment, it will learn only a simple version of the local sparrow song. But there is another more elaborate version of the song that adults sparrows sing, "remixed" on top of the generic song. The fledgling has a 50-day window to learn the detailed song or it never will. This demonstrates that elaborated sparrow song is transmitted through learning or cultural transmission, but the generic song is innate or hard-wired.

In another case, monkeys appear to be multilingual, learning the alarm calls of several other monkeys. Primatologist Klaus Zuberbuehler studies West African monkeys, who can translate each other's calls. Zuberbueler tells a story where he is walking back to camp after a long day of studying monkeys and he hears a monkey troop sound off a chorus of leopard alarm calls. He walks on and hears more leopard alarm calls, and then still more. Slowly, it dawns on him. The leopard is not tracking monkeys, it's tracking *him*. Later, relieved at not being eaten by the leopard, Zuberbueler realized he wasn't a human outsider studying the monkey communication—he had become just another multilingual primate.

Displacement

Most animal call systems in the wild lack displacement. One example of animal displacement comes from the insect world. A honey bee has about 1 million neurons in its brain compared to the human 80 billion (give or take). Despite this vast difference, they can signal the existence and location of nectar situated some distance away from the hive through a waggle dance. The bee moves in a figure-eight motion, which conveys the distance and direction of the food source. Bees even take into account the movement of the sun as they dance. Importantly though, the honey bee has to see the food source to perform the dance. There are a few instances of monkeys deceiving other primates with calls. The capuchin monkey may give the alarm call for a predator when there is no predator, thereby distracting other monkeys from food. In the wild,

however, animals don't appear to talk about things they have never seen before, as do humans.

Productivity and Grammar

Recently, there has been some indication that other non-human animals have some capacity for productivity, or a little grammar, in their call systems. Work with Cambell's monkeys reveals that they combine two sounds to create new meanings like "not urgent".

Ape Language Projects

It is clear that non-human animal communication in the wild has some things in common with human language, but productivity, displacement, and grammar are not found to the same degree in animal communication as they are in humans. Early in the 1900s, psychologists began to wonder though whether apes in captivity would behave like humans given the right kind of environment. A husband and wife team, the Kelloggs, decided to raise an infant chimp named Gua alongside their infant son, Donald. Gua was raised and socialized as a human child, immersed in language. Because chimpanzees developed faster than humans, Gua was meeting her developmental milestones earlier than Donald. She was far more mobile than Donald and feeding herself competently. Gua could respond to language but was not producing language. Quite the contrary, instead of Gua learning to speak, Donald allegedly began to "pant-hoot" like a chimpanzee at which point, the Kelloggs decided to end the study.

A second attempt was made by another couple, the Hayes, in the 1950s with a chimpanzee named Viki. It was thought that Viki might be able to learn spoken language (English) through behaviorist principles. Behaviorism stressed the idea of learning through a system of rewards and punishments. It was thought that language was no different. Viki underwent a behaviorist program, receiving rewards for producing the correct sounds of English. Because she had trouble enunciating, her mouth was manipulated into the correct shape. Viki, however,

only produced the words: mama, papa, up, and cup, and even those were not distinct.

What is now clear is that these studies were doomed to failure from the start. Without even considering the brain, the morphology, the form, of the human vocal tract (the larynx, pharynx, mouth, and nose) differs from that of other primates. The larynx, also known as the voice box, is situated lower down in the throat in humans than in other primates. The larynx houses the vocal cords. Air from the lungs is pushed through the vocal cords (flaps of tissue that vibrate), through the pharynx, and on into the mouth where most sounds of language are shaped. In chimpanzees, the larynx is higher up the vocal tract such that most of the air is pushed through the nose, making it difficult for chimpanzees to enunciate the sounds of language. A problem that the human configuration presents is that a descended larynx means that there is a shared pathway for both air and food/water, meaning that speaking and eating in close proximity is a problem. In short, the ability to articulate many different sounds is a choking hazard. Human infants are born with a high larynx, allowing them to breathe and drink in close proximity. The larynx then begins to descend around three months of age.

Apes and Sign Language

In 1966, Washoe the chimpanzee was the first non-human to learn signs in American Sign Language (ASL). She was raised by the Gardners, a psychologist couple. Washoe learned about 350 words of ASL and could combine up to five words. She used signs to refer to categories of things; the sign for “dog” was used for any dog and not just a specific dog. At first, Washoe was rewarded with tickling, but later this was suspended because it was interfering with the goal of conversational language. Washoe showed some ability to produce features of human language, namely productivity, displacement, and cultural transmission.

Productivity: “Waterbird”; Drinkfruit

Displacement: Washoe could refer to objects not present.

Cultural Transmission: Washoe taught some signs to other chimps.

Washoe the chimpanzee (1965-2007) was taught signs in ASL. “Washoe” by unknown is licensed under fair use.

Because chimpanzees are very strong, five times as strong as an adult human male, and can be potentially aggressive, one researcher turned to another, less volatile, primate, the gorilla. Graduate student Penny Patterson was loaned Koko, a female western lowland gorilla (*Gorilla gorilla*) from the San Francisco zoo to be studied in an ape sign language project. Koko excelled at ASL, learning anywhere from 400 to 800 signs. It is claimed that Koko also produced her own signs, which Patterson called Gorilla Sign Language or GSL. Koko is reported to have had conversations with Patterson, a startling claim since in other projects apes only ever made requests in ASL. Here is one reported conversation:

KOKO: That me (pointing to a picture of a bird).

RESEARCHER: Is that really you?

KOKO: Koko good bird.

RESEARCHER: I thought you were really a gorilla.

KOKO: Koko bird.

RESEARCHER: Can you fly?

KOKO: Good.

RESEARCHER: Show me.

KOKO: Fake bird, clown.

RESEARCHER: You're teasing me. What are you really?

KOKO: (after a few minutes) Gorilla Koko.

In this case, Koko appears to use linguistic displacement, talking about herself as a flying bird, which can only occur in her imagination. Here is another example of an alleged conversation:

PENNY (researcher): What did you do to Penny? (three days ago)

KOKO: Bite.

PENNY: You admit it?

KOKO: Sorry bite scratch. Wrong bite.

PENNY: Why bite?

KOKO: Because mad.

PENNY: Why mad?

KOKO: Don't know.

In this case, Koko appears to be talking about something that happened in the past, which would qualify as temporal (time) displacement. Also, the question arises of whether Koko understands the morality of unprovoked biting, or perhaps Koko is protesting her captivity and can't quite analyze her emotions.

Another approach to teaching apes language are lexigrams. Lexigrams are symbols that represent different things in the captive ape's environment. Most lexigrams are arbitrary with respect to what they represent so that the lexigrams are more like human language than some ASL signs. Sign language has many signs that are not arbitrary, such that the sign for drink resembles the act of drinking. Sarah, a bonobo chimpanzee (*Pan paniscus*), was being taught to use lexigrams with minimal success. Her adoptive son Kanzi was there during the sessions. Researcher Sue Savage-Rumbaugh reports that Kanzi, who had not been formally taught, began to use the symbols spontaneously. This is an important difference between Kanzi's communication and the apes taught to sign. Koko and Washoe had learned to use signs through a system of rewards. Kanzi's communication was spontaneous, more like how human children spontaneously acquire language.

"Sue Savage-Rumbaugh (L), Kanzi (R), and his sister Panbanisha (C) working at the portable keyboard." is licensed under CC BY-SA 4.0

Kanzi's understanding of English, his receptive language, exceeds his ability to produce it, not unlike young children. He can understand simple requests and acts on them accordingly, even if the request is strange. For example, if the researcher asks Kanzi to "put the shoe in the refrigerator," Kanzi will often do so. This suggests to the researchers that Kanzi might understand simple sentence structure or grammar. More complex statements like "Put the umbrella, but not the banana under the chair" are more difficult for Kanzi. In one test of language comprehension, Kanzi performed slightly better than a two-year-old child (Kanzi: 76%; Child: 66%).

Critiques of the Ape Language Projects

When the ape sign and lexigram projects began there was a great sense of optimism that apes would be able to communicate all sorts of inner thoughts that humans previously had no access to. This would have profound

implications for who apes are, who humans are, and how we view and treat apes and non-human animals in general.

One project, however, decimated the field of ape language projects. Psychologist Herbert Terrace obtained a juvenile chimpanzee he named Nim Chimpsky to start up an ape language project. Nim learned many signs in ASL and appeared to be a huge success. Unlike the Washoe and Koko projects, Nim's sentences were examined systematically and quantitatively. It was found that Nim's success was limited to using signs he had imitated. There was no evidence for productivity, and he never combined signs into new sentences or words. Nim never learned to sign spontaneously without a reward, and Nim's sentence structure was random. So, while Nim was able to use signs to make requests, grammar, that cornerstone of human language, escaped him. Criticisms of the Nim Project were that he was often isolated in a cage and lacked a nurturing environment, which could explain his inability to master grammar.

It is clear that apes are using signs to make requests of humans. In that regard, apes, and humans are communicating. But, of course, we do this with our canine pets as well. Dogs understand that the word "walk" will likely result in going outside. But whether apes know the meaning of the sign is still unclear. The criticism lodged against the ape sign projects by psychologist Steven Pinker and linguist Noam Chomsky is that apes were conditioned to know that certain signs produce results, but don't understand the underlying meaning of sentences. Apes can predict because they are highly intelligent creatures, that signs for "more treat" or "treat more" will result in a treat. This is called conditioned response. In effect, Pinker and Chomsky think the apes are performing clever tricks rather than using language.

"Wilhelm von Osten and Clever Hans" by unknown is licensed under public domain

Another criticism is that the researchers were subconsciously prompting the animals to respond. This is called the Clever Hans Effect. Clever Hans was a horse that "could do math". His trainer Wilhelm von Osten would present Hans with a math problem, then Hans would stamp out the correct answer with his hoof. It was later revealed that Hans was picking up on subtle, and maybe even subconscious cues of his trainer. When Hans was nearing the correct answer, people would give off subtle cues and Hans would stop stamping. While Hans couldn't do math, he was remarkable at reading emotional cues. Critics say apes are giving the trainers what they want to hear based on reading on emotional cues.

A third critique of the ape language projects is called cherry picking. Cherry picking means selecting the evidence that confirms your hypothesis while ignoring results that do not. For example, communication that seems like conversation, productivity, or displacement is documented, but conflicting results are discarded as not relevant or accidental. The results of Koko's language progress are entirely anecdotes or stories. We don't have the full range of Koko's utterances, and significant data has not been reported—the

quantitative data. With data, or videos of Koko's language production, we can evaluate what Koko's responses were really like on the whole. Some conversations with Koko seem convincing, others less so. Critic Jane Hu (2014) described a live AOL chat between Koko and the public, where Koko responds to the question, "What's the name of your cat" with "Foot". We could ask, for example, how often did Koko respond inappropriately versus appropriately given the context?

Most of these ape language projects happened in the 1960s and 70s. Sadly, Koko recently died in 2018. The only project still going involves Kanzi, now in his 30s, whose results have been the most systematically studied. The foundations that started these studies, however, (Gorilla Foundation and Great Ape Trust) were marked by employee resignations, accusations of mismanagement, and endangering the animals.

Though there is still debate around the subject of ape language, many people agree that animals have some building blocks of language, some capacity for productivity, displacement, and grammar, but none use these to the extent that humans do. This is not to say that humans are therefore better than apes, but that we simply have a different communication system, which is not too surprising since we are, after all, different species. Whatever their linguistic abilities, whether they truly understand the meaning of words or are conditioned by rewards, Washoe, Koko, and Kanzi are truly remarkable and intelligent creatures.

Storytelling

Author Terry Pratchett writes in *Witches Abroad*, "People think that stories are shaped by people. In fact, it's the other way around." What does he mean by this? Don't people create stories? Of course, they do, but stories also have great power in shaping how we think and see the world. Jonathan Gottschall makes the argument that storytelling is what humans do best and is a talent unique to us. *Homo fictus*, he suggests, is as good a descriptor of our species as is *Homo sapiens*. Students often remember a story more so than say a definition or a

lengthy explanation. Who remembers the story of Jack the Baboon who ran the railroad switches? Who remembers the definition of tool? Chances are Jack sticks out more in your memory than, “an object used to alter the condition or position of another object.” Gottschall says that storytelling is automatic for humans. When people were shown shapes moving around a screen, most saw more than just geometry, but a drama unfolding. Our minds, Gottschall argues, are made for telling stories, and they are how we make sense of the world around us. We impose the structure of stories on our everyday experience, using our imaginations to create our world. We are immersed in stories—action adventures, jokes, romance, comedies, dances and holy stories—which bring order to our world. Music and photos also tell stories. For instance, my friend recently posted this photo entitled, “A Short Story about Decisions.”

We are swimming in stories that revolve around our values and identity—stories of our history, ancestors, human triumph, and outrage. Gottschall points out that even in our sleep, we don't escape storyland. Stories shape our

experiences and create and transmit culture. In the United States, our sacred values, stories, our identities, and symbols are contested and debated daily on social media. Consider these issues, the values they represent, and the stories that support or negate them: Whether the government should limit semi-automatic weapons, whether health care is a human right, how DACA recipients, asylum seekers, and refugees should be treated, what bathroom transgender people should use, and whether people can "take a knee" at sporting events. Our values are constantly being reformulated, and new stories and symbols are created to support those values.

In *Hogfather* Terry Pratchett writes, "Humans need fantasy to be human. To be the place where the falling angel meets the rising ape." When we read books, we can magically become immersed in a different world, to the point where we can forget where we are. We fill in the details with our imaginations—the furniture in a room, the layout of a house, or the expression on a character's face, building the story alongside the author. Indeed, brain scans indicate that we experience stories not passively, but actively, as if we are actually experiencing what the character is experiencing. In this light, stories are a powerful way to transmit culture, by allowing the viewer to experience the character's feelings. Performance mentors like Todd Herman know the power of a good character and a good story in improving performance. Herman advises his clients to create an alter ego with a back story such that when the going gets tough, one simply embodies the alter ego and their backstory to give them confidence and courage. Beyoncé famously created her alter ego Sasha Fierce to be able to perform aggressively and sensually when she needs to. As Beyoncé explains, "I have someone else that takes over when it's time for me to work and when I'm onstage, this alter ego that I've created kind of protects me and who I really am" (MacInnes 2008). Other famous people have adopted different personae to embody a character. Dr. Martin Luther King, for example, wore eyeglasses even though he didn't need them. And Winston Churchill had a collection of hats for when he needed to embody different characters.

Every culture has its own stories that reflect and reinforce the values of that society, and often these stories are reiterated during rituals. Americans have

had national stories of George Washington chopping down his father's cherry tree, Pilgrims and natives feasting together peacefully, and Columbus "discovering America". These stories aren't just entertainment, but a way to promote certain values and visions. And of course, these stories, or myths, can change over time as the values of a society changes. Today many recognize Indigenous Peoples day, for example, rather than Columbus Day on October 8. Stories are not just backdrops or reflections of culture, they can shape culture as well. Gottschall points out that the television program *Will & Grace* had the effect of changing American minds about same-sex relationships—the "Will & Grace Effect."

Author Chimamanda Adichie cautions that "single stories" create narrow and simplistic ideas of other people and their experiences. When we are exposed to a multitude of stories from other walks of life or different cultures, we allow ourselves to see, and maybe even feel, the perspective of others and widen our own worldview. There is fear that social media, especially Facebook, serves up only those stories which reinforce the user's worldview. These streams of single stories could lead to a kind of fossilization of thinking, an "us and them" mentality, and an inability to see another's point of view. Restricting books, burning them, or preventing certain groups of people from accessing them allows for only a single story. Activist and author Malala Yousafzai was shot by the Taliban for simply wanting an education, and for seeking out other stories about what girls and women could be. Anthropology is all about recognizing that there are many stories about what humans can be.

Language and Thought

What people say affects the thought of other people. If this weren't the case then advertising wouldn't work, teaching wouldn't work, and culture itself would not work. But there is another idea, that the structure of language—the categorization it uses, the sentence construction, tenses, and how it refers to gender—affects how people think. This idea is called the Sapir-Whorf Hypothesis. The strong version of Sapir-Whorf suggests that one cannot think outside one's language, or that language is thought itself. In this model,

language is a kind of mental trap that you can't escape. It is pretty clear that this is not the case, because language-less babies can learn a native language. People can also learn and understand foreign words that don't occur in their native language. For example, English speakers do not have an equivalent word for *Weltanschauung*, which in German means delight over someone else's misfortune. Even though there is no equivalent word in English, the meaning of the word is immediately grasped. Another example in Swedish is mångata, which means moonlight reflected on water.

The weak form of Sapir-Whorf, however, subscribes to the idea that the structure of language shapes the way you think, or at least forces you to pay attention to certain things. A visual analogy to this is a study that asked participants were asked to watch a video and count how many times a basketball was passed between players. Participants in the study focused so keenly on the passing that they missed a person in a gorilla suit who wandered through the scene. Linguist Lera Boroditsky points out that humans can't pay attention to everything, and so we carve up our world into manageable categories using language. Linguistics structures and categories, she argues, can influence how we perceive space, time, color, events, and quantities. According to Boroditsky, how we carve up the world says a lot about who we are, and each language represents a different way of thinking.

Boroditsky, for example, points out that some Australian aboriginal cultures use cardinal directions—north, south, east, and west—to refer to small-scale situations. You could say that there is a honey ant on your southwest toe, for instance. In this case, Boroditsky argues, language forces one to think about where they are in space at all times. In other cases, people carve up the color spectrum in different ways, sometimes having no category for a particular color. W.H. Rivers found that natives of the Torres Straits had definite words for white, black, and red, but had no distinct word for blue, often using "black" to describe it. There does appear to be a dimension of color words that is not cultural, but deeply embedded in the human mind, as everyone has color names for "dark" and "light". And, if a language has only three color terms, it is almost always "dark", light", and "red". People with no specific terms for numbers, like

the Pirahã of Brazil, aren't able to keep track of exact quantities. Yet, they remember a huge number of terms for plants and animals. The Pirahã also have to indicate how they came about information or evidence, whether it was heard, seen, or deduced. English speakers don't have to indicate how they got their information. When Daniel Everett tried to teach the Pirahã his religion, he was put in an awkward position because he was unable to verify his beliefs to the satisfaction of the Pirahã.

Boroditsky also points out that some languages force one to consider where the information came from. The way we phrase things reflects mental concepts on things like time. Every language the metaphor of space to talk about time, just not all in the same way (Spinney 2005). In English we say "back in time" or "the past is behind us" or "I look forward to hearing from you". Or we can say the meeting has been moved up two days or moved forward two days, which might be very confusing for a non-native speaker of English. In other languages like Aymara, the past is in front because it has already been seen or experienced. The unseen future is behind. Boroditsky explains, "I think what's important about this is that linguistic diversity is a real testament to the ingenuity of the human mind. That our minds have the exquisite capacity to create not one pass at the physical universe that we're all trying to describe, but seven thousand different passes. There's not one linguistic universe, there are seven thousand universes."

We can similar similar ideas out side of language. Certain activities force us to focus on certain things to the exclusion of other things. Kids playing video games really don't hear their parents yelling for them because their attention is diverted elsewhere. This is a well-known phenomenon called the Spotlight Theory of Attention. Human attention is like a spotlight where it can only focus on a certain amount of information at any one given time and everything else is ignored. The effect is so pronounced that burn victims play a video game Snow World during procedures like wound dressing to divert their attention away from the pain. Snow World players reported lower incidences of pain and fMRIs showed reduced blood flow in pain regions of the brain. We can see how language can force a person to focus on certain information to the inclusion of

other information, and be less aware of factors not required for communication. Patients run out of "cognitive resources" to focus on the pain (McGonigal 2015). In a sense, language is like Snow World, diverting our limited cognitive resources toward what is required of speakers.

Other linguists, like John McWhorter, author of *The Language Hoax*, acknowledge that language structure shapes thought a bit, but he doesn't think it amounts to an entire worldview. McWhorter thinks that slightly different conceptions of color, time, or space are interesting, but they are the tip of the iceberg when it comes to the worldview of an entire culture. One CNM student who also happened to be a firefighter pointed out that firefighters think of structures in terms of the front entrance of the structure, which is labeled "alpha". The sides going clockwise are labeled "beta, charlie, and delta". McWhorter might argue that this is interesting, but isn't tantamount to a worldview. Learning a second language he argues, is useful because you can connect with speakers and learn about how they see the world from what they say, and less so by the structure of their language.

Language Change and Language Shift

Languages, like species, are changing constantly. When students in English literature are confronted with Shakespeare, Chaucer, or Beowulf, they are often at a loss to comprehend Old English, Middle English, or even Shakespeare's modern English. It can even be difficult for parents to understand their own children. My son, for example, used a word in a way I had never heard of before when he said, "You are soooo budget Mom." He has also accused me of being a "noob", a computer novice, on several occasions. Neologism or new words, like vlog, noob, and tweet reflect our increasing use of technology and the Internet. Often people feel that language, perhaps along with morality in general, is deteriorating. This perspective is a prescriptivist one, the idea that there are right and wrong ways of speaking or writing. Many linguists, however, tend to see language as simply changing to suit new situations. These linguists are more

descriptivist, being interested in how and why language changes over time. Of course, features like politeness and some conventions are writing are often needed because they allow us to communicate both respectfully and easily.

Perhaps no other form of linguistic change has gotten so much grief as texting. For some, texting heralds the end of civilization itself. McWhorter tends to take a more nuanced approach to texting, describing it simply as "fingered speech." He says that texting is a different writing system that reflects the rhythms of spoken language rather than written language. "Lols", McWhorter argues, don't mean you are actually laughing, but rather represent an empathy marker, a way to show the person that you're connecting with them emotionally. These texting conventions fill in for the expressions and head nods that normally accompany spoken conversations.

Though language is constantly renewing and replenishing itself, language shift, giving up one's native language for a more dominant one, is increasing. Half the world's population speaks just 50 of the 7,000 languages, and the remainder of the world's population speak the other 6,950. Those languages, spoken by relatively few speakers are in danger of being lost forever at a rapid rate. We can think of this trend as being related to the Anthropocene because those areas in great environmental jeopardy are also places of great linguistic diversity. These "hotspots" of biological diversity contain 70 percent—more than 3,000—of the world's languages. As people can no longer sustain a living on their traditional lands as a result of logging, intensive agriculture/ranching, mining, oil drilling, and so on, they become displaced. And consequently, they also tend to give up their traditional life-ways, including their language. As Barry Mosses explains, economics is often at the heart of language loss." In other cases, there are movements to actively disassociate a people from their language, often punishing children for speaking their native tongues. An estimated 50 to 90 percent of the world's languages will be gone by the end of the century.

There is some cause for hope though. The link between biodiversity and linguistic diversity may usher in a new kind of approach to both conservation of species and cultures. As Larry Gorenflo explains, "It provides a wonderful

opportunity to integrate conservation efforts—you can have people who can get funding for biological conservation, and they can collaborate with people who can get funding for linguistic or cultural conservation" (Kinver 2012). Linking of science, conservation, and culture has paid off in other arenas like the Cofán people of Ecuador, who work to preserve the environment, and engage in scientific studies while maintaining their cultural heritage.

Languages, like species, can be critically endangered. What matters most is not sheer numbers, but young people. When languages are no longer being taught to children, then there is little basis for passing on the language, and they soon become endangered or go extinct. And if language indeed influences thought, then we also lose ways of perceiving the world as well as stories that encapsulate the beauty and human genius of these cultures.

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Chapter 7: Primates

“Thinking” by Axel Hahn

Primates

In the 1970s a young graduate student primatologist named Barbara Smuts was working under the wing of the renowned primatologist Jane Goodall. They were studying the chimpanzees of Gombe Stream in Tanzania. An adolescent chimpanzee named Goblin was giving Barbara, a petite woman, trouble. Male chimps are hierarchical, and constantly jockey for political positions in the

troop. The young low-ranking males work their way to the top by first intimidating females. Goblin smacked, jabbed, punched, and shoved Barbara daily. Barbara explained what was happening to Goodall, who advised her to just ignore Goblin. One day Goblin decided to grab the raincoat that Barbara was carrying on her back. Raincoats are critical equipment in the rainforest and so Barbara resisted and the two began a tug of war over the coat. Suddenly without thinking, Barbara leaned forward and punched Goblin as hard as she could in the face. Goblin collapsed whimpering on the ground for a moment and then went over to the large alpha male, Figgin, for support. Thankfully, instead of attacking Barbara, the powerful chimpanzee reached over and simply patted Goblin on the head. Goblin never bothered Barbara again.

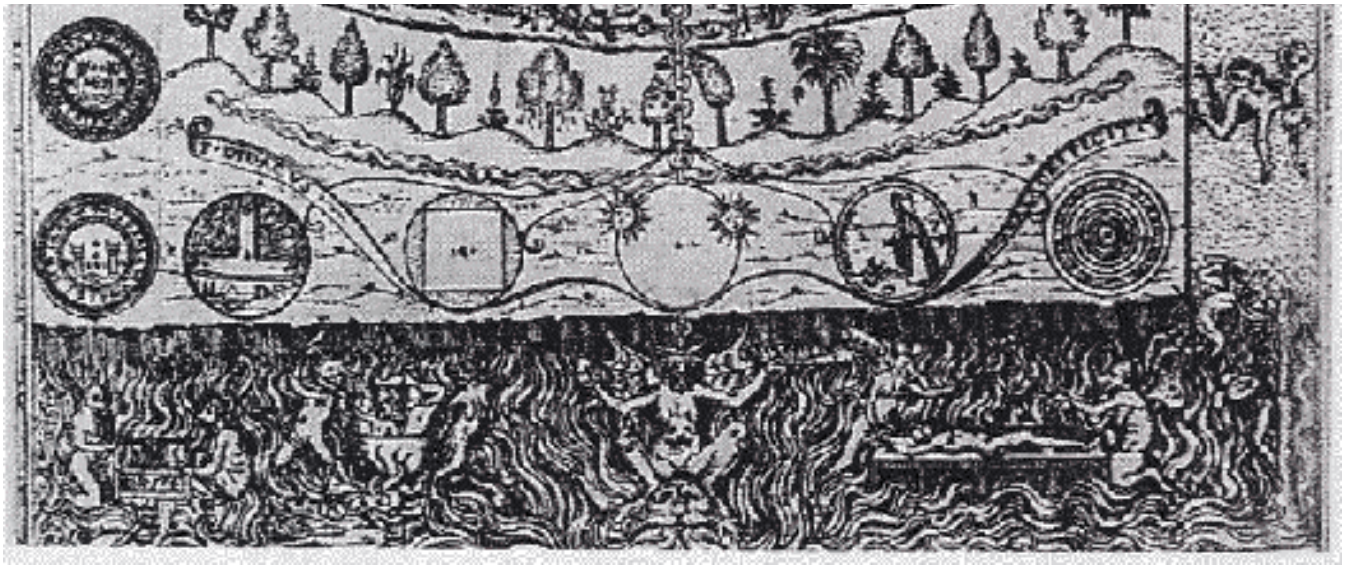
Listen to Barbara Smuts tell the story on RadioLab:
https://www.wnycstudios.org/podcasts/radiolab/segments/91706-lucy

Primates are everywhere in Western entertainment: King Kong, Curious George, Grape Ape, Donkey Kong, King Julien, Marcel the capuchin from *Friends*, and "Monkey" (who is not a monkey) from Kung Fu panda. Primates also appear in Japanese folklore in tales like the Monkey and Crab. Baboons figure prominently in Egyptian mythology, sometimes being associated with virility and sometimes with Thoth, the god of writing. Among the Classic Maya, howler monkeys are associated with artisans and scribes. The Greek Cercopes were mischievous brothers that were turned into monkeys by Zeus. Typically, the monkeys in these tales are up to no good and receive comeuppance for deviousness and lying. But what are primates exactly, and how can they shed light on what it means to be human?

As we have seen, humans have much in common with other animals, especially apes and monkeys. We share tools, reasoning, complex sociality, emotion, reciprocity, and even culture, according to some definitions of the term. We also share susceptibility to many of the same zoonotic diseases like polio, measles, ebola, and COVID-19. Because humans share so much in common socially and biologically with apes, monkeys, and similar species, we are all classified as Primates. Primatology is a sub-discipline of biological

anthropology that focuses on primate behavior, biology, and conservation.

In antiquity, many people subscribed to the idea of the Great Chain of Being, which was a classification system that included animals, plants, rocks, and divine beings. These were each ranked according to their moral perfection. God is at the top of the chain and dirt at the bottom. The closer to God, the more godly. The further away from God, the less godly. Angels were near the top, and dirt was near the bottom. This system was entirely subjective, or based on personal opinion.



The Great Chain of Being is licensed under public domain

In contrast, The Great Chain of Being Carolus Linnaeus (1707-1778), a Swedish botanist, decided to categorize all living things based on their physical similarities. In his *Systema Naturae,* he outlined a system of naming as well. Most of us are familiar with the genus and species system of the taxonomy called the binomial system, meaning two-name system. Our genus is "Homo" and our species is "sapiens", meaning "wise man" or "wise person." Unlike the Great Chain of Being, Linnaeus' system was not based on ranking species according to better or worse, but rather on their physical similarities. The categories of the classification become increasingly more narrow, like nested dolls. The broadest category in the kingdom, as in the animal and plant kingdoms. The other categories are phylum, class, order, family, genus, and species. (The category of the domain was added before kingdom in recent years). Primates is an Order in the taxonomic system. There are about 300 species of primates most of which live in tropical climates making it one of the largest groups of mammals in the world.

Linnaeus' naming system which he created in the 18th century is still in use today. But now, we add the additional information on genetics to the basic system of physical comparison. Genetic analysis is critical because some species that look very much alike, aren't that closely related, and can yield surprising and counter-intuitive results. For instance, New World Monkeys and Old World

Monkeys look alike superficially, but Old World Monkeys are more closely related to apes than to New World Monkeys. In Chapter 8, we learned about SNPs or changes in a single letter in DNA. SNPs can be compared to estimate how closely related species are. A system that categories based only on physical characteristics is called a grade. A clade, however, is based on relatedness between species. Categorizing all living species is of course a daunting task, and no one person can hope to classify all of them as Linnaeus attempted to do. The Catalogue of Life is an online database of the world's known species, containing 1.64 million species of the estimated 1.9 million species in the world.

What is a Primate?

You are likely familiar with the Class called Mammalia. Mammals share several features. Mammal characteristics include:

- Nurse Young
- Vertebrates
- Warm-Blooded
- Fur
- Live Young

Primates are a group of related species within the Class Mammalia, and so they share all the features of mammals, plus the features of primates. So, they share several features in common that are absent in other mammals. Some of these common tendencies are morphological (related to form) and others revolve around life history (features having to do with the timing and duration of life events). Not all primates have every single trait listed and so these can be thought of as primate trends or tendencies.

Primate trends:

- **Relatively long period of immaturity compared to other mammals marked by learning the social and physical environment**
- **Late sexual maturity**

- **Few offspring**
- **High degree of parental investment in offspring**
- **Complex sociality (grooming, alliances, conflict)**
- **Grasping hands (some have opposable thumbs)**
- **Stereoscopic vision (visual fields overlap for 3D vision)**
- **Relatively large brain to body size**
- **Reduced sense of smell**

Physical Features of Primates

The primate hand has five fingers and is capable of grasping (but the spider monkey is an exception with no thumb). Some primates like apes and Old World monkeys have true opposable thumbs, meaning the thumb can be oriented in opposition to the other digits. Grasping hands allows primates to manipulate their environment and for some, make and use tools. Primates have an expanded capacity for touch, especially by the hands, rather than smell. Some primates, especially those that are arboreal, living in trees, also have grasping feet.

Primates have grasping hands. "Leathery hand" by Will Keightley is licensed under CC

Primates tend to have a relatively poor smell, but keen eyesight. Mammals in general have about the same number of genes that influence the sense of smell. In primates, many of these genes are no longer functioning. The genes are either turned off by regulator genes or are deactivated by mutations. This is why we train other animals like dogs and rats to sniff out drugs, explosives, and even diseases. Rats, for instance, have been trained to sniff out land mines in Cambodia, of which there are 6 million. One rat named Magawa was so good at finding land mines that he was given a gold medal by the People's Dispensary for Sick Animals. While primate smell isn't extraordinary, primates instead are the "most visually adapted order of animals" (Heesy 2009). All primates have fields of vision that overlap, which allows for keener three-dimensional depth perception called stereoscopic vision or stereopsis. With stereoscopic vision, the fields of view overlap, and the two different images seen by each eye are combined in the brain to form a three-dimensional image. Because many primates are arboreal, it has been suggested that keen eyesight is critical for judging distance and depth of tree branches. Others argue that this type of vision developed in relation to the predation of insects. A binocular field of vision is common in predators who need to judge distances. Non-overlapping fields of view are more common in prey animals, who need a wider field of vision to spot predators.

Primates tend to live in social groups. Social grooming is especially important for many primates. Baboons who groom each other regularly, are more likely to come to each other's aid in a crisis. Thus, social grooming is a form of reciprocity (exchanging favors). There are exceptions, for example, orangutans lead mostly solitary lives.

Primates have stereoscopic vision. “Her eyes” by 8 Eyes Photography is licensed under CC BY-NC-SA 2.0

“Baboon youngsters playing” by Tony Roberts is licensed under CC BY-NC-SA 2.0

Primates also have larger than expected brains for their body size. This is called the encephalization quotient. In addition, brain areas associated with memory thought, and association are increased in primates. Primates proportionally devote more brain to the neocortex than any other animal. The neocortex is the seat of cognition, memory, abstractions, philosophy, and so forth. As we have seen, primates can solve complex problems and chimpanzees outcompete humans on some memory tasks.

> Primates use flexible thinking not only to forage for patchily distributed food and solving physical problems but also to negotiate group dynamics. Primates often live in socially complex groups and must form and manage social ties

Brain areas associated with memory, thought, and association are increased in primates.“Western lowland gorilla” by Jean is licensed under CC BY 2.0

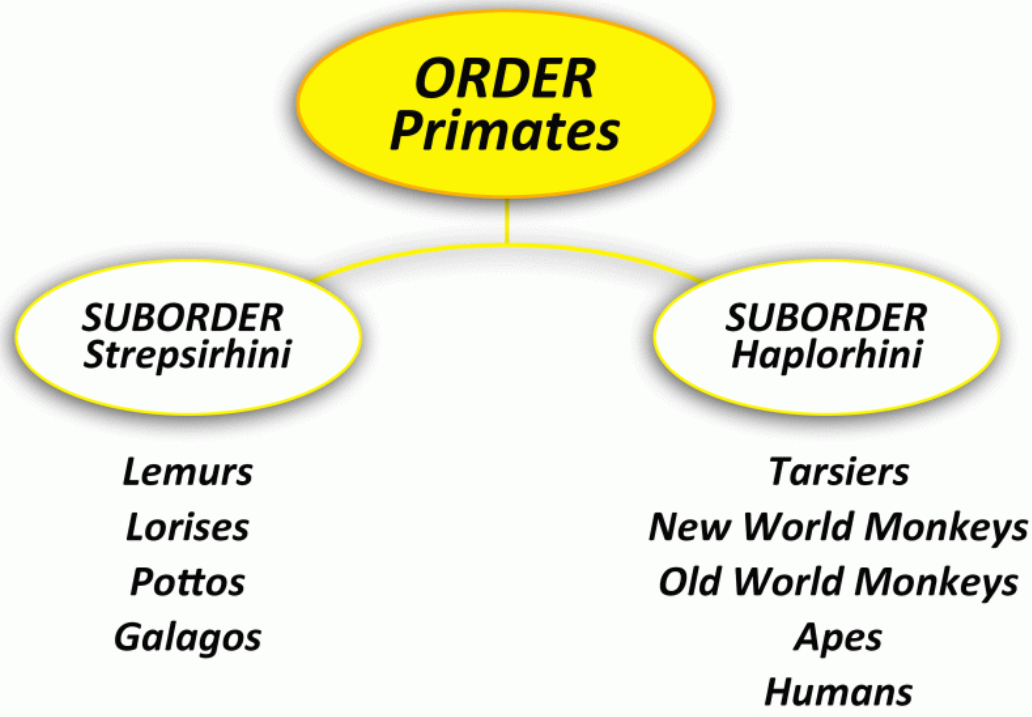
(called affiliation) and avoid conflict (called agonism). Chimpanzee males often work together and cooperate to dominate other chimpanzees. Another socially complex aspect of primate life is dispersal. Dispersal occurs when males or females move out of their natal group at maturity and join another group. As with human exogamy, moving out of one’s natal group can be a risky endeavor, requiring skillful negotiation. Not so different from humans, the social lives of primates can be stressful. Robert Sapolsky has studied the stressful effects of baboon social life. He spent 30 years darting African baboons to check their hormone levels, a measure of how much stress they experience. Sapolsky learned that baboons, especially low-ranking baboons and baboons who lack social connections have high stress levels and poor health. As Sapolsky puts it “Primates are super smart and organized just enough to devote their free time to being miserable to each other and stressing each other out” (Shwartz 2007).

In addition, primate infants take a long time to develop, and a strong mother-infant bond develops. Most primates give birth to a single offspring and offspring often receive extensive care called “parental investment” from the mother or, less commonly, from both parents. During this long period of dependency, the infant learns appropriate behavior and how to solve problems. Humans stand out in this arena with an impressively long period of juvenile dependence.

Great apes tend to have a high degree of parental investment in their offspring. “Baby

Primate Groups: The Streps and the Haps

There are several groupings within the Primate order, but there are two main groups (suborders) within the primate order the strepsirrhines and the haplorrhines or the "streps" and the "haps." Each group contains species that are closely related. In previous times, primates were groups according to physical similarity only, much like Linnaeus' classification system. Today, the groups are based on genetic similarity and evolutionary relatedness.



Strepsirrhines have the following features in common:

- wet-nosed (rhinarium)
- tooth comb (modified incisors and canines for grooming)

- tapetum lucidum (eye shine)
- grooming claw on the second toe
- small bodies
- reliance on scent

Strepsirrhines are thought to have branched off from the primate line earliest and are therefore different in many respects from other primates. That is, they retain features of earlier fossil primates. They tend to be smaller, more often nocturnal, better smellers, less social, and more insectivorous (insect eaters) than other primates. Strepsirrhines include lorises, galagos, pottos, and lemurs. Lemurs only live on the island of Madagascar (where there are no monkeys) and have diversified into more than 30 species, all of which are endangered. Most lemurs are arboreal, or tree-dwelling, but others are terrestrial, living on the ground. Arboreal lemurs move about mainly by clinging and leaping. Because their bodies are adapted for leaping, lemur legs are long in comparison to their arms. While ideal for moving among branches, moving on the ground results in an odd balletic leaping movement.

Toothcomb of a ring-tailed lemur, with canine-like premolars behind it. by Alex Dunkel is licensed under CC BY 3.0

Some lemurs are nocturnal while others are diurnal, active during the day. The body size and diet of lemurs vary considerably. Some lemurs have interesting and unexpected behaviors. For example, black lemurs bite into poisonous millipedes, which combined with their saliva can act as an insect repellent (Birkinshaw 1999). Primatologist Louise Peckre and colleagues (2018) found that lemurs rub the millipedes on their anuses to prevent threadworms from

laying eggs on their anal regions. These behaviors are known as “self-anointing.’

Lorises are omnivorous, solitary, and arboreal, meaning they live in trees. The Javan slow loris is now critically endangered due to the illegal pet trade, use in traditional medicines, and deforestation. The slow loris (*Nycticebus javanicus*) is the only venomous primate. Although owning slow lorises as pets is illegal, they have appeared as pets in popular Youtube videos. According to primatologist Anna Nekaris (2013), when kept as pets, loris teeth are painfully removed, and they are exposed to bright lights which can blind them because they are nocturnal. Nekaris argues that social media, on the whole, is harming rather than helping the slow loris and advocates for Youtube to have a way for people to police animal cruelty videos. “Bushbabies” also called galagos are another well-known species of loris.

“Bushbabies” are a type of loris. “Galago-bushbabies” by alpros is licensed under CC BY-NC-ND

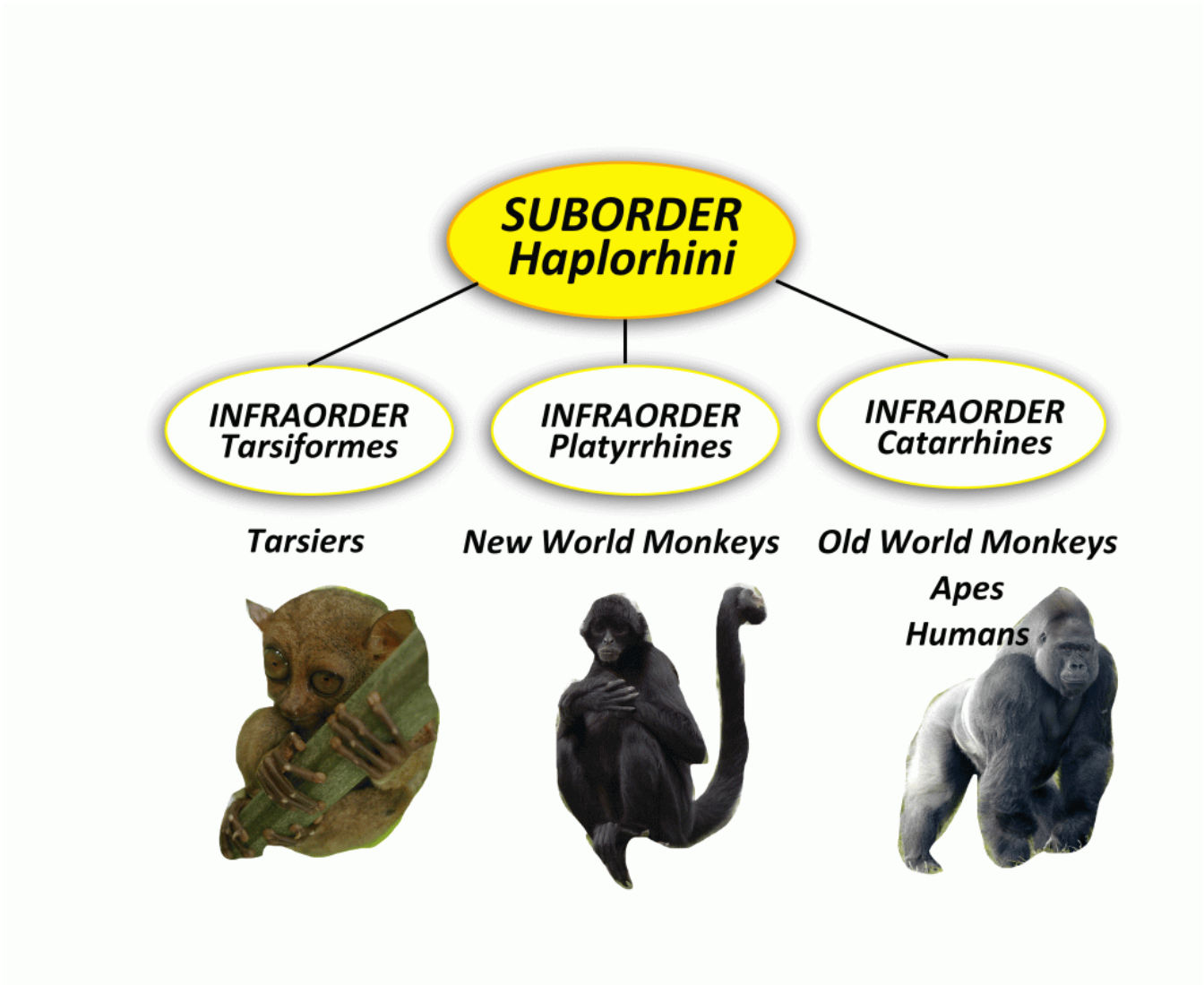
Haplorrhines

The Haplorrhines consist of tarsiers, monkeys, apes, and humans. These species do not always look similar, but again genetics indicate they are more closely related to each other than they are to the strepsirrhines. The haplorrhines (or dry noses) have different features compared to the strepsirrhines. These include:

- No rhinarium (no wet nose)
- reduced reliance on smell
- No tapetum lucidum (no eye shine)
- Bigger body

- Bigger brain to body size
- longer gestation
- more parental care
- more social grooming with hands

Within the haplorrhines, there are three groups (infraorders). Remember, these groups are based on how closely related they are based on genetics. These are the tarsiers, platyrrhines, and catarrhines. Tarsiers belong to their own group and were once thought to be more closely related to pottos, galagos, lemurs, and lorises. Tarsiers live in Southeast Asia and are nocturnal insectivores. Despite being nocturnal, they have no tapetum lucidum (eye shine). Tarsiers have gigantic eyes which are each larger than their brain. It moves by vertical clinging and leaping and has an enlarged tarsal or foot bone as an adaptation to leaping from tree to tree.



The Haplorrhines. "*Carlito syrichta* (Philippine Tarsier)" by Jasper Greek Golangco is licensed under copyrighted free use. "Spider monkey with long arms" by Petruss is licensed under CC BY SA 3.0. "Gorille des plaines" by Thurundir is licensed under CC BY-SA 4.0

The other two groups (infraorders) within the Haplorrhines are the platyrrhines and the catarrhines. Platyrrhine means flat nose and catarrhine means narrow nose. The platyrrhines are the New World Monkeys from Central and South America. The catarrhines include Old World monkeys, apes, and humans.

New World Monkeys: The Platyrrhines

New World monkeys live only in Central and tropical South America. These monkeys have been separate from Old World monkeys for about 35 million years. These monkeys have flat noses with wide-spaced nostrils and are called the platyrrhines, meaning "flat-nosed." The New World monkeys are mainly arboreal and most are diurnal, active during the day and sleeping at night. Some New World monkeys, like howler and spider monkeys, also have prehensile tails, meaning they can be used to grasp tree branches. Old World monkeys of Africa and Asia do not have prehensile tails. All platyrrhines are arboreal, living in trees.

Some species of New World monkeys rely on tree sap and these are called gumivores. Others, like the spider monkey, rely largely on fruit and are frugivores. Howler monkeys are the only New World monkey to rely heavily on leaves and are folivores.

New world tamarin monkey: cotton-top tamarin (Saguinus oedipus; critically endangered)

“Cotton top tamarin – what you looking at?” by skepticalview is licensed under CC BY-NC-ND 2.0

New World tamarin monkey: Golden Lion Tamarin (endangered).

New World marmoset: Geoffroy’s marmoset.

“White-headed marmoset” by Michelle Bender is licensed under CC BY-NC-ND 2.0

New World cebid monkey: Capuchin monkeys of Costa Rica.

“En clase de biología” by Carlos Luna is licensed under CC BY 2.0

New World cebid monkey: The Howler monkey, Belize.

"Mexican Black Howler Monkey – El Pilar, Belize" by Michael Klotz is licensed under CC BY-NC 2.0

New world cebid monkey: Uakari, Amazon region, South America.

“White Bald-headed Uakari, Middle Solimões – Amazonia” by Giovanni Mari is licensed under CC BY-SA

New World cebid monkey: The squirrel monkey.

“Curious squirrel monkey” by Jeroen Harpe is licensed under CC BY 2.0

Old World Monkeys: Catarrhines

Old World monkeys are more closely related to apes and humans than they are to New World Monkeys (platyrrhines). The approximately 75 species of Old World monkeys live in Africa and South Asia and are typically larger than their New World counterparts. They have more closely spaced nostrils and their noses are less flat than New World monkeys. Because of this distinction, they are often referred to as the catarrhines. Old World monkeys can be placed into two groups: the colobines and cercopithecines. The colobines live in southern Asia and Africa and the cercopithecines live mostly in Africa. All New World monkey species live in social groups.

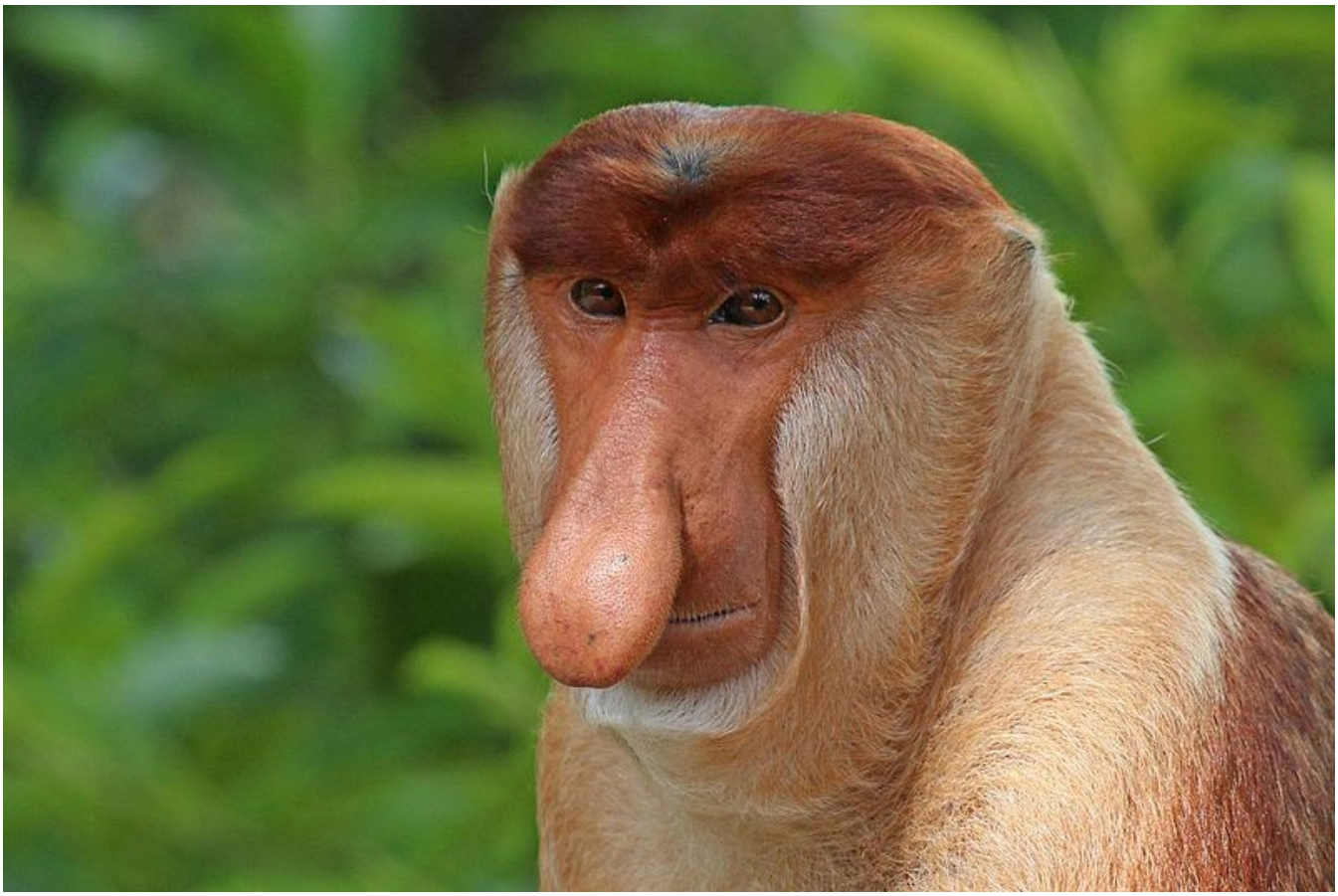
Langurs are a well-known colobine species. Several species of langurs are endangered or critically endangered like the grey-shanked douc (*Pygathrix cinerea*) of Vietnam. This Old World monkey is losing ground to agriculture, logging, hunting, and the pet trade. At least four other langur species are also

critically endangered. Another well-known colobine monkey (*Nasalis larvatus*) is the proboscis monkey of Southeast Asia. The males and females of this species are sexually dimorphic. Sexual dimorphism refers to differences in "secondary sexual characteristics" like size, weight, coloration, and behavior. Males have much larger noses than females (sexual dimorphism), which can be up to 10 cm. These unusual monkeys are now endangered.

Old World colobine monkey (Vietnam): The Grey-shanked Douc Langur (*Pygathrix cinerea*) is one of the most endangered primates in the world.

"Grey-Shanked Douc Langur at The Endangered Primate Rescue Center – Cuc Phuong National Park, Vietnam" by Chris Goldberg is licensed under CC BY-NC 2.0

Colobine monkeys of southern Asia: Proboscis monkeys (Nasalis larvatus)



Proboscis monkey (Nasalis larvatus) male. CC By-SA 4.0

The cercopithecine monkeys live mostly in tropical Africa. They tend to have larger bodies than colobines. Some cercopithecine monkeys have moved into savanna environments and are largely terrestrial, living mostly on the ground. Terrestrial monkeys like baboons have ischial callosities informally known as “butt patches”, which are an adaptation to sitting on the ground. Terrestrial monkeys also tend to be sexually dimorphic. Male baboons, for example, are larger than females and have longer canines. Macaques, baboons, mangabeys, and guenons are examples of cercopithecines.

Old world cercopithecine monkey (Japan): Japanese macaque (Macaca fuscata)

“Japanese macaque” by Greg Schechter is licensed under CC BY 2.0

Old World cercopithecine monkeys (Africa): Chacma baboon (Papio ursinus).

“Baboons” by Derek Keats is licensed under CC BY 2.0

Old World cercopithecine monkeys (Africa): Gelada baboon (Theropithecus gelada).

Old World cercopithecine monkey (Africa): lesser spot-nosed guenon (Cercopithecus petaurista).</p

“Lesser spot-nosed monkey” by Nathan Rupert is licensed under CC BY-NC-ND 2.0

Apes: Catarrhines

All apes live in the Old World, either in Africa and southern Asia. Compared to monkeys, apes are large-bodied, large-brained, and most are terrestrially adapted. Also, unlike monkeys, apes do not have tails. The ape shoulder has greater rotation than monkeys allowing them to hang and swing from branches. All apes are diurnal, and active during the day. Apes are more closely related to Old World monkeys than New World monkeys. Apes are divided into the lesser apes or gibbons and the great apes. The great apes, gorillas, chimpanzees, bonobos, and orangutans, are the largest of all primates. Gorillas, chimpanzees, and bonobos live in tropical Africa, while the orangutan lives in southeast Asia on only two islands of Indonesia. Most are primarily herbivorous eating leaves or fruits, and to a lesser extent in some species insects and meat. The African great apes live in complex social groups, while the orangutan is mainly solitary. All great apes are endangered.

Gibbons

The lesser apes live in Southeast Asia and are smaller than other apes with smaller brains. Lesser apes are mainly arboreal and have a particular type of locomotion called brachiation. Brachiation involves swinging from branch to branch by the arms, including a phase of free-flight. Lesser apes resemble monkeys, but they lack tails. Lesser apes often live in socially monogamous pairs, but males do not typically provide much in the way of parental investment. The lesser apes are various types of gibbons.

Gibbons are lesser apes and live in southeast Asia.

"Gibbons" by Amy the Nurse is licensed under CC BY-NC-ND 2.0

Gorillas

Gorillas are the largest of the apes and live exclusively in Africa. The gorilla lives in social groups called troops consisting of 10-20 gorillas including the silverback male, adult females, and their children. The silverback male, named for the silvery hair that develops on his back and rump, is the only breeding male in the group and he protects his reproductive access to females in the group. As in humans, this is referred to as polygyny. Males (350 lbs.) tend to be much larger than females (155 lbs.), exhibiting a high degree of sexual dimorphism or difference in form between males and females.

Gorillas have a mainly vegan diet of leaves sometimes supplemented with ants, and spend most of their waking hours eating. Gorillas locomote by knuckle-walking, that is, they walk on the knuckles of their hands rather than on their palms. Gorillas are mostly terrestrial, typically building nests on the ground for sleeping. Infants are helpless and require a high degree of parental investment from the mothers. Newborn gorillas nurse at least once per hour. Silverbacks will protect offspring from aggression and socialize juveniles. The lifespan of a gorilla in the wild is between 35 and 40 years.

There are two general varieties of gorilla, the western gorilla, and the eastern gorilla, all of which are critically endangered. “Critically endangered” is the last survival status above extinct. Mountain gorillas are a well-known eastern gorilla (*Gorilla beringei beringei*) living in central Africa in the Congo, Rwanda, and Uganda in the vicinity of the Virunga volcanoes. Numbering only about 880 individuals, they are critically endangered. Threats to mountain gorillas include poaching, political unrest, and loss of habitat due to human expansion. Fortunately, mountain gorilla numbers are increasing since an all-time low in the 1980s of 254. The lowland eastern gorilla population, however, declined 70% in the last 20 years. There are no mountain gorillas in captivity. Previous attempts at captivity have resulted in death.

Orangutans

Orangutans live exclusively in Indonesia on Sumatra and Borneo and are the only great ape to live outside Africa. Orangutans differ from other great apes in that they are mainly solitary, and live high in the rainforest canopy. Orangutans live mainly on fruits and leaves, and like all great apes build nests. They’ve even been known to fashion leaf umbrellas to protect themselves from rain. Orangutans make a unique kissing sound called a “kiss squeak” when they are agitated. Like gorillas, orangutans have sexual dimorphism, with males being twice the size of females. Orangutans are critically endangered due to the pet trade, logging, and palm oil production. Palm oil is especially endangering orangutans, destroying the last orangutan habitat to make way for palm oil plantations. Like other apes, orangutan infants require a great deal of maternal care, staying with their mothers for six years. Orangutans are particularly susceptible to extinction because they reproduce only every 7 or 8 years, the longest birth spacing among mammals. In the 1970s, Biruté Galdikas famously studied Bornean orangutans in the wild and tried to reintroduce captive pet infants and juvenile orangutans back into the wild. This required a great deal of care on the part of Galdikas, even to the point of sleeping with infant orangutans and waking up in a puddle of orangutan urine and feces(Galdikas 1996). Because of the intense parent-infant bond, Galdikas also had to carry an orangutan infant through the sometimes flooded forest to make her

observations on orangutans.

Chimpanzees and Bonobos

There are two species of chimpanzees, *Pan troglodytes* (chimpanzees) and *Pan paniscus* (bonobo). Chimpanzees live in tropical Africa as well as a savanna environment. Like gorillas, chimpanzees are knuckle-walkers. Chimpanzees spend time on the ground and in trees. They prefer fruits and also occasionally eat protein such as mammals, birds, or eggs. Chimpanzees are less sexually dimorphic than gorillas, though males are somewhat larger. Chimpanzees form multi-male and multi-female troops of up to 60 chimps but typically travel in smaller parties. Of all the primates, they have the highest incidence of tool use, using termite and ant sticks, rocks for nut cracking, leaf sponges, and even a kind of trusting spear. Female chimpanzees use tools most often.

Males tend to be dominant among chimpanzees. Females move out of their group upon sexual maturity while males remain. This allows males to form coalitions. The coalitions are critically important and based on friendships cemented through grooming—literally scratching each other's backs. For this reason, chimpanzees are often described as "political". Dominant males will have preferential access to food and sexual partners. Males also perform dramatic displays—hooting, jumping, dragging objects, and thumping—designed to intimidate other males. Males will also hunt on occasion and eat more meat the females. Chimpanzees and bonobos are the only adult primates besides humans to share food. Chimps share food for many of the same reasons humans do—to support close relatives (mother to offspring), to support friendships (reciprocal altruism), and tolerated theft (protecting the food is more costly than sharing).

Among chimpanzees, females, rather than males, move out of their natal troop (the troop they were born into) into a new troop (dispersal). Males remain in their natal troop and form reciprocal bonds and strong male-male relationships. They also defend their territory and perform silent boundary patrols of their territory. Jane Goodall reported one troop of chimpanzees

systematically killing all the males in a neighboring troop that had splintered off from the first group.

Chimps use a wide range of vocalizations from grunts to pant-hoots. They also use gestures. The outstretched hand is used to request an item usually food. Unlike humans, chimps do not point in the wild but can be taught to do so in captive environments.

"Chimp does Hamlet" by Rhys Davenport licensed under CC BY 2.0

Female chimpanzees undergo an obvious ovulation cycle called estrus, which is marked by a large red genital swelling. Male chimps are only interested in copulation during estrus. Male chimpanzees also prefer to mate with older females because they are more competent mothers than younger female

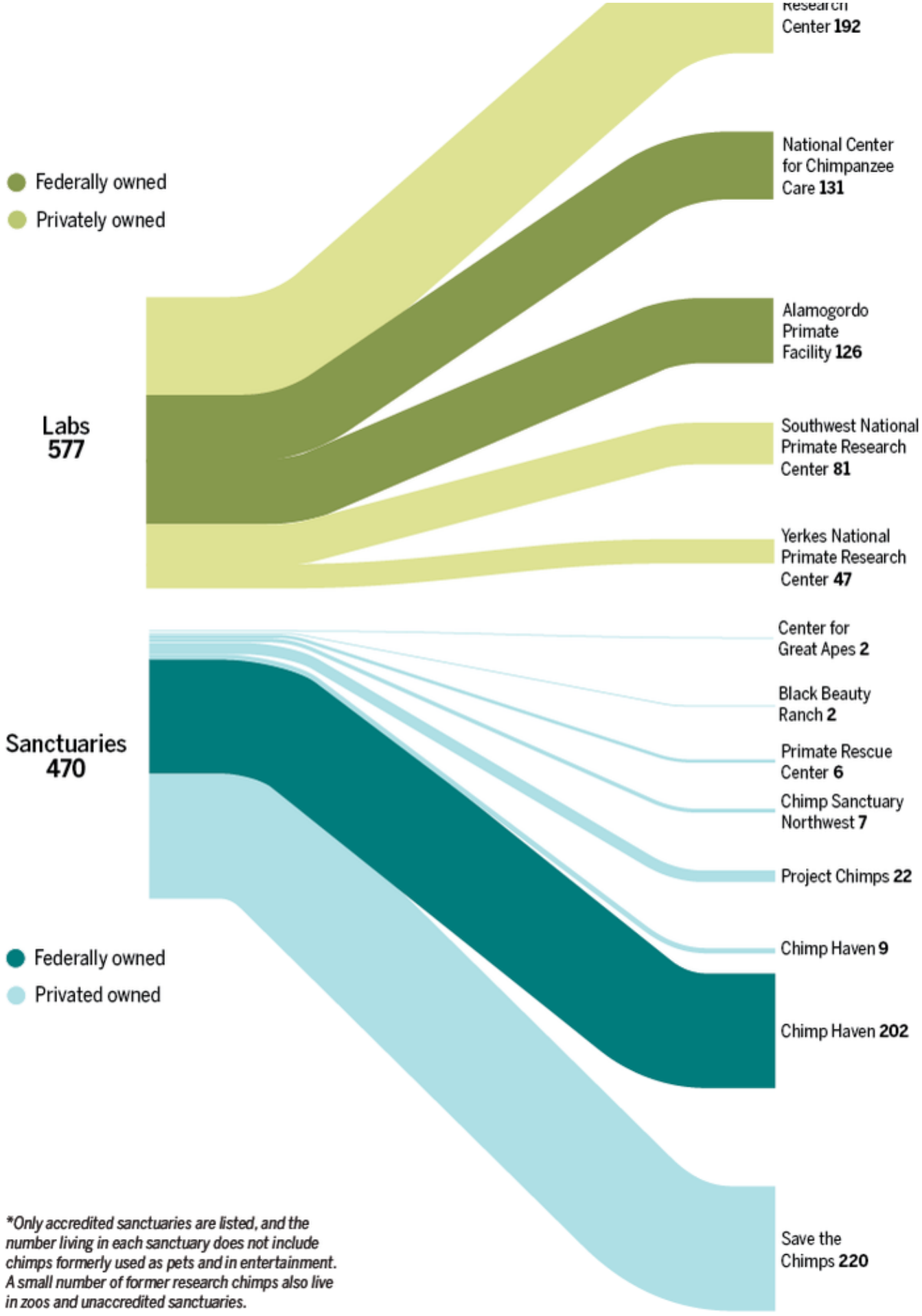
chimpanzees.

Bonobos have been isolated from chimpanzees for about a million years by the Congo River, and they have diverged somewhat because of their isolation from each other. Neither chimps nor bonobos can swim. In 1990, Joe-Joe, a chimpanzee at the Detroit Zoo fell into the retaining moat and sank to the bottom in front of onlookers. Truck driver Rick Swope realized Joe-Joe was drowning, jumped a short fence, hopped in the water, and and found Joe-Joe face down at the bottom of the moat. Swope dragged the chimpanzee out of the water squeezing the water out of the chimp as he hauled him ashore. Swope was face to face with Joe-Joe, and Swope said the chimp looked grateful. The next day Swope, who simply left the zoo with his family, was on the front cover of the *Detroit News (*Cohen 2010). Chimpanzees complete inability to swim make the recent disovery of Fongoli chimps playing in water all the more remarkable.

While bonobos look very similar to chimpanzees, they are socially very different. Among bonobos, females tend to be more dominant and females display by dragging objects. Males bonobos, who stay in their natal group, get their status from their high-ranking mothers. Overall, bonobos are less aggressive than chimpanzees and resolve social tension through sexual behavior. Bonobos engage in non-reproductive sexual behavior, sex not intended for reproduction, by rubbing genitals, rump rubbing, “penis-fencing,” and other same-sex and opposite-sex sexual behavior. This non-reproductive behavior is used to alleviate social stress, especially among females. Bonobos are not the only non-human primates to engage in same-sex interactions. There are numerous species that engage in sex not directly related to procreation as described in Joan Roughgarden’s book *Evolution’s Rainbow*. For instance, Japanese macaques in Mindoo in central Japan exhibit female-female sexual interactions and even monkey-deer sexual interactions (Gunst et al. 2018).

Chimp Retirement

Since humans and chimps are so similar genetically, chimp biomedical research began in the United States in the 1960s. Chimps were taken from Africa and sent to newly created primate research centers. The U.S. government stopped importing chimpanzees from Africa in 1973 and began a breeding program. Captive chimps reached their peak in 1996 when 1500 chimpanzees lived at primate centers, including one in Alamogordo, New Mexico. In 2013, a report came out from the Institute of Medicine saying that invasive research on chimpanzees was unnecessary and as a result, the National Institutes of Health decided to stop supporting invasive research on chimps (Kaiser 2013). The U.S. Fish and Wildlife Service (USFWS) declared U.S. captive chimps endangered ending all biomedical research (Grimm 2015). All but 50 of the 350 federally owned chimps were slated for retirement (Grimm 2017). Chimp Haven near Shreveport, Louisiana, is a retirement sanctuary for biomedical research chimps. But retirement has been slower than expected due to funding, health issues, transportation, and difficulties with reintegration. Today, the Alamogordo Primate Research Facility still houses 126 chimps.


Federally owned
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Labs
577
Research Center 192
National Center for Chimpanzee Care 131
Alamogordo Primate Facility 126
Southwest National Primate Research Center 81
Yerkes National Primate Research Center 47
Sanctuaries
470
Center for Great Apes 2
Black Beauty Ranch 2
Primate Rescue Center 6
Chimp Sanctuary Northwest 7
Project Chimps 22
Chimp Haven 9
Chimp Haven 202
Save the Chimps 220
Federally owned
Privated owned
*Only accredited sanctuaries are listed, and the number living in each sanctuary does not include chimps formerly used as pets and in entertainment. A small number of former research chimps also live in zoos and unaccredited sanctuaries.

Primate Conservation: The Human Toll

The relationship between humans and other primates has been the source of increasing study and interest and now has its own name, ethnoprimatology. According to a 2017 study, 60 percent of primates are threatened with extinction and 75 percent of species are declining (Estrada et al. 2017). Perhaps not too surprisingly, people are the problem. Logging, deforestation, mining, poaching, and social unrest are common causes of primate decimation. Protecting primates is not a simple task. As many as 150 rangers in Virunga National Park, Africa's oldest national park and mountain gorilla refuge, have lost their lives defending the park and the gorillas from poachers and rebel militias (Howard 2016). Today, thanks to the continued dedication of the rangers, the numbers of mountain gorillas in the park are low but increasing. Sadly, Virunga National Park closed in 2018 in response to the murder of a ranger and the kidnapping of two tourists and their driver (Sims 2018).

Mountain gorilla conservation has not been straightforward with regard to local populations. The Batwa forest dwellers of Uganda were displaced from the Bwindi Impenetrable forest where they lived as hunter-gatherers for almost certainly thousands of years. The Batwa were removed at gunpoint to make way for a mountain gorilla national parks (Bwindi Impenetrable and Mgahinga Gorilla National Parks) and gorilla ecotourism. The Batwa were not compensated for their land because as traditional hunter-gatherers there was no land ownership. Today, the Batwa live on the periphery of their ancestral lands, unable to hunt and gather in the forest. Child mortality is high, with 40 percent dying before the age of five. Batwa work as farm hands for food or low wages or sometimes they dress in fake animal skins and dance for tourists. In a recent article for the BBC, it was reported, "According to Mr. Muhangi from the wildlife authority, from each $600 fee paid by a tourist for a gorilla trek, $8 is allocated to local communities but nothing goes directly to the Batwa" (BBC News 2016). They also face extreme discrimination. One woman was set on fire for foraging in a farmer's garden (she survived). Recently, a Batwa man was arrested for killing a duiker, a small antelope, and is being held by police

(Survival International 2017). As a result of their eviction, the Batwa live in squalor, and malaria, AIDS, malnutrition, and alcoholism have taken hold. The Batwa, in effect, have become conservation refugees, not so different from the San who were evicted from the Kalahari Game Preserve.

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Chapter 8: Human Variation →

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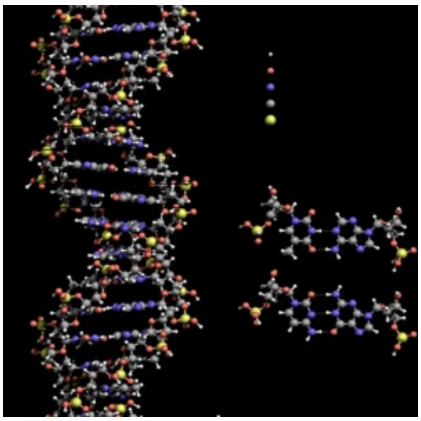
Chapter 8: Human Variation



"The structure of DNA" by brian0918g is licensed under public domain

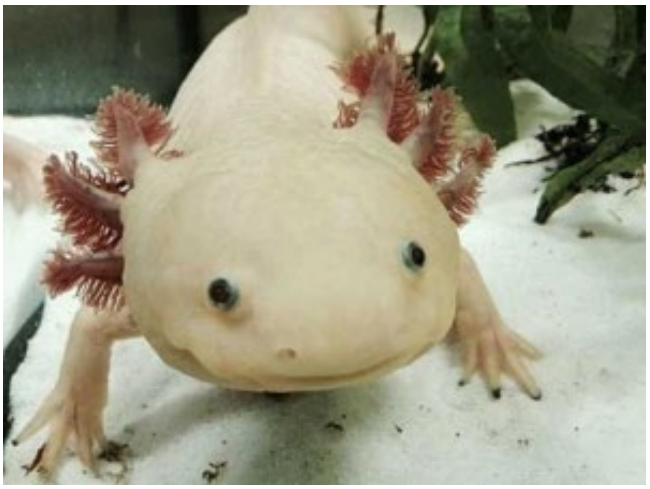
My son is colorblind and has trouble distinguishing red and green and a few other colors. For a long time, he thought pumpkins were yellow and that we had a green couch. Now we refer to that couch as the "green couch" using finger quotes. His colorblindness is a result of a genetic mutation. In other cases, genetic mutations are more dramatic. On the island of Pingelap, about one in ten people are completely colorblind. That is, they see *only* in black and white. In the world population, the incidence of total colorblindness or *achromatopsia* is 1 in 40,000. How did this happen? It is said that a catastrophic typhoon hit the island of Pingelap in 1780 and the king, who had achromatopsia, was one of only 20 people that survived. Given the limited number of people, and perhaps the king's personal charisma, the mutation for the condition spread over time. Unfortunately, this form of colorblindness also makes people very sensitive to

the sun, and they can't see very well at all during the daytime. One solution has been to fish at night, at which the Pingelap people excel. The achromatopsia mutation is an example of the Founder Effect, when a small number of people, in this case probably just one, influences the future prevalence of traits in the general population of a group.

The Code of Life

In 2003, The Human Genome Project mapped out the entire human genome, the entire set of genetic instructions for our species. All humans are, genetically speaking, very much alike, sharing 99.9 percent of our DNA in common. However, people aren't identical and genes differ from one person to another. Phenotype refers to the expression of genes, such as height or hair color. Some phenotypic variation is not outwardly obvious, like blood type. When we talk about the genes themselves we use the term genotype. So how and why do humans vary?

DNA (deoxyribonucleic acid) is composed of nucleotides, which are molecules made up of sugars, phosphates, and nucleotide bases. There are only four bases: adenine, thymine, cytosine, guanine, and thymine—A, T, C, and G for short. Just as zeros and ones make up current computer systems, these four letters form the basis of all life on earth. The bases are paired with one another —A with T and G with C—to form the steps of the DNA spiral ladder or double helix. The human genome, the complete set of genetic material, contains about 3 billion base pairs. But before we start celebrating our vast genome, it is now known that the axolotl, a kind of salamander native to Mexico, has 32 billion base pairs (Bakalar 2018). That's 10 times the size of the human genome. This huge genome is likely related to the fact that axolotls can regrow limbs. So much for human exceptionalism in the base pair department.



Humans have 3 billion base pairs. The axolotl has 31 billion base pairs. "A captive axolotl" by th1098 is licensed under CC BY-SA 3.0

Some sequences of nucleotide bases in the genome code for proteins. We call these genes. Perhaps humans have the most genes and that explains our dominance. It wasn't so long ago that we did not know the total number of genes in the human genome. In the *History of Everyone Who Ever Lived*, geneticist Adam Rutherford describes how the world's pre-eminent geneticists placed bets on the number of genes in the human genome, anticipating the results of the Human Genome Project. Some experts guessed around 100,000 genes. Today we know rice has 50,000 genes, bananas have 36,000, and the "water flea" 31,000. Humans, as revealed by the Human Genome Project, crossed the finish line at a disappointing 20,000 genes.

Mistakes Are Made

Occasionally when DNA replicates, a copying error or mutation occurs. These

mutations occur randomly. With every child born, there are approximately 50 new mutations. Changes in a single base from one letter to another are called SNPs ("snips") short for single nucleotide polymorphisms. SNPs are the most common form of genetic difference between people. Sometimes a change in one letter has no effect, other times, a SNP can affect a physical trait like eye color. And in rare cases, a SNP can lead to a debilitating disease like cystic fibrosis, sickle-cell anemia, or Huntington's disease. SNPs account for much of human variation. Two people chosen at random are likely to differ in 1 in every 1,000 nucleotide bases or 0.1 percent. With the advent of companies that identify certain SNPs from a sample of spit, we are learning more about how SNPs are distributed around the world and what their effect is if any. There's even a website called "SNPedia" that provides information about different SNPs. Other types of changes in bases can happen as well, including inversion, insertion, deletion, or duplication of bases which can result in human variation.

People inherit genes from both their mother and their father. The genes you inherit from each parent may be slightly different. These variants of genes, called alleles, are sometimes either dominant or recessive. A dominant allele will mask the expression of the recessive allele. Sometimes, you need two copies of the recessive allele for the disease to be expressed. Inbreeding within a population can lead to problems because a person is more likely to inherit two copies of a faulty allele. Carlos II (1661-1700), King of Spain, is a case in point. To protect the Spanish Hapsburg dynasty, marriages between cousins and between uncles and nieces were common in the royal line. As a result, Carlos' family tree collapsed in on itself. Where Carlos should have been 64 ancestors, he had only 32 (Rutherford 2016). The result was that Carlos was physically and mentally infirm along with being infertile.

"Charles the II in His Twenties" by Luca Giordano is licensed under public domain

A famous SNP that caused disease originated with Queen Victoria of Great Britain. She was a carrier of hemophilia, a blood clotting disease. The SNP is thought to have arisen through spontaneous mutation, and she passed it on to some of her daughters and sons. Her children and grandchildren married nobility from around Europe and Russia, spreading the SNP to several royal families, earning hemophilia the name “royal’s disease”.

Queen Victoria passed on a SNP for hemophilia to her descendants. “Queen Victoria” by Alexander Bassano is licensed under public domain.

Populations Change over Time

Why do populations look different from others or have higher frequencies of certain SNPs than others? There are two important ways in which SNPs get distributed that we will discuss: founder effect and natural Selection. The founder effect happens when a small group of people establishes a population, bringing with them a limited about of genetic variation. The founding group is

then isolated from others. Sometimes the founders bring with them chance mutations, so subsequent generations are more likely to have those mutations as well. For example, a form of dwarfism Ellis-van Creveld accompanied by polydactyly, having extra fingers, occurs in Amish populations in Pennsylvania due to the Founder Effect. The mutation can be traced back to a single couple (the "founders"). People practiced endogamy (marriage within the group) and the recessive gene for polydactyly was, therefore, more likely to occur than if they practiced exogamy (marriage outside the group). Likewise, on the remote island of Tristan da Cunha in the far south Atlantic, there are just 300 residents, but more than half of them suffer from asthma (Zamel et al. 1996). Why? Because of the 15 original settlers, two were asthma sufferers. On the Micronesian atoll of Pingelap, about one in ten people are totally colorblind, seeing only black and white. It is thought that a typhoon wiped out most of the population in 1775. The king, who was thought to have carried the defective gene, survived and passed it on to his many descendants. Interestingly though, those affected have excellent night vision.

Iceland's founders are well documented through *Íslendingabók*, The Book of Icelanders. Many people are related, but may not know it. Because of the problem of potentially inheriting two copies of a deleterious (bad) gene or accidentally dating a cousin, some enterprising Icelanders developed the Islendiga-App, which warns you about dating potential relatives. If you bump phones and an alarm goes off, you may want to look elsewhere.

Northern New Mexico has also been shaped by founder effect. Many people in northern New Mexico have inherited a mutation that causes cerebral cavernous malformation (CCM). The disease causes blood vessels to form clusters in the brain and spinal cord producing headaches, seizures, and potentially strokes. The disease is caused by a mutation in the CCM1 gene, and unfortunately, the gene is dominant, so a person who has the mutation has a 50 percent chance of passing it on to their children. Some people with the gene have no symptoms, and there can be a wide range of severity. The disease derives from Cristóbal

Baca, an early Spanish colonist of New Mexico in 1600. Researchers at the University of New Mexico Hospital and the Baca Family Historical Project are starting an effort to better diagnose people. (See this site if you have CCM and want to participate in a study to try to determine why the disease differs in severity).

Natural Selection

In natural selection, a trait has some advantage in a particular environment that causes individuals with that trait to survive and reproduce at a higher rate than individuals without the trait. Unlike founder effect, traits confer some advantage to the organism. A clear example of natural selection comes from the New Mexico rock pocket mouse. Mice that live in sandy desert areas of New Mexico are a sandy brown color, blending in with their environment from predators. But New Mexico also has several areas of lava flows like The Valley of Fire. In this region, mice tend to be grayer, blending in with the lava flow. More sandy coloration is a liability on the darker lava, and those mice are selected out of the population by being eaten by predators leaving the darker mice to survive and reproduce at a greater rate. Genetic studies show mutations

in the MC1R gene leading to dark coloration. On different lava flows different mutations have been selected for resulting in dark coloration. Even if the dark mice have just a 1 percent advantage, 95% percent of mice will be dark in 1,000 years (HHMI). Importantly, the mutations occur at random, but natural selection acts upon those random mutations.

The same process, natural selection, that has shaped the rock pocket mouse has shaped the human phenotype, from lactose tolerance (a.k.a. Lactase persistence) to disease resistance to skin color. Human babies can digest lactose until about the age of 4 to 6, then the ability shuts down and people become lactose intolerant. In this case, the gene does not code for a protein but switches on and off the gene that produces lactase. In some populations, SNPs arose such that the ability to digest lactose never switches off and adults can drink milk freely. Not too surprisingly, populations that can drink milk are those where herding animals are important, or were important in the past, to their ancestral populations. This is a good example of how a cultural trait, herding, led to the selection of a biological trait, lactose tolerance. In fact, humans are the only mammal that can do this. Shaping our biology as a result of culture is called gene-culture co-evolution. The ability to digest milk, even if it conferred a small advantage, would have led to most people being lactose tolerant, similar to the pocket mouse example.

As with the pocket mouse example, different mutations led to lactose tolerance in different populations. Different SNPs account for lactose tolerance in Europe, Africa, and the Middle East. The same SNP accounts for lactose tolerance in Europe and India, indicating a common origin. In northern Europeans, lactose tolerance is a result of just one SNP, a mutation in a single base pair. The Masai cattle herders of Tanzania and other sub-Saharan Africans, however, have a different mutation that also results in lactose tolerance. Like the pocket mice, these mutations popped up randomly but were acted on through natural selection because they were advantageous in cultures with domesticated animals that could be milked.

The Masai mutation for lactose tolerance (lactase persistence) is different from northern Europeans. "Masai Milking Cow 07_05" by Photo Bobil is licensed under CC BY 2.0

Another example of natural selection in humans is the sickle cell trait. A disease called sickle cell anemia is caused by a variant of a gene that produces hemoglobin. The variant is caused by a single SNP, a switch from A (adenine) to T (thymine). Sickle cell anemia is a painful disease that can result in shortened lifespan if left untreated. The normal variant of the gene is designated as S and the affected gene as s. Individuals inherit variants of the gene (called alleles) each from their mother and father. If a person has SS (homozygous dominant), then they do not have the disease. If a person has the variants Ss (heterozygous), then they do not have the disease but are a carrier. Two copies of the variant ss (homozygous recessive), one from the father and one from the mother, cause sickle cell anemia. The variant ss causes the red blood cells to become sickle-shaped, preventing them from transporting oxygen.

Why would such a harmful mutation become so common in a population? Why

wouldn't it fade away if it was so deleterious? The answer is natural selection. People with the variants Ss, who are carriers of the disease, are also resistant to malaria, a zoonotic disease transmitted by mosquitoes. Those with the SS variants are not resistant. The Ss variants survive at a greater rate than SS. Sickle cell trait is prevalent in those areas where malaria is common like western Africa, the Arabian Peninsula, and southern India. Because western Africans were brought to the United States as slaves, sickle cell anemia is prevalent among African Americans as well. Blood tests can determine if someone is a carrier and ascertain the likelihood of transmitting the disease to offspring.

SS Homozygous	No sickle cell anemia, but susceptible to malaria
Ss Heterozygous	No sickle cell anemia and resistant to malaria
ss Homozygous recessive	Sickle cell anemia

Skin Color

All primates can produce melanin in their skin, which is a natural sunscreen. Skin color depends on the type of melanin produced in skin cells called melanocytes. Melanin also affects what eye color you have. Blue eyes derive from a mutation in a genetic "switch" for the OCA2 gene (Eiberg 2008). The switch reduces the ability of the gene to produce melanin in the eye resulting in blue eyes. Melanin also colors animal hair and bird feathers. But why does human skin color differ?

Ultraviolet radiation damages DNA in the skin and disrupts cell processes. Dark skin protects against ultraviolet radiation and the mutations it can cause. Melanin acts as a barrier between the ultraviolet rays and the nucleus of the

skin cell, which houses the DNA. In short, melanin protects DNA and helps prevents skin cancers. Those with dark skin in high UV regions, which correlates generally with latitude, would have a selective advantage over lighter-skinned people. But protecting DNA in skin cells is not the only advantage. Dark skin also conserves folate, which is destroyed by ultraviolet-B sunlight (UVB). Folate is essential because low folate in pregnant women can result in severe birth defects called neural tube defects. After all, the demand for folate increases during pregnancy. Thus, dark skin confers a great advantage over light skin in the tropics not just because it prevents skin cancers, but also because it prevents birth defects. These advantages would quickly make dark skin universal in areas of high UV, much like the dark fur on rock pocket mice on lava flows. Because folate is destroyed by sunlight, pregnant women take folic acid or eat foods high in folate to prevent neural tube defects. In the United States, many foods like cereals, bread, and pasta, are supplemented with folic acid for this reason.

We can then ask, why do some people have lighter skin? Lighter skin is a liability in the tropics, but those with lighter skin can better synthesize vitamin D (a hormone necessary for the absorption of calcium) in more northerly climates. Melanin greatly slows the production of vitamin D. A very dark-skinned person will take six times as long to produce the same amount of vitamin D as a light-skinned person. Nutritional rickets, a deforming bone disease, can develop in the presence of vitamin D deficiency. Women with rickets have reduced pelvic openings, and have difficulty delivering babies, making the selective factors for light skin strong in some areas. Some of the first c-sections in the U.S. were on enslaved African American women who suffered from pelvic deformities, likely brought about by vitamin D deficiencies. Foods are now enriched with vitamin D to prevent Vitamin D deficiencies (in the past, kids took cod liver oil). Vitamin D deficiencies are now being recognized as having other effects including a weakened immune system and an association with cancers. Like dark skin in the tropics, light skin is naturally selected for in areas of lower ultraviolet radiation.

There are still other skin phenotypes that are the product of natural selection.

The ability to tan is also an adaptive trait based on genetic and environmental interaction. Tanning is the ability to increase melanin production when needed. In some areas of the world, the amount of sunlight varies considerably from one season to the next (e.g., the Mediterranean). Local populations have physiological mechanisms to darken their skin during yearly seasons of high sunlight. In other areas of the world, cloudy conditions prevail even during summer seasons and very little tanning ability has evolved (British Isles).

Biology and Destiny

All traits are genetic. Even if you spend hours at the gym and are ripped, that is still a genetic trait. How can that be? Genes produce chemicals that respond to all that iron pumping, ultimately creating big muscles. But all traits are also environmental. Wait, what? That's right, the old nature-nurture debate has long been put to rest. For example, height has a genetic component, but diet also plays a role in how tall you will be. This is why people have become taller over the generations. Better nutrition and simply more food allow genes to reach their height potential. Superman is a good analogy. Under a red sun, he's just your ordinary, mild-mannered, Clark Kent type. Under a yellow sun, he can fly and has x-ray vision. A yellow sun permits Superman's genes to achieve their potential. This happens in other species as well. Himalayan rabbits raised in cold temperatures will have dark pigments on their nose, paws, and tail, and those raised at warmer temperatures are all white (Lobo, 2008). In this case, temperature affects whether a gene will be expressed or not. The temperature at which alligators are incubated determines whether they will be born male or female. Grasshoppers born into crowded conditions will have increased hopping ability, presumably to more easily migrate out of their current habitat. Genes and environment can't be separated; instead, they interact to produce traits. Some traits, however, are more *heritable* than others, which means that the environment plays a lesser role in their expression. Rather than "nature versus nurture", it is more accurate to speak of "nature through nurture."

Sometimes the media portrays traits as purely genetic. For example, a non-mutated gene ACTN3 occurs in virtually all Olympic power athletes like

sprinters and power-lifters (MacArthur 2008). The gene variant produces a protein that allows for fast muscle contraction. One company called ATLAS at one point even marketed to parents to identify children's version of the gene, to direct their kids into the correct sport. But the gene, of course, isn't near the whole story. First, like other complex traits, other genes also influence athletic ability (though they are still poorly understood). And environmental factors, namely diet, and high-level training, also affect athletic success. What if you have the fast-twitch gene, but sit in a cubicle all day? Will you still become an Olympic athlete? Not likely.

Jamaicans have high frequencies of the ACTN3 gene and have dominated sprinting in the Olympics. But, running is a national pastime in Jamaica, comparable to football in the United States. In fact, the gene is thought to predict just 2–3 percent of the muscle variation in the general population. To illustrate this point, Usain Bolt very likely has at least one fast-twitch allele for ACTN3, but so does your anthropology instructor. The presence of the variants of ACTN3 can't be the whole story. Genes and environment work together. Studies vary widely, finding that ACTN3 only accounts for 0 to around 2 percent difference in sprinting speed (Lieberman 2021). In his book *Exercised*, Lieberman suggests that there are likely many genes that influence athletic ability, just as there are more than 400 genes that influence height. There is no single gene that accounts for running ability within populations or between populations (Lieberman 2021).

Usain Bolt almost certainly has one copy of the "power athlete "version of ACTN3, but so does your anthropology instructor. licensed under CC BY 2.0

Race

Racial classification involves assigning humans to categories based on phenotype, especially traits that are outwardly apparent. In the recent past, American children were taught that there are 5 great races of the world, a taxonomy based on Johann Blumenbach's racial hierarchy of the late 1790s. This is the essentialist view of race—that there are discrete groups with large gaps between them. According to Blumenbach, "Caucasians" were the most ideal form, and everyone was of a degenerate form of human.

The essentialist view of race runs into immediate problems in light of the continuous nature of traits, especially skin, hair, and eye color. Skin color and eye color are not straightforward SNPs like lactose tolerance or sickle cell trait. Rather, they are influenced by several different genes, more than 15 for skin and 16 or more for eye color. As a result, skin color can be "blended" in children of parents with different levels of skin pigmentation. Then, skin color is not an essentialist category, but rather a continuum. If skin color is meant to reflect deeper qualities of a person or a person's wider genotype, what do we make of siblings, even fraternal twins, who are considered different races based on their skin color? And how does a single individual who shares perceived features of different races—like dark skin and blonde hair— get categorized? For instance, blonde hair arose independently in Europe and Melanesia. (In Melanesia the blonde trait is caused by a single SNP, a C switched to a T). How would these

people be categorized based on phenotype? Which trait is considered more important to race, and why? People have to decide, culturally, whether someone belongs to a race or not.

Blonde hair of Melanesia arose separately from northern European blonde hair. "untitled" by Tribes of the World is licensed under CC BY SA 2.0

During Blumenbach's time, nothing was known about genetics. Augustinian friar Gregor Mendel (1822–1884), who began the study of genetics by working out the inheritance of pea plants, had not even been born. Instead, Blumenbach based his categories on his perception of phenotype and his own biases. Many

today assume still that racial categories correspond to deep underlying genetic differences.

With the Human Genome Project results, we know more about the genotypes of human populations. For instance, we now know that the genetic variation between any two individuals is about .1 percent. Since we have 3 billion pairs of bases, that means about 3 million differences. Most genetic variation, SNPs, and other forms of mutation (85–95%) are found within populations—nations and linguistic groups— around the world. As writer Malik Kenan in "Why Both Sides are Wrong in the Race Debate" writes, "Imagine that some nuclear nightmare wiped out the entire human race apart from one small population—say, the Masai tribe in East Africa. Almost all the genetic variation that exists in the world today would still be present in that one small group." A smaller percentage of genetic variation occurs between supposed races, about 3–5 percent. Maybe this 3 to 5 percent difference is useful for dividing up people? As Kenan points out, the differences between human populations are purely statistical, not essential or absolute. This means populations are more likely to contain certain alleles, but not everyone has them. Secondly, statistical differences could be found between virtually any two populations, such that there could theoretically be hundreds or thousands of races based on genetics if we decided that those categories would be useful and productive for society or science. If you're looking for statistical genetic differences between populations, you will find them. Even if there are genetic differences between populations, complex traits like athleticism, intelligence, musicality, and so forth are not influenced by a few genes, but likely hundreds of genes as well as the environment. We always have to decide which criteria, whether phenotypic or genotypic, to base our categories, and also we need to consider why these categories are needed.

In another light, race is very much real even though as a biological category it has little value. Culturally, race is very much real. We know that we humans create our world—we decide that money, companies, borders, and so forth—are real things. The same is true for race. The great lengths to which people will go to create racial categories are enlightening. In the United States, for example,

the one drop rule meant that any African ancestry qualified someone as being black, but not white, even if most of their ancestors were European and light-skinned. As a result, Barack Obama was the first black president of the United States, even though his anthropologist mother was considered white. Some racial categories are ridiculously specific. For example, Louisiana had several categories for people of African descent, including quadroon (¼ African), octoroon (⅛ African), and even hexadecaroon (1/16 African). In other cases, racial categories were explicitly cultural. Pilar Ossorio, legal scholar, microbiologist, and bioethicist writes:

"And historically, in order to be a naturalized citizen in this country, as an immigrant, you had to be categorized as white or black. So the courts had to make decisions about who was white and who was not. Is an Armenian person white? There were several cases dealing with Asian people, and are they white or not white. And so one of the things that would happen is the person would come into court and say, "Look, my skin color is as white as anybody else's skin color in here who is categorized as white. The court often decided who was white and who wasn't based on whether they felt that the person would politically fit well into the kind of society we were trying to build."

Individuals have gone to great lengths to be recognized as a particular race. A 1970 law in Louisiana stated that 1/32 African-American genes qualified an individual as black. Susie Guillory Phipps, who considered herself white, discovered she was legally considered African American when she ordered a copy of her birth certificate. The Phipps family began a 20,000-dollar legal battle to get the law declared unconstitutional and to get Susie Phipps officially declared white.

Kim Tallbear (2014) explains how racial classification has affected tribal membership for native people: "In most US tribes, you have a specific blood quantum needed for enrollment – often one-quarter. That means you have to be able to show with paper documentation that you have one out of four grandparents who is full blood. Or you might have two grandparents who are

half-blood – however, you can make those fractions work." According to TallBear, some tribes have turned to DNA testing to determine who qualifies for membership. While genetic testing can determine paternity, no test can determine a genetic link to a particular tribe. Native identity is not racial, but rather, Tallbear argues, being culturally part of an indigenous community. Relying on biology as a qualification for tribal membership, she argues, means handing over control of tribal identity to genetic research institutions (Tallbear 2016).

Forensic Anthropology

Forensic anthropologists examine human remains to try to identify a deceased individual to be used as evidence in court. To achieve this, forensic anthropologists examine bones and sometimes DNA to estimate the individual's stature, health, injuries, sex, age, how they lived, and outward appearance. Forensic anthropologists will also use cultural cues, like clothing, jewelry, and other effects, to aid in the identification. Work is often conducted with unidentified soldiers' remains, mass graves, victims of terrorism, natural disaster victims, crime victims, and sometimes bodies in unmarked graves.

We know that race is not an essentialist category with all members of a perceived race having all genetic variants. However, there is a statistical likelihood of having characteristics if your ancestors were from a particular geographical area like Europe, Asia, or Africa. Forensic anthropologists use cranial measurements and a formula to estimate how similar the victim was to modern geographical populations. Based on these findings, the forensic anthropologist can estimate what social category the person would likely be classified as. If the victim's ancestry is not very mixed, then the estimate will be more accurate. However, if the person's ancestry is mixed, it will be very difficult to know how that person's was viewed socially in terms of race.

https://www.nytimes.com/interactive/2017/05/04/us/texas-border-migrants-

dead-bodies.html

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Chapter 9: How Did We Get Here?

I vividly remember my anthropology professor explaining how Raymond Dart is credited with discovering the first Australopithecine in South Africa 1924— a strange primate that walked on two legs some 3 million years ago. Technically, the real discoverers were miners who were instructed to bring anything strange they found to Dr. Dart's attention during the course of their excavations. After explaining the discovery of the Taung Child as it is called, my professor changed his tone to storytelling mode. Dart wanted to make casts of the spectacular "career-making" fossil in England just in case something catastrophic happened to the actual remains. Dart was unable to go to London at the time, so

his wife Dora was responsible for transporting the Taung Child to the lab in London. After arriving in the city, Dora took a cab to her hotel, but accidentally forgot the box with the skull in the backseat of the cab. The Taung Child then got a whirlwind tour of London. Eventually, the taxi driver discovered the box with the skull, assumed it was the head of a baby, and immediately called the authorities. My professor ended the story abruptly by stating that Dart and his wife divorced soon thereafter.

Paleoanthropology

Paleoanthropology is a specialized field in biological anthropology that is interested in human origins. This subject is investigated through two main avenues—the study of ancient fossils and genetics. Paleoanthropologists group ancient species into taxonomic groups (just like modern primates are classified in taxonomic groups) according to their morphology and sometimes their genetic makeup. This is done in order to understand the evolution, or change over time, in the human species.

Fossils are simply the remains of once-living organisms, whose tissues (usually bones and teeth) have been replaced by rock. Fossils only form when the organism was quickly buried and conditions are ideal. As a result, the fossil record represents only a small fraction of the populations that were once living. Paleoanthropologists also group species based on their genetics. This approach is only possible when tissues have not been fully mineralized or fossilized. This sparsity of the fossil record and the lack of preserved genetic material makes paleoanthropology a challenging discipline.

The processes by which species diversify today, as seen in the rock pocket mouse example, were also at play in the past. Mutations occur randomly and processes like natural selection and founder effect lead to diversification in species. These processes can lead to many branches that derive from a common ancestor. Change over time does not happen in a linear step-wise fashion, but rather in a branching fashion. In this chapter, we will look at some of those species that are thought to be ancestral to humans and why they are considered to be in the human family.

The Problem of Time

It was once thought that there wasn't much time for a lot to happen on planet earth. Many scholars attempted to calculate the age of the Earth and/or people on the Earth using the available texts. Archbishop James Ussher's calculation used, in part, the genealogies and reigns outlined in the Bible along with known dates of rulers. Ussher calculated the beginning of creation to 6004 BP. These calculations were taken very seriously, and even Sir Isaac Newton attempted an estimate.

While Usher's estimate was extremely influential, the physical evidence did not align well with this relatively short time frame. In the 1790s, John Frere, great-great-grandfather of famous paleoanthropologist Mary Leakey, excavated stone tools four meters (that's about 12 feet) below the

ground surface in ancient lake deposits in Suffolk, England. How did these artifacts get to be so deep in the ground. he wondered? Going against conventional thought, Frere concluded, “The situation in which these weapons were found may tempt us to refer them to a very ancient period indeed.” A similar situation was coming to light in France. In the 1840s, a customs official named Boucher de Perthes uncovered stone tools associated with extinct elephant remains (mammoth) deep in ancient Somme River gravels in France. Like Frere, he concluded that the human presence in Europe much be much older than previously thought.

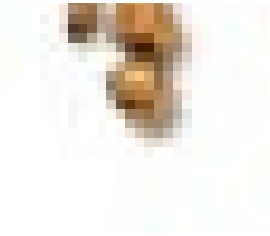
The problem was that people were finding artifacts and fossils in places where conventional thinking said they shouldn’t be. The deeper the geological layers, the older the fossils. These layers and the fossils they contain provide a blueprint for how life changed on earth since its beginnings around 4.5 billion years ago. If the earth’s history were scaled to a year, humans appear in the last hour of the year. We now know based on geology and paleontology that the earth is much older than previous believed, and that humans and our cousins are relatively late arrivals.

Paleoanthropologists study fossils and genetics to understand the human family tree. “Neanderthal Skulls” is licensed under CC BY-NC 2.0

So what kinds of things do paleoanthropologists look for in the fossil record? Paleoanthropologists of course look for fossils that have features of primates. In addition, they look for morphological traits that stand out as human in the field of other primates. Bipedalism, large brain to body size, a reduced face and changes in dentition (teeth) are features that are unique to humans in the primate order, and so paleoanthropologists use these to identify human ancestors, or hominins. Bipedalism is an especially important feature because it is the earliest to show up in the fossil record. All hominins are bipedal. Other human-like features like large brains, a reduced face, and changes in dentition, appear later in the fossil record.

Australopithecines

Some of the earliest and best understood hominins were Australopithecines, all of which have so far been discovered in Africa. There are several different species of australopithecines: *Australopithicus afarensis*, *Australopithecus africanus*, *Australopithecus sebida* and several others. Skeletal morphology (the form of the skeleton) reveals that Australopithecines walked on two legs as their main means of locomotion (moving around). No other primate besides humans is habitually bipedal. Chimps, bonobos, and gorillas can walk on two legs, but they are facultative bipeds, meaning the can walk on two legs for short periods. More typically, they propel themselves forward with their back legs, and support the front part of their bodies with their arms on curled-up hands—knuckle-walking.



“Lucy (Australophitecus)” by 120, CC BY 2.5, https://en.wikipedia.org/wiki/Lucy_(Australopithecus)#/media/File:Reconstruction_of_the_fossil_skeleton_of_%22Lucy%22_the_Australopithecus_afarensis.jpg

The Hips Don’t Lie: Evidence for Bipedalism

The most famous Australopithecine is probably “Lucy”, an *Australopithecus afarensis*, discovered by Donald Johanson in Hadar, Ethiopia, in 1974. Lucy dates to about 3–3.5 million years ago (mya). She is remarkable not so much for her age, but for the completeness of her skeleton, with 40% of the bones being present. Lucy was about 20 years old and just under 4 foot when she died. Her brain was small (chimp sized), but she was clearly bipedal. Much of her postcranial skeleton (from the neck down) was present. Her pelvis, or hip bones, were especially informative. Lucy’s hip structure was more “bowl-shaped” like humans, and her femurs and knee joints angled inward, as in humans, to maintain a central center of gravity while walking upright. In contrast, chimpanzees have an elongated pelvis and femurs (upper leg bone) and knees that do not angle in. Therefore, the structure of the Australipithecine hip is an indicator of bipedalism.

Other indications of bipedalism in Australopithecines include the absence of a divergent big toe, as chimps have. The australopithecine toe is in line with the others making it adaptive to bipedal walking. The foramen magnum, which is the large opening for the spinal cord at the base of skull, is oriented downward, indicating the head sat atop the spinal column. Based on the arm bones, however, Australopithecines may have been partially arboreal.

Note that this foramen magnum is oriented toward the back of the skull because the animal is not bipedal. "Walrus Skull" By Travis is licensed under CC BY-NC 2.0

Another piece of evidence for bipedalism in Australopithecines are the famed Laetoli footprints in Tanzania, discovered in 1978. At Laetoli, numerous animal prints have been preserved in volcanic ash. Following a volcanic eruption, hominins (and other creatures) walked on ash, creating footprints, which were subsequently buried by more ash and preserved. The hominin footprint showed no evidence of quadrupedalism or knuckle walking and were dated to around 3.6 million years ago. In all, 70 hominin footprints created by three individuals were discovered. In 2016, two new trackways at Laetoli were reported (Ichumbaki et al. 2016).

"Cast of Footprints, Laetoli Museum", by Teresa is licensed under CC BY-NC 2.0

The shift to bipedalism is thought to be a response to an episode of drying in Africa in which tropical rainforests developed into savanna/woodland environments. Bipedalism may have been a response to this environmental shift. Several ideas about why bipedalism, which involves a radical restructuring of the body, was favored. Bipedalism entails costs, namely, stress on the lower spine, especially for pregnant females. It must therefore have conferred some advantage given this drawback. Bipedalism may have helped hominins see further, and it could have helped hominins to carry objects, transport food, and make tools. Bipedalism may also have enabled hominins to cool off better in the more open environment. Finally, bipedalism is more efficient than knuckle-walking for traveling long distances, potentially beneficial in a savanna/woodland environment. As it stands, we know that early hominins were bipedal, but are uncertain of the conditions under which this trait was selected for.

Homo habilis in Middle Earth

The first hominin that is sometimes classified into our own genus—the genus Homo—evolved in eastern Africa from Australopithecine populations around 2.1–1.5 million years ago and is called *Homo habilis*.

The term *Homo habilis* roughly means “handy man” in Latin. Compared to australopithecines, habilis has more human-like features including the cranial capacity is larger and it has a less proganathic (projecting forward) face and a more vertical forehead.

Habilis is thought to be one of the first hominins to make and use stone tools—the Oldowan stone tool tradition, though stone tool cut marks are known from a pre-habilis site (Lovett 2010). Captive chimps have been shown by human trainers how to smash up long bones and use the splinters to puncture containers full of Kool-Aid. Monkeys produce flakes from smashing rocks, but so far, they haven’t used them to cut with. Making and using sharp edges seems to be within the performance capabilities of apes and even monkeys, but applying cutting edge technology in the wild is not in the repertoire. This propensity for making stone tools, is quite a bit more like modern humans than apes. It seems likely that cutting edge production in hominins was conditioned or selected for by a distinctive subsistence pattern, namely a strong dependence on hunting and/or scavenging meat. It is thought that Homo habilis scavenged for meat.

Habilis was fully bipedal, although it had not yet developed the modern human body proportions; it lacks the longer legs and shorter torso adapted for running and striding, that we see in later hominins. There are relatively few postcranial fossils from *Homo habilis* and different specimens show a range of variation, making it a controversial species. Many researchers lump them together with Australopithecines, considering them all to be a continuous, highly variable species. One paleoanthropologist has suggested that the world of early Homo was like Middle Earth in *The Hobbit*, inhabited by many very different looking bipedal primates.

Homo erectus

By about 2.0 to 1.8 mya, *Homo erectus* represents a continuation of anatomical and behavioral trends already present in *Homo habilis*—increased encephalization, stone tool use, reduced prognathism and teeth, and of course bipedalism. Erectus had a larger relative brain size than habilis, but still smaller than modern humans. Erectus also had a thick skull and massive browridge that continued, shelf-like, across the forehead.

homo erectus by **BuluLulu** on **Sketchfab**

The biggest change was in the development of its nearly modern postcranial skeleton (that is, body proportions and stature). This is thought to be associated with an adaptation for striding, running and covering large distances during the day while foraging, probably indicating an increased dependence on hunting animals. Erectus is the first hominin to be found outside of Africa. There is variability between erectus fossils, especially between Asia and Africa, and some designate the African erectus as *Homo ergaster*.

Our best evidence for reconstructing *Homo erectus* body build for comes from a fossil known as Turkana boy (or Nariokotome boy) recovered from near the shore of Lake Turkana in Kenya, which dates to about 1.5 mya (Note: some researchers consider Turkana boy to be *Homo ergaster*, the African contemporary of *Homo erectus*). Turkana Boy is a near complete skeleton of a young boy, who based on tooth eruption patterns was about 10 or 11 years old at the time of his death. He stood about 5 feet tall when he died, and would have grown to about 5' 6" as an adult. It is not known what caused his death or how he came to be so quickly buried by sediments and was thereby so incredibly well preserved. Despite his modern body build and stature, his cranial capacity as an adult would have been about 900 cc, about 440 cc less than the average brain size of modern people.

By comparing tibia (the larger lower leg bone) lengths of adult erectus specimens, paleoanthropologists have estimated the average height of Homo erectus to be between 5'5 and 5'7".

Turkana boy. Note modern body but primitive-looking head.

This is close to the average height of modern Europeans in the 18th and 19th century. Furthermore, this average height stays stable for about 2 million years, through the appearance of later species. Anatomically modern humans, that is, humans identical in morphology to us, who appeared about 200-300 thousand years ago in Africa, were slightly taller, averaging about 5'10", which is taller than the average height of most present-day people. The take-home message here is that our modern body proportions and stature evolved early—much earlier than our modern brain size—and has stayed constant ever since. This suggests that this body build was a fundamental aspect of our adaptation to the environment.

Homo erectus emerged during the geological time period marked by a series of ice ages and radical fluctuation in the Earth's climate. This time period, called the Pleistocene began around 2.5 million years ago and ended around 12,000 years ago. The Pleistocene consisted of a series of glacial periods, periods of long-term reduction in the temperature of the Earth's surface and atmosphere, resulting in the presence or expansion of continental and polar ice sheets and alpine glaciers, interrupted periodically by warmer interglacials. This cold-warm pattern alternated on a fairly regular cycle about 100,000 years long (see the Milankovitch cycles). The world's configuration of continents was the same as today, but some land masses were exposed because much of the world's water was bound up in enormous ice sheets, more than 2 miles thick in places. Ocean levels at one point were 330 feet lower than present levels.

Handaxes

The appearance of *Homo erectus* coincides with a new, more sophisticated stone tool type called the Acheulean handaxe. These tools could be used for a variety of purposes like digging or cutting. In addition, they could be used to produced sharp flakes of stone that were tools in and of themselves. Acheulian handaxes were widespread and took a sophisticated brain to produce. Kanzi, the bonobo chimpanzee, can produce a simple flake to cut a rope, but no chimpanzee in captivity or in the wild has made anything close to an Acheulian handaxe.

Acheulian handaxes were made by Homo erectus and Archaic Humans. "Acheulian Handaxe and iPhone" by Alex Pang is licensed under CC BY-NC_SA 2.0.

"The Swanscombe Hand-axe Sculpture" by mira 66 is licensed under CC BY 2.0

Unlike previous species, fossils and archaeological sites of *Homo erectus* are found not only in Africa, but also in Europe and Asia. Some erectus fossils have been found on islands in southeast Asia, like Java, which means these hominins could make rafts or boats, perhaps out of the bamboo that grows throughout the region, to cross significant expanses of open sea. They were also able to survive and prevail in temperate climates with extended freezing winter weather in places like England, northern Europe, and northern China, which suggests that they could make and control fire for warmth.

A recent site in Dmanisi, Republic of Georgia suggests the picture of Homo erectus may be more complex

than previously thought. Georgia is a small country between Russia and Iran on the east coast of the Black Sea. Here, in Pleistocene fossil deposits, five well-preserved *Homo erectus* crania were discovered around 2010 (Skull 3). The *Homo erectus* skulls at Dmanisi are relatively small in size. One of those skulls (Skull 5) looks very primitive, meaning more like earlier fossils, with a very small braincase (346 cc) and prominent canines, more like *Homo habilis* than erectus. What's more, the associated stone tools are of the earlier Oldowan industry, not the more developed Acheulean industry typical of *Homo erectus*. The tools at Dmanisi were associated with butchered bones of large grazing animals typical of a savannah, or grassland environment. The site dates to as old as 1.8 mya. The discoveries at Dmanisi mean that genus Homo ventured out of Africa much earlier than had previously been thought, and at a much more primitive level of development with respect to body build, cranial capacity and tool kit.

The variation at Dmanisi is surprising. Had the fossils skulls been found at different sites, they may have been designated as different species (SciNews 2013). This points to an ongoing problem in assigning fossils to taxonomic categories, namely, it is hard to know whether a fossil represents a single species or variation within a single species.

Skull 5 at Dmanisi.

The site of Dmanisi is a Medieval site and a lower Paleolithic site.

Archaic Humans

Around 500,000 years ago, larger-brained hominins evolved from *Homo erectus* populations in Africa and subsequently spread into Europe and Asia. These hominins are collectively called Archaic Humans and represent several species: *Homo heidelbergensis*, Neanderthals, Denisovans. Archaic humans are identified by large brains, reduced robustness, reduced prognathism (jutting out of the face), and reduced postorbital (behind the eyes) constriction. Archaic humans continue using the Acheulean handaxe, and also developed their own technological innovations. Tool finds include hafted flaked stone points on spears (from South Africa) and finely crafted wooden spears found preserved in a coal deposit in Germany—both from about 350–400,000 years ago. There is direct evidence that Archaic Humans had control of fire and used prepared hearths for warmth and cooking.

Perhaps the most well-known Archaic Human is the Neanderthal. Neanderthals are often classified as *Homo sapiens neanderthalensis*, a subspecies of humans. The first Neanderthal was found in a quarry in

Feldhofer Cave in the Neander Valley of Germany. Neanderthals were more robust than modern humans, shorter and stockier, likely an adaptation to living in Pleistocene conditions. Neanderthals are mainly known from Europe and the Middle East from around 300,000 years ago to around 40,000 years ago. Neanderthal colonization of Europe was facilitated by the control of fire. Compared to other hominins, we know a lot about Neanderthals, and have even sequenced their complete genome, the complete set of an organism's DNA (Prufer et al. 2014). Another variety of Archaic human from Siberia, the Denisovans, is known only a finger bone and two teeth and was identified through analysis of DNA.

Neanderthals had large brains, somewhat larger than modern humans. The morphology of the Neanderthal skull is, however, distinct. Instead of the high, domed skull of humans, Neanderthals had long and low brain cases and thick brow ridges. Neanderthal faces were more prognathic (projecting forward), their faces and teeth were larger than modern humans. Early Neanderthals used Acheulian handaxes, but later developed more sophisticated stone tools and techniques. They also very clearly controlled fire as evidenced by the remains of hearths.

An early Neanderthal site is Sima de los Huesos, the "Pit of the Bones", located in northern Spain. This site is important because it is the largest collection of fossil hominins in the world with 28 early Neanderthals represented in the collection (Calloway 2016). At 400,000 years old, it is also the oldest fossil site for which we have hominin DNA (Meyer et al. 2016). The site is literally a pit inside a cave, and excavators must rappel down to access it. Sima de los Huesos is also important because some argue that the deposition of the people in the pit was intentional and perhaps even ritual in nature, a definite sign of modern human behavior. A single Acheulean handaxe, dubbed "Excalibur", was also found among the skeletal elements. As discussed in Chapter 2, ritual behavior is not common in any species besides humans. Paleoanthropologists are interested in looking for traits that are quintessentially human, (like ritual, large-scale cooperation, language and other symbol systems) in order to investigate when humans became ourselves, behaviorally speaking. Others argue that the skeletons at Sima de los Huesos were washed in naturally. The debate over natural deposition versus intentional is a common thread in paleoanthropology and continues to be a source of debate.

A 2015 find is even more mysterious that Sima de los Huesos—Rising Star Cave in South Africa (Berger et al. 2015). Paleoanthropologist Lee Berger put the call out through social media for small paleoanthropologists for an hominin excavation. The six women who signed on had to pass through a 7-inch wide opening to access the finds. The research resulted in the recovery of more than 1,000 hominin fossils and at least 12 individuals—the largest collection of a single species of hominin in Africa. The skeletal elements are human-like in many respects and more primitive in others. Most notably *Homo naledi*, as the species has been called, had a very small braincase. The braincase and postcranial skeleton are more akin to *Homo erectus* and even earlier fossils.

In 2017, another chamber was discovered with three more *Homo naledi* individuals (Hawks et al. 2017). Because the chambers are so difficult to access even today with modern equipment and lighting, the researchers suggested that the deposition might be ritual in nature. Given the tininess of the brain of

Homo naledi, others are skeptical. At first, the date of the site was unknown, but in May 2017, the researchers published the surprisingly late dates of between 200,000 and 300,000 years using multiple dating techniques (Dirks et al. 2017).

The other significant aspect of the *Homo naledi* find was how it was brought to the public. Hominin finds are so rare, that often the public doesn't hear about them until years later, and the researchers do not share the fossils with others until their own analysis is completed. With the *Homo naledi* find, the excavation was "live-tweeted" on Twitter and the analysis published in an open-source journal called *eLife*. In addition, 3D models of *Homo naledi* are available for free download. As anthropologist Kristina Killgrove explains how unusual this is, "In the past, fellow researchers and teachers would have to wait multiple years—and pay hundreds of dollars—to get a cast of the new fossil" (Killgrove 2015). Berger and his team ushered in a new era of accessibility by making the *Homo naledi* find and all of its data accessible to researchers and the public.

Homo naledi is an important recent find. "Fossil discovery announcement, 10 Sept 2015" by GovernmentZA is licensed under CC BY-ND 2.0

We know, for instance, that Neanderthals buried their dead. At Shanidar Cave in the Zagros Mountains of Iraq there are 10 Neanderthal burials in a cave. While there are no grave goods accompanying the dead, the skeletons are fully articulated, or put together. If the dead were not buried, we would expect

scavengers to take away skeletal elements, such that only fragments would be left behind. In other cases, like La Ferrassie in France, the bodies of Neanderthals are oriented east to west and head-to-head suggesting intentional burial. Like Sima de los Huesos, Neanderthal burial is suggestive of behavior that is like that of modern humans, and different from what we see in chimpanzees.

Humans regularly care for others who are injured, sick, or elderly. Sometimes we even support others we don't know through charities like GoFund Me. Another intensely social species does this as well–ants. Matabele ants (*Megaponera analis*), will drag their injured back to the nest where their wounds are licked by "nurse ants." Ants who are treated in this manner have a 90percent survival rate (Fox-Skelly 2018). There is evidence that Neanderthals did the same. Shanidar Cave and other Neanderthals sites have skeletons of older and infirm people—some with evidence of trauma, blindness, and toothlessness. It is thought that Neanderthals cared for others that could not have easily cared for themselves based on the healing of bone injuries. Care for the injured and infirm suggests human-like compassion. That said, in some human forager groups, older people are abandoned or even killed outright. In other traditional societies they are highly valued, and having grandparents in linked to higher survival rates for children. Jared diamond describes Papua New Guineans that chew up food so that older, toothless elders are able to eat (Diamond 2013). In contrast, some have written about how elderly people have been abandoned in the wake COVID-19, much like some traditional societies abandon their elderly. At Standing Rock in North Dakota, the loss of elders to COVID has been likened to a "cultural book burning." As one tribal member put it, ""It takes your breath away. The amount of knowledge they held, and connection to our past" (Healy 2021).

There is another side of the coin, however. At the site of Krapina in Croatia (and other sites), there are Neanderthals bones that clear signs of stone tool cut marks—what look like butcher marks. We of course don't know the exact circumstances behind these finds, but all the evidence points to Neanderthals cannibalizing other Neanderthals. But humans also practice cannibalism with regularly and often for ritual purposes. For the Yanomami of Brazil, the soul can only rest after death if it burned and then consumed (Ukiwe 2018).

Jared Diamond: Lessons from Hunter-Gatherers | NatGeo Live

Genetic analysis indicates Neanderthals did not evolve into anatomically modern humans (AMHs). Some previous hominin, perhaps *Homo heidelbergensis*, evolved into modern humans in Africa. From there, modern humans spread out of Africa and lived at the same time as Neanderthals. Genetic analysis indicates that some modern people have distinct Neanderthal SNPs. This likely means that early modern humans interbred with Neanderthals, and some modern people still carry this Neanderthal legacy. If you have non-sub-Saharan ancestry, then you likely have some Neanderthal SNPs too. I know I do.

Fur, Fire, Sweat

We have compared and contrasted humans with other animals in a previous chapter. A question that paleoanthropologists ask is “How old are these traits?” and “How did they come about?” For instance, paleoanthropologists are interested in when complex tool-making and hunting began, when and why big brains arose, when hominins began to use fire and when we lost our body hair.

Hunted Foods as an Important Resource

Hunter-gatherers known from the recent historical record clearly depend heavily on hunted foods—meat—for sustenance. Is this pattern a defining feature of hominins from the very beginning, or did it develop relatively recently, for example with the appearance of anatomically modern humans? This has been the subject of heated debate among archaeologists and paleoanthropologists. One reason the debate is so important is that hunting is seen as a key factor that makes us human.

No other primate relies significantly on hunting for subsistence. Chimpanzees, the ape most closely related to humans, hunt, kill, and eat small animals—red colobus monkeys are their preferred prey—but meat makes up at most 3% of their diet in terms of caloric intake. What chimps eat the most is ripe fruit—in some parts of their range, over 50% of chimps' caloric intake comes from ripe figs. In contrast, among modern hunter-gatherers, hunted foods take up between 40% and 60% of the diet on average depending on the environment. In Arctic environments, meat and fish can take up nearly 100% of the total diet—there are literally no plant foods to collect and eat during most times of the year in the Arctic.

Based on stone tool cut marks on animal bone, *Homo habilis* appears to have been a scavenger of meat some 2 million years ago. The earliest evidence for direct hunting, as opposed to scavenging, comes from the site of Schöningen in Germany (Kouwenhoven 1997). Here there are 400,000-year-old remains of fore-hardened wooden spears alongside butchered horses. So, we know that the pattern of heavy reliance on hunting has deep roots going back hundred of thousands of years. The spears represent not only sophisticated projectile technology, but also very likely cooperation and coordination among a group of hominins for a common purpose.

In addition, hunting had affects on hominin biology, especially the brain. Meat, especially cooked meat, could have helped to fund the energy-expensive human brain. Big brains also come with a big price tag. Big brains require a surprising amount of energy, up to 20% of the human energy intake and more for developing infants. Meat fats provide a concentrated sources of calories, which can be used to fund the cost of brain growth. Gorillas, who are mainly vegans, cannot even get enough calories from their diet to grow a bigger brain. As anthropologist Greg Downey puts it, there just aren't enough hours in the day for a gorilla to grow a bigger brain. Evidence for scavenging and hunting in the paleoanthropological record is of interest to paleontologists because it points toward the human pattern of increased energy input to offset brain growth. Another important source of energy for early hominins is fire.

Fire and Cooking Made Us Human

Today, we humans are totally reliant on fire and every culture cooks food. Fire is basically a chemical reaction between carbon (like charcoal) or carbon-containing materials (like wood or grass) and oxygen; the reaction releases heat and light that can be used by human in virtually every life-sustaining activity we engage in. Fire also releases carbon dioxide, a greenhouse gas. It can be thought as the first step in

our ability to alter the environment on a global scale. The early discovery of the control and use of fire is probably at the top of anyone's list of crucial developments that made us what we are. Fire was a new and powerful means of harnessing energy from the environment, and can be considered a kind of tool. Anthropologist James C. Scott puts it this way in his book *Against the Grain*; In the lower *Homo erectus* levels, there is evidence that big cats were preying on hominins. In the upper levels where there is evidence for fire, the pattern gets reversed. Fire, he argues, enabled hominins to become predator rather than prey. Scott thinks of it as being domesticated, in the sense of being tamed.

Although the advantages of fire use seem obvious to us now, the question of what fire actually did for its earliest users—what were its specific adaptive advantages—is an interesting one. On the first pass, most people would point to warmth and protection from predators as likely benefits of fire for early humans, and there is little doubt that this was the case. Fire also would have allowed hunter-gatherers to intensify, get more food out of an area of land, by hunting with fire and increasing productivity of the landscape by burning. Fire might also have allowed humans to colonize new areas by using fire to make them more productive, as well as providing safety from new potential predators.

In his book *Catching Fire* (2009), Harvard anthropologist Richard Wrangham argues that the use of fire for cooking food in order to make it more digestible was a turning point in the development of the modern human brain, physique, and way of life. Fire, in a sense, is a way of "outsourcing" your teeth and gut, by doing the work of digestion literally outside your body. The chimpanzee gut by comparison is about three times the size of a human's, and the chimp has to expend more energy digesting food. In effect, cooking allowed hominins to eat far less food and to eat a wider range of foods. Cooking food, Wrangham points out that cooking increases the proportion of nutrients digested and reduces the energetic costs associated with digestion. This extra energy could be put toward a new project—building a larger brain. Other primates, like gorillas, simply can't get enough energy from their environment to channel toward building a larger brain. There's not enough hours in the day to eat enough leaves to support the body and have some leftover for funding the brain. Fire and cooking, Wrangham argues, allowed hominins to break through that energy barrier and fund the high cost of an expanding brain. Wrangham further points out that humans do not thrive on raw food diets, and non-essential functions like reproduction shut down on strict raw food diets.

Hominins had fire before totally modern humans came on the scene. The earliest evidence for the use of fire by hominins appears to be at Koobi Fora, a site in northern Kenya associated with *Homo ergaster/erectus*. Here, baked, reddened earth and charcoal particles are found next to stone tools lying on a buried surface dating to about 1.6 million years ago. Burnt bones of savanna grazing animals are found in association with Oldowan tools and fossils of *Homo ergaster/erectus* at a site in South Africa called Swartkrans Cave. Both of these contexts are considered to be fairly compelling evidence for the use of fire by *Homo erectus*, although there are still some debate over whether the fires could have been caused naturally. It can be difficult to distinguish intentional fires from natural ones, especially early on in the record (King 2017). It is also hard to know whether people produced the fire or whether they acquired from a natural one. Wrangham is cautious about the early dates for fire, although his

hypothesis about the importance of cooking in human evolution would seem to require that the control of fire should appeared at about the same time as hunting.

Aside from warmth, protection, a tool for getting food, and a way increase energy intake, fire likely brought people together. Hunter-gatherers often congregate around fires to eat together and tell stories. And often fore has a spiritual aspect. Among the Eveny reindeer herders of Siberia it is common practice to offer vodka to the fire when entering a new camp. This practice is called “feeding the fire”. As an older Eveny woman put it, “The fire is the foundation of life, we feed. we warm ourselves, we’re nourished with its help.” (Vitebsky 2005:86)

Sweating in Out

Sophisticated tools, big brains, fire, and bipedalism are all fairly obvious features of humans that can be traced back in the paleoanthropological record. Somewhat less obvious is another feature of humans that stands out among primates and that is our “furlessness” and our “sweatiness”. Humans are the sweatiest of all the primates, which enables us to stay cool in very hot environments. Our sweat glands are also more watery, a better cooling system than that of other mammals. Most mammals cool themselves not by sweating but by panting, losing heat through their wet tongues and lungs. With our dense and watery sweat glands, humans can cool off more effectively and have greater endurance in mid-day heat than other mammals. This is especially important because of our large brains. As skin cancer specialist Sharad Paul (2016) points out, just like computers, “larger brains need larger cooling systems.” With enough persistence, a human hunter can literally run a grazing animal like a deer or antelope to death in mid-day heat, thanks to our sweatiness. But of course, most foragers rely on subtler methods, like poisoned darts.

According the anthropologist Nina Jablonski (2010), our dense watery sweat glands was an essential adaptation to the more open savanna/woodland environment in Africa that *Homo erectus* occupied. Like modern humans, *Homo erectus* would have avoided confrontations with predators by hunting and scavenging during the heat of the day when lions and leopards are asleep under the trees. In order to effectively cool off, an increased ability to “sweat it out” was selected for.

The selection for sweat glands came with another related adaptation, our lack of fur. A thick coat of body hair or fur reduces the cooling effects of sweating, and thus to be effective, sweat glands do better on naked skin. Jablonski argues that furlessness is a response to the need for sweat glands. Humans babies do have a covering of fur called languno in utero, but lose it shortly before before birth, and we are born naked and furless.

The final consequence of our water sweat and furlessness is skin color. Chimpanzees, beneath their fur, have light skin, not needing further protection from the sun’s damaging UV rays. But if you are furless, protection is needed. Jablonski argues that the loss of fur precipitated another adaptation—the selection of darker skin to protect against damage to skin by ultraviolet light and loss of folate, which can lead to birth defects. In effect, the shift to a more open environment created a cascade of consequences,

sweatiness, furlessness, and increased pigmentation.

Anatomically Modern Humans

Anatomically Modern Humans (AMH's) are morphologically distinct from previous Archaic Homo sapiens and Homo erectus forms. AMH's average cranial capacity is slightly smaller, the brow ridge is reduced, and the faces are smaller. AMHs have a more gracile (less robust) cranial and postcranial skeleton. The modern human skull has a high vertical forehead and the face is situated below the frontal braincase (less prognathic). Anatomically modern humans likely arose from some form of Archaic human living in Africa, though we don't know which one.

Anatomically modern humans (that is, people who look like us) likely arose in Africa between 200,000 and 300,000 years ago. This is indicated by the fossil evidence and genetic evidence. First, some of the earliest AMH fossils are found in Africa at the sites of Omo and Herto, and more recently at 300,000 years old the site of Jebel Irhoud in Morocco. Secondly, genetic anthropologists have looked at DNA from people around the world in order to investigate where early ancestors originated. But the geneticists did not focus on nuclear DNA, the DNA we usually talk about that we inherit from our mother and father. Rather, they looked at mitochondrial DNA. Mitochondrial DNA (mtDNA) resides in the mitochondria of cells. Mitochondria help cells to use oxygen and produce energy. Cells that require a lot of energy, like muscles cells, have many mitochondria. Because there are multiple mitochondria in each cell, there tends to be many more copies of mtDNA than nuclear DNA, making it ideal for studying ancient genetic variation.

Unlike nuclear DNA with its 3 billion nucleotide bases, mitochondrial DNA has only 16,500 bases, so it is much smaller. Like bacterial DNA, mitochondria has a circular chromosome. Also, in contrast to nuclear DNA which is derived from the mother and father, mitochondrial DNA is only inherited through the mother. So you, whether male or female or non-binary, have your mother's mitochondrial DNA. Another difference is that mitochondrial DNA is not as good as nuclear DNA at checking for mistakes when cells divide. For this reason, mitochondrial has 20 times the mutation rate as nuclear DNA.

Because of these frequent mutations and simple inheritance, we can look at mitochondrial DNA and tease apart ancestry. If living people have identical mutations, then it is very likely they are related through their mothers. By the same logic, mitochondrial DNA can be used to connect living people to people from the distant past. Scientists also use what is called a molecular clock (Alex and Moorjani 2017). First, the number of mutations that arise in a single generation are calculated. Then, if you compare two people you can estimate the time elapsed since they shared a common ancestor by counting the differences.

Syrian Hamsters to the Rescue!

One early concern in linking modern people to past people through mtDNA, was that the mutation rate of mtDNA might be too fast, and therefore too messy to be of any use. Surprisingly, it was shown through domesticated Syrian hamsters that the mutation rate was not too fast. It turns out that all domesticated Syrian hamsters are descended from a single female hamster collected from Aleppo in the 1930s. If the mutation rate was very fast then it would expected that the mtDNA of domesticated hamsters would vary a lot, and it would not very useful for sorting out ancestry. After analyzing the mitochondrial DNA from feces from widely distributed domesticated Syrian hamsters (yes, they collected hamster poo through the mail), they found the DNA was identical! Since Syrian hamsters have been domesticated only since 1938, the researchers knew the mutation rate wasn't too fast and could potentially be used to determine ancestry.

Domesticated Syrian hamsters are descended from a single maternal ancestor as demonstrated by the mtDNA. "Leonard" by Sweet-Rainb0w is licensed under CC BY-NC-ND 2.0

A Revolution in Ancient Genetics

One of the first applications of the idea of connecting modern people with people living in the past comes from the Romanovs, the Imperial Russian family. The Romanovs—the tsar, tsarina, and their five children— were murdered on July 16, 1918 by the Bolsheviks. Following the Revolution, the location of the remains of the Romanovs was a mystery. In 1991, in the Russian Ural Mountains, skeletons fitting the description of the Romanovs came to light. But was it them? Researchers tracked down living descendants of the tsar and tsarina, and compared the SNPs of their mtDNA to the tsar and tsarina SNPs. Both were matches. The fact that both the tsar and tsarina's mtDNA matched modern relative's mtDNA, along with the other material evidence, meant this was a closed case; the mystery of the Romanovs had been solved through the help of mtDNA. (Incidentally, Tsarina Alexandra was the grandchild of Queen Victoria, who spread a SNP for haemophilia to the tsarina and her son Alexei). Mitochondrial DNA also helped solved the case of Richard III, who was buried in an unknown location. Richard had scoliosis, so when a body with scoliosis was found beneath a parking lot in Leicester, England in 2012, in a plausible location for Richard's burial, the body's mitochondrial DNA was compared to known a descendant of Richard. They were a perfect match (King et al. 2014).

The bodies of the Romanov family were identified through mitochondrial DNA. Public domain.

Out of Africa

Analysis of mtDNA can be used to investigate broader patterns of human migration. The region with the greatest mtDNA variation is likely the place where humans originated, based on the idea of increased time for new SNPs to develop in the mother population. In other regions, we should see SNPs that are derived from the original mother population, based on the Founder Effect. When mtDNA was analyzed from people around the world, the region that had the most variation was Africa. Biologist Lewis Spurgin (2013) explains why this is important:

"Travelling across unknown lands is a dangerous business, so we would expect ancient humans to avoid travelling a long way except when they needed to, and they probably didn't travel en masse. Instead, when humans colonised new lands, it was probably a few intrepid explorers looking for new pastures. And the DNA evidence bears this out. Across the world, we see 'bottlenecks' at the genetic level — signatures where a small group of individuals, carrying a relatively small number of genetic variants, have set up new colonies. This is the key to understanding why the most genetically diverse human population can be found in Africa, while the populations of further migrations are descended from a much smaller stock of brave (or desperate) migrants."

Both the fossil evidence and the mtDNA evidence point to Africa as the origin of modern humans. From there, humans spread to other parts of the world encountering Neanderthals, Denisovans and likely other Archaic Humans. It is not known why no archaic humans are left to tell their side of the story. Did modern humans wage war with them? Did they out-compete them? We currently don't know why we are the only representative of the genus.

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Chapter 10: Portals to the Past

"Cueva de las Manos, Argentina" by Lisa Weichel,is licensed under CC BY 2.0

Archaeology is only partly about discovering things; for me, archaeology is about thinking about things. —Stephen Lekson

aking a noon-day break from excavating on Albuquerque's windswept

T West Mesa in the summer of 2002, we stretched our legs, cramped from kneeling in a small square pit since 6 am that morning. Someone started a game of hacky sack. Reaching down to retrieve the hack, I saw something black and shiny in the sand. “Gotta be cultural”, I thought. The crew gathered around. We hadn’t found much despite two straight weeks of digging. Looking closely at the obsidian object, we soon realized that I held in my hand an obsidian Folsom point fragment, a kind of spear tip. The person who last touched the point lived more than 10,000 years ago, at the close of the last ice age. The artifact and its maker belonged to a different geological epoch—the Pleistocene—also known as the ice ages. Ultimately, our excavation would show that a small band of people was hunting a species of giant bison at the edge of a small lake. The point, along with other artifacts recovered at the site was a portal to the past. Within 10 years, the area would be transformed into a modern neighborhood.

Excavation of the Boca Wash Folsom Site, West Mesa, Albuquerque, Photo: Bruce Huckell

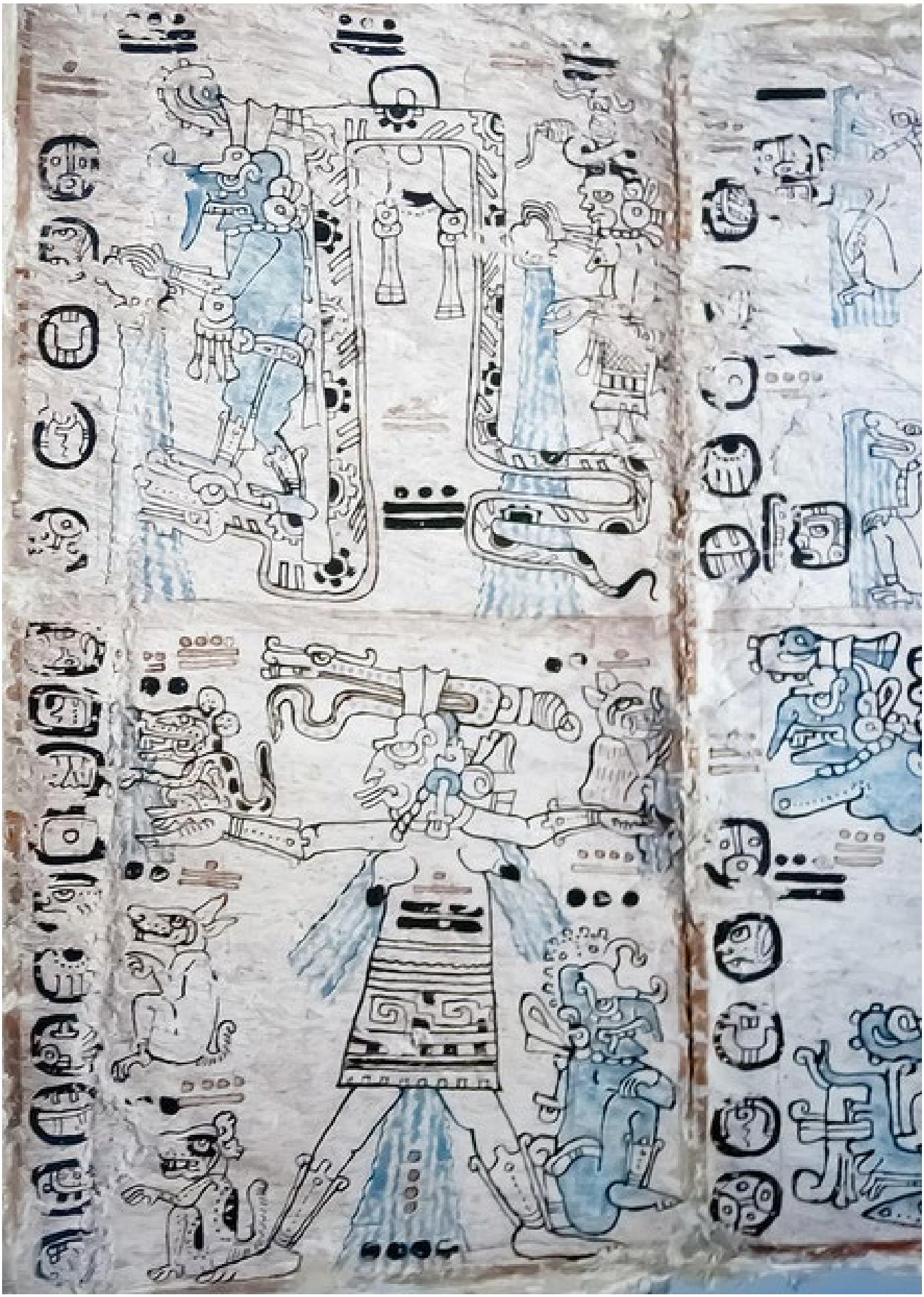
One of the deepest of human fantasies is to travel in time to the distant future or the remote past. While we can’t blast back in time through a wormhole or in a DeLorean, we can go anywhere in our minds. This mental time travel may not be unique to humans, but certainly, no other animal is obsessed with the past and future like we are. As “storytelling animals”, we are enchanted by tales of galactic wars of long ago or a future planet ruled by apes. We marvel that because light takes time to travel to our eyes when we gaze up at the stars we may be looking thousands of years into the past. And it’s not just a modern obsession. The ancient Maya, fanatics for calendars and time, inscribed dates well into the 5th millennium A.D. Archaeology is an important sub-field of anthropology. If anthropology only looked at contemporary cultures, we would miss out on a great deal of cultural variability, just as if we only examined WEIRD cultures.

Archaeology asks: Who were these ancient people, what were their lives like, and how have they shaped who we are today?

Portals to the Past: Writing and Material Culture

Short of a time machine, one way to know the past is to read what people have put down in writing. Traditionally, the term "history" has been reserved for the last bit of human existence in a few selected parts of the world where writing developed—Western Europe, the Middle East, China, India, and Mesoamerica. Writing is powerful stuff. The ancient Maya revered the writings of their ancestors and thought that reading ancient texts literally brought their ancestors back to this plane of existence. The venerable astronomer Carl Sagan wrote of the magical quality of books in *Cosmos*, "One glance at it and you hear the voice of another person, perhaps someone dead for thousands of years. Across the millennia, the author is speaking, clearly and silently, inside your head, directly to you. Writing is perhaps the greatest of human inventions, binding together people, citizens of distant epochs, who never knew one another. Books break the shackles of time—proof that humans can work magic."

Writing is a relatively recent invention dating back some 5,000 years, and as the burning(s) of the great Royal Library of Alexandria in Egypt attests to a fragile medium. Where written records do not exist, sometimes referred to as prehistory, archaeologists must rely on material culture, physical things that people leave behind.



Maya Dresden Codex, an early Maya text. Flickr, Creative Commons

It is no doubt enriching to read documents written by people who were Cultureliving in the distant past, and there will always be some kinds of information that can only be conveyed by written documents (or film and sound recordings). While writing is an amazing window into the minds of the long-dead, material culture has some advantages over documents. Archaeologists have an old saying: "potsherds don't lie". People, on the other hand, are another matter entirely. As anthropologist Roy Rappaport once pointed out, "Any system of communication that employs symbols can also embody lies." In short, writers always have an agenda—some kind of bias or view of the world that colors their perspective.

Material culture can be quite revealing. In studies of modern refuse, it has been shown that people underestimate the amount of junk food they consume and grossly overestimate how much they recycle. My master's thesis advisor, Ed Staski at NMSU, compared people's reported alcohol consumption to what was in their garbage, and found, not surprisingly, that people make inaccurate estimates about how much they drink. Needless to say, if we relied on what

people reported alone, we'd have a skewed understanding of current and past human behavior. Archaeologists don't study the past, rather, they study the physical remains of the past to understand what happened and why.

Fresh Kills landfill on Staten Island, 1980. Public domain.

Archaeological Methods

Archaeology draws heavily on other sciences including biology, genetics, organic and inorganic chemistry, and physics. These applications of scientific techniques are collectively called archaeological science. An example of archaeological science was recently conducted by archaeologist Patty Crown at the University of New Mexico. Along with Jeffrey Hurst of the Hershey Corporation, Crown discovered the chemical signature for cacao in ancient cylindrical vessels at Chaco Canyon, New Mexico. Not only does this research show that liquid chocolate was in the pots, but given that cacao grows nowhere near New Mexico today, archaeologists can develop and test further questions of trade and exchange between the American Southwest and Mesoamerica to

the south more than 1,000 years ago.

Another approach that archaeologists have used to gain insight into past behavior and to test hypotheses is experimental archaeology. Experimental archaeology uses modern-day re-creations to gain insight into the past. For example, archaeologist Bruce Huckell at UNM wanted to know if a certain type of stone spear point could penetrate the hide of a mammoth. When an elephant at the local zoo died, the body was donated. Huckell showed through experimentation that replicated stone points could penetrate the skin of an animal with the approximate skin thickness of a mammoth.

CNM Students learn the basics of stone tool manufacture. Photo: Sue Ruth

Less dramatic are stone tool replications designed to understand the techniques used to produce stone tools. In my face-to-face courses, I often invite Ron

Fields, an archaeologist at the Salinas Pueblo Missions National Monument and expert in stone tools, to show students the basics of making stone tools, also known as flint knapping. Other experiments are conducted on an even more massive scale like this backyard Stonehenge.

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Chapter 11: Human Revolution

The Human Revolution

In the previous chapters, we have discussed human features that appear in the paleoanthropological record: bipedalism, big brains, hunting, stone-tool making, fire and cooking, and even the rise of sweat glands and furlessness. We now turn to the question of when and where other humans features first appeared—storytelling, music, bodily decoration, and belief in the supernatural. That is, when, where, and why did we become truly human?

Anatomically modern humans (AMH's) appear in the fossil record around 200,000 years ago in Africa. Evidence for the full spectrum of human behavior, however, doesn't appear in the record until around 40,000 years ago. The shift to modern human behavior, with our interest in art, ritual, games, stories, music, language, and symbolic thought, is sometimes called the Human Revolution, the emergence of the modern human mind. The lag between physical modernity and cognitive modernity is likely due in part to problems of preservation and the sparseness of early human populations. Thus, the emergence of the modern human mind probably occurred long before we see it in the archaeological record.

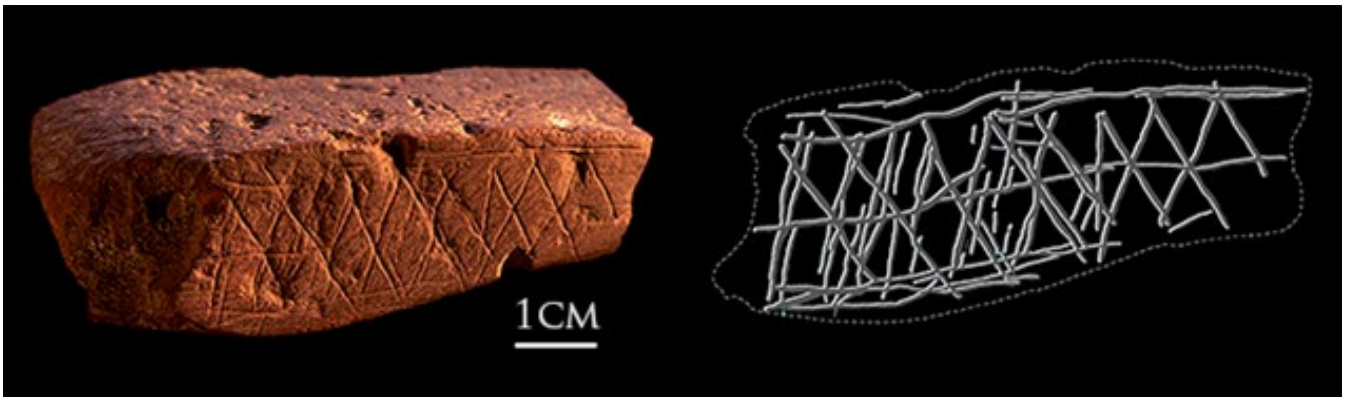
The Upper Paleolithic

All people living in the Pleistocene (2.8 mya —12 kya), the last ice ages, were hunter-gatherers, living off wild non-domesticated foods. No one was farming or herding in the Pleistocene. While the philosopher Hobbes characterized the

hunter-gatherer lifestyle (man in a state of nature) as “poor, nasty, brutish, and short”, life during the Pleistocene may have been one of relative abundance and health, especially compared with some later farming communities. They may have been the *original*, original affluent society.

The very earliest glimmers of modern human behavior and thought occur in Africa. Fittingly, one of the earliest pieces of evidence of a modern human mind is a kind of crayon. The decorated block of red ocher, a mineral pigment, was discovered at Blombos Cave in South Africa and dates to 75,000 years ago. More recently, abalone shells filled with red ocher have been found at Blombos dating to ca. 100,000 years ago—perhaps the remains of an early artist’s palette. People were likely painting, scarring, and tattooing their bodies long before we find evidence for it in the archaeological record given the vagaries of preservation.

While the earliest examples of modern behavior occur in Africa, some of the most spectacular preservation of early modern humans occurs during an archaeological time period called the Upper Paleolithic (ca. 40 kya-12 kya), or Upper Old Stone Age, in Europe. (Note that the Upper Paleolithic describes a human time period, whereas the Pleistocene describes a geological one). The reasons for this are several. First, modern archaeology was born in Europe in the 18th and 19th centuries. Europe was where the archaeologists were and they studied sites in that region because they were available. Secondly, there are numerous caves and rock shelters (rocky overhangs) in Europe; these are perfect containers to protect and preserve archaeological remains. Finally, environmentally, the European subcontinent was in a climate zone during the last ice age that supported vast herds of grazing animals. These animals in turn supported a relatively dense population of humans, who in turn left a plentiful archaeological record.



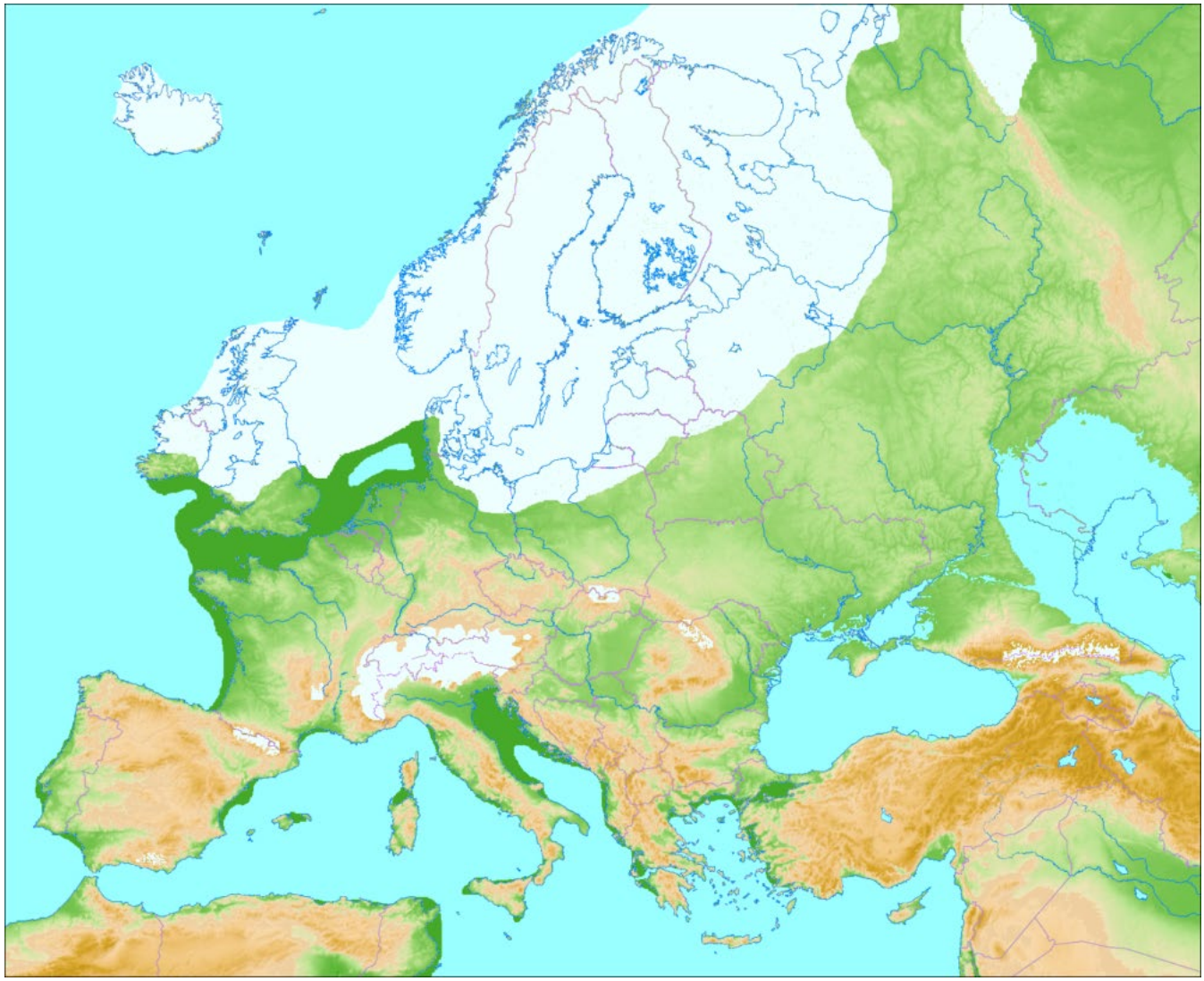
"Red ocher crayon from Blombos Cave, South Africa" by Chris. S. Henshilwood is licensed under CC BY-SA 3.0

Several innovations become apparent in the Upper Paleolithic archaeological record that indicate the full spectrum of totally modern human mind. These include art, elaborate burial, sewn clothing, jewelry, and ritual. These are the hallmarks of modern behavior. These features indicate that these were people like us, not only in their physical appearance, but intellectually, behaviorally, and emotionally.

Modern humans were living alongside Pleistocene megafauna in Europe and elsewhere.

"Mammoth of BC" by Tyler Ingram is licensed under CC BY NC-ND 2.0

During the Pleistocene, Europe was inhabited by very large animals, or megafauna, including mammoths, woolly rhinos, giant cave bears, bison, along with wild horses, caribou, cattle, and lions. Upper Paleolithic people were hunting some of these animals and were reliant on terrestrial and aquatic animal protein. There is less evidence of plant consumption, though plants were likely a part of the diet as well.



Europe at the height of the last ice age ca. 20,000 B.P. Note that the northern extremes are covered in ice sheets and that Great Britain and Ireland are connected to the mainland. "Weichsel-Würm-Glaciation" by Ulamm is licensed under GNU Free documentation license

Technological Innovations

Neanderthals and even *Homo erectus* had fairly sophisticated tools and were able to hunt and make fire. But with modern humans, there was an explosion of creativity. An innovation that became prevalent in the Upper Paleolithic was the atlatl or spear thrower. This weapon is essentially a stick that propels a long dart. This technology allowed humans to increase the force behind their weaponry as well as get some distance between themselves and their prey. The atlatls of the Upper Paleolithic were sometimes beautifully decorated with Pleistocene megafauna. The atlatl proved to be a useful weapon and its use lasted into the modern age. Spanish conquistadors, for example, encountered Aztecs equipped with obsidian-edged atlatl darts.

While “cave people” are often depicted wearing simple animal skins and furs, needles found on Upper Paleolithic sites indicate that people wore tailored clothing. Having to live and survive in the colder temperatures of the Pleistocene, people were by necessity highly skilled at making clothing from animal skin. Some figurines that date to this time also suggest sewn clothing. A series of burials at Sungir (ca. 28,000 B.P.) in Russia were covered in tens of thousands of mammoth ivory beads, which appear to have been sewn onto garments that did not survive. At other Upper Paleolithic sites dating around 25,000 BP, people were buried wearing necklaces of arctic fox teeth and shells. Like people today, Upper Paleolithic people were concerned about their appearance and very likely used symbolic markings, body decoration, and clothing to differentiate between people of different groups, just as we do today. Julia the chimpanzee may be making a fashion statement with her “grass-in-ear” behavior, but humans take personal adornment to another level.

Art and Music 1101

Einstein said “I often think in music. I live my daydreams in music. I see my life in terms of music.” The instinct to express oneself musically is very old. Early bone and ivory flutes have been found in European caves dating to 30,000 BP.

Recently, a replica of one of these flutes was made, giving us a sense of what these instruments might have sounded like. Considering that these instruments were found in caves, the sound of the flutes would have been amplified by sound waves bouncing off the cave walls. Bullroarers have also been discovered in Upper Paleolithic contexts. These are instruments consisting of a thick piece of shaped wood attached to a cord. When swung in a circle, the bullroarer makes a haunting sound that can travel long distances. Historically bullroarers have been used around the world—in Australia, Ireland, North America, and elsewhere—for ceremonies and entertainment. In traditional societies, music is not just entertainment but tied to ritual. By making music together and dancing, people often develop a sense of collective effervescence and unity.

Upper Paleolithic instrument. "Bone flute dated in the Upper Paleolithic from Geissenklösterle, a German cave on the Swabian region. Replica" by José-Manuel Benito is licensed under CC BY SA 2.5

Cave Art of the Upper Paleolithic

While the first indications of decorative art occur much earlier and there are even a few possible Neanderthal examples (Davidson 2014), representational art appears for the first time in the Upper Paleolithic and equivalent time periods in Asia. In contrast to purely decorative art, representational art

resembles something in the physical world. Caves of southern France and northern Spain contain images of Pleistocene horses, ibex, mammoths, rhinos, lions, bears, and even a great auk.

The most famous of these caves is Lascaux (pronounced Las-CO) in southern France dating to around 17,000 years ago. Like so many archaeological sites, it was not found by archaeologists but by curious teenagers exploring the countryside. With 600 paintings and 1,500 engravings, Lascaux contains the largest collection of ice-age art anywhere. For that reason, and for the delicacy and beauty of the images, it was placed on the United Nations Educational, Scientific, and Cultural Organization (UNESCO) list of World Heritage Sites. These are cultural sites around the world that are considered to have universal value for humanity. New Mexico has two cultural sites and one natural site on the list. Can you name them?

"Scene from Lascaux Cave, France" by William Cromar is licensed under CC BY-NC-SA 2.0.

Another famous Upper Paleolithic site, discovered by a young girl named Maria

de Sautuola, is Altamira in Spain. Though Maria de Sautuola's father argued that the paintings dated to the ice age, the site wasn't accepted by the French archaeological establishment until French Upper Paleolithic cave art was discovered. Archaeology, as it turns out, is political. One of the panels is 45 feet in length. These panels were not one-time paintings, but "touched up" and added to with overlapping images over time. This layering effect is called a palimpsest. The term palimpsest is often used to refer to paper that has been reused, a common practice in Medieval times. Upper Paleolithic artists used the contrast between dark and light pigments (charcoal, ocher, and hematite) to create a sense of three-dimensionality. This effect is called chiaroscuro. The paintings are so surprisingly sophisticated for their time that when the Spanish artist Pablo Picasso looked upon the paintings at Lascaux he remarked, "We have invented nothing."

Both Lascaux and Altamira were opened to the public in the mid-1900s. Tourists, however, increased the temperature of the cave as their exhalations contained both water vapor and carbon dioxide. Carbon dioxide is of course the greenhouse gas that we are all familiar with that traps heat and causes atmospheric temperatures to rise. Trapped inside the cave, these gasses led to a kind of "caval warming", ripe for the growth of mold, algae, and bacteria. Both caves were closed to large numbers of visitors and they have since stabilized. Replicas of parts of both caves called Lascaux II and Altamira II have been created to give tourists a sense of the actual site.

Scene from the Lascaux Museum Exhibition, by Lascaux 184 is licensed under CC BY-NC-SA 2.0

We are so used to electricity that it is easy to forget that these were completely pitch black caves. Lascaux alone contained 150 animal fat lamps that were used to light the interiors of the caves. Remember, control of fire had occurred long before, at least by 350,000 B.P. in Europe by Neanderthals and much earlier elsewhere. The light in the cave would have flickered, perhaps giving the animals a sense of motion. One creative soul has put together overlapping images of Upper Paleolithic art that is much like a cartoon flip book, giving life and motion to these ancient creatures. That is, these images could potentially have acted as early movies, probably accompanied by that quintessentially human compunction—storytelling.

Paintings are not just located on the walls of the caves, but also the ceilings. People would have had to build some kind of scaffolding, much like Michelangelo's work on the Sistine Chapel. Indeed, there are indentations in the walls of the caves that likely held support for the scaffolding.

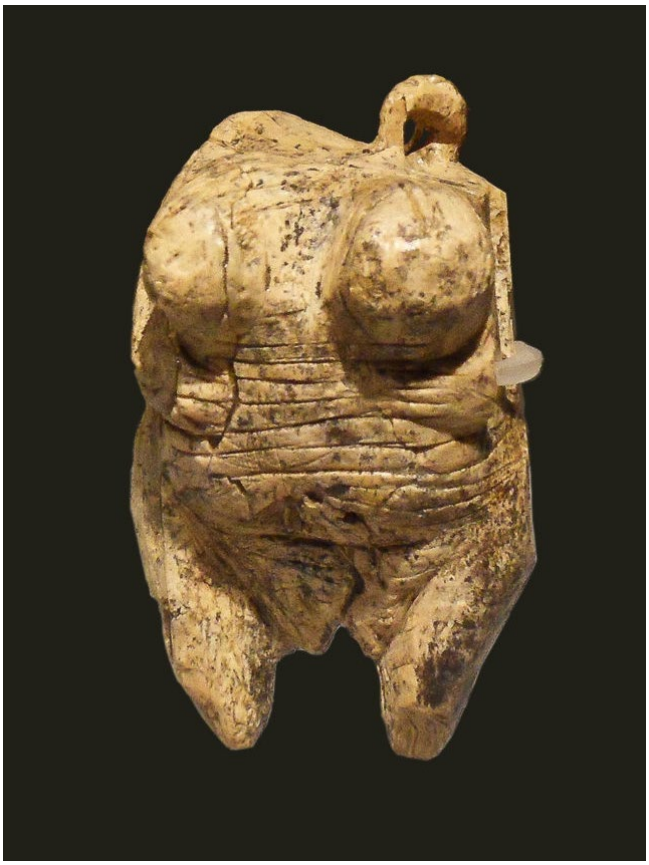
Animal fat lamp from Lascaux by Sémhur is licensed under CC-BY-SA-3.0-2.5-2.0-1.0

Upper Paleolithic cave art sites continue to be discovered as the mouths of some of these caves have been long obscured. Chauvet Cave in France, discovered in 1994 was the subject of Werner Herzog's film Cave of Forgotten Dreams and may be the oldest example of an Upper Paleolithic cave dating to around 35,000 years. The subject matter of the cave is also unusual, depicting dangerous animals like lions, bears, rhinos, and mammoths compared to the predominance of horses at Lascaux. Another cave called Cosquer has its opening beneath the waters of the Mediterranean. As the ice sheets of the Pleistocene melted, ocean levels rose, submerging the once-dry entrance. In the submerged portion of the cave, there are no paintings and only engravings.

Presumably, the paintings have been washed away by rising sea levels. In the portion of the cave that is not submerged, there are paintings of horses, possible jellyfish, and a Great Auk, a species of penguin. Sadly, four divers died when they lost their way in the cave. It was this event that brought the cave to public attention.

Portable Art

In addition to cave art, portable art is abundant. These, of course, qualify as artifacts, being transportable from place to place. Upper Paleolithic artists excelled at depicting animals in all their earthy glory. In one instance, an herbivore (chamois) is either defecating or perhaps giving birth as a bird perches near its behind. Another very famous example of portable art is the lion-man/woman. The artifact combines both human elements (like bipedalism or walking on two legs) and lion elements, embodying the human ability to create new realities.



The earliest dated portable

While portraits, or depictions of actual people, are uncommon, there are about 200 known "Venus figurines" or woman figures (Thurman 2015). (The term Venus figurine is not used in some circles to avoid assuming that the figurines represented goddesses). These are voluptuous female bodies made from clay, ivory, and stone. There is little attention paid to the face, head, and extremities. The interest is in the body—the breasts, buttocks, and belly. Several of these figurines appear to be pregnant with an everted navel. The earliest representational art in Europe is a Venus of Hohle Fels in Germany dated

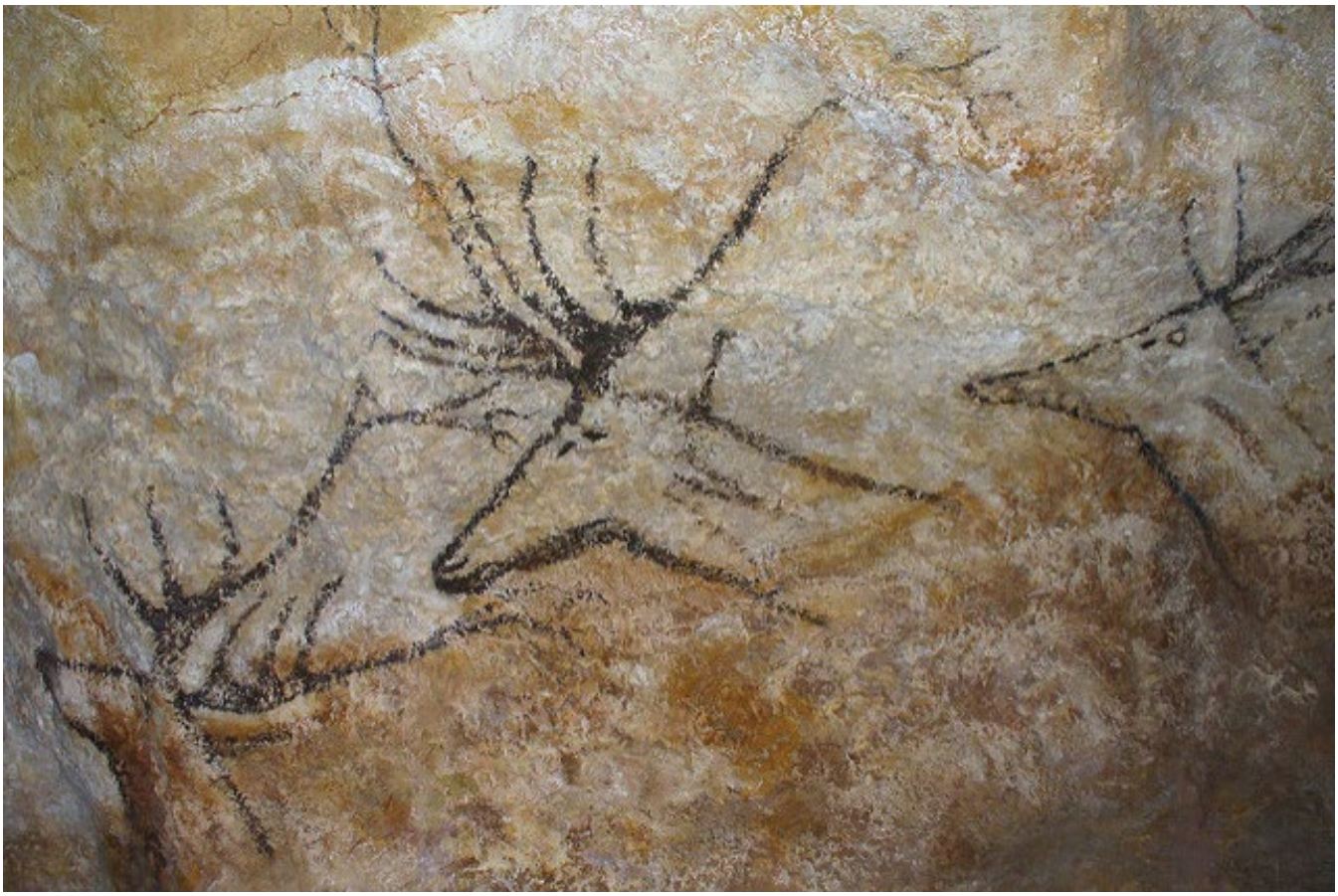
representational art. "Venus of Hohle Fels" by Thilo Parg is licensed under CC BY 3.0

to ca. 35–45 thousand years ago. There are also woman figures in cave art that use the natural topography of the cave to indicate the pregnant belly and vulva.

But what do these figures mean? Some Venus figurines, like the Venus of Hohle Fels, contain traces of red ocher, a red mineral pigment, possibly suggesting a ritual rather than functional nature. Others have suggested that the figurines are an effort to cope with the dangers of childbirth or were a fertility fetish. Still, others suggest they depict an early European goddess. Venus figurines, however, span thousands of years and a wide area from Western Europe to Siberia. Determining the meaning of something that spans that kind of time and space is challenging. We know that symbols in our own culture can change in meaning over just a few generations, so imagine the possible varied meanings Venus figurines might have had over thousands of years.

Meaning of Upper Paleolithic Art

Some types of questions in archaeology are truly difficult to answer even with an abundance of remains. The nature of Upper Paleolithic art is one of them. There are some reasonable ideas though. Many have noticed that the horses at Lascaux are large-bodied and pregnant looking, not unlike Venus figurines, suggesting a concern with fertility or an interest in the origins of life. Several cultures have ideas about humans emerging from caves to this world, and it is possible that Upper Paleolithic people viewed caves in a similar light. In addition to depictions of robust animals, there are also very clear indications of atlatl darts flying towards animals. As mentioned Abbe Henri Breuil argued that these images represent hunting magic, a kind of sympathetic magic where like affects like, in which symbolically killing the animals or imitating the kill helps in the actual hunt.



Other images suggest an abiding interest in seasonal changes in the animal world. One bison appears to be shedding his wool for the summer. Another image at Lascaux shows just the head of caribou, which some have argued looks like annual migrations of caribou as they cross rivers. We know from excavating open-air sites—sites not in cave or rockshelter contexts—that Upper Paleolithic people targeted and killed caribou at vulnerable points along rivers so they would have seen these crossings. In an example of portable art on a long bone, one side of the bone depicts mating European vipers, a spring event, while the other depicts salmon, which run in the spring.

Others have argued that the caves served as a kind of temple to indoctrinate members into the group through a rite of passage. The interiors of caves were not used as living spaces, as the refuse of everyday life does not occur there, lending some support to this idea. The images, it has been argued may have served as mnemonic devices for important stories which convey the values,

symbols, and ancestors of a culture. There is one famous painting in Lascaux that involves a humanoid and a bison that appears to depict a story.

Some Upper Paleolithic cave art may have served as mnemonic devices for storytelling. "Lascaux Caves" by I, Peter80 is licensed under CC BY-SA 3.0

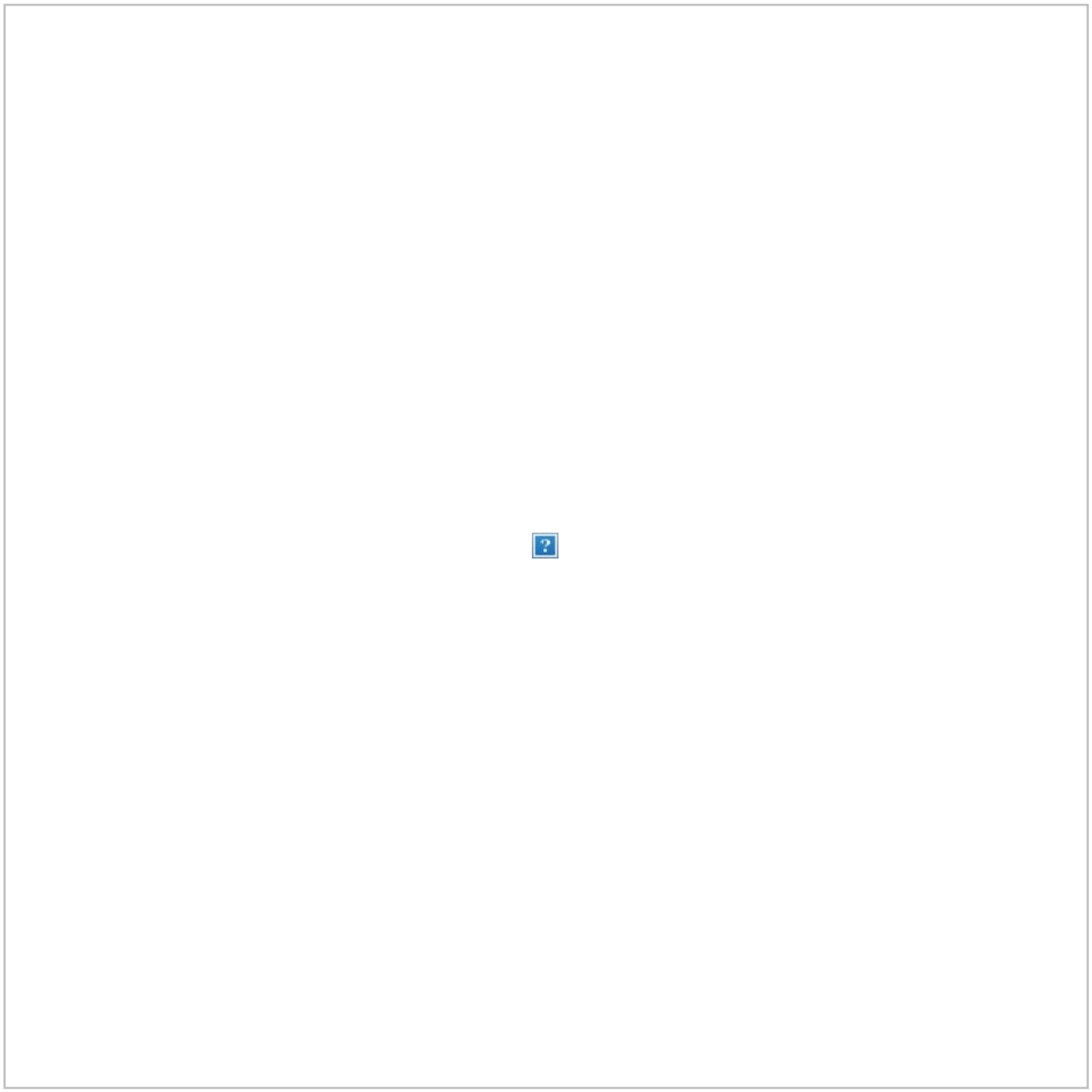
Of course, some of the art might be "art for art's sake". Children love to paint and create for the sheer joy of creating and experimenting. Even chimpanzees have been known to paint in captivity. We know from measurements on finger traces on soft cave walls and footprints on ancient cave floors, that children were in the caves and also decorated the walls along with adults. Humans need to create, represent the world around them, and breathe meaning into symbols in a way that no other animal does. For thousands of years, we humans haven't just lived in the world, we have created it as well.

Elaborate Burial

Another hallmark of the Upper Paleolithic is elaborate burial practices. Before this time, there is little scant or controversial evidence for ritualized burial (Sima de los Huesos and Rising Star). Again, it may be that the record simply hasn't preserved the material traces of ritual burial and that it only becomes evident later as populations become larger and more stable. Neanderthals some 60,000 years ago buried their dead at Shanidar Cave in Iraq, but there are no grave goods, red ocher, or other indications of ritual.

Burial in the Upper Paleolithic becomes a far more elaborate affair. At Sungir, burials include one adult male and two children, who are buried head-to-head. The site dates to ca. 24,000 years ago, and the three burials include more than ten thousand ivory beads, along with mammoth ivory bracelets, beaded caps, decorated belts, ivory pendants, an ivory lance made from a straightened woolly

mammoth tusk, and an animal pedant among other grave goods. Experimental archaeology often tries to replicate ancient technologies to gain insight into how tools were made, how long they took to make, and the types of skills that would have been required. Each bead, based on experimental archaeology, is thought to have taken an hour to make. The burials at Sungir indicate that Upper Paleolithic people were highly skilled artisans. Who among us today would even know where to begin to straighten an elephant tusk?



Adult male burial at Sungir, Russia. "Sunghir-tumba paleolítica". Licensed under Public domain via Wikimedia Commons Photo: José-Manuel Benito Álvarez, own work.

Another set of burials at a site called Dolni Vestonice in what is today the Czech Republic, like Sungir, indicate an interest in ritual and the afterlife. Three young people, two males and perhaps one female were buried together with careful positioning, perhaps a kind of visual story. The men on either side of the central figure both met violent deaths, with one having a wooden pole through his pelvis. His hands were placed on the central figure's pelvis. The male on the right was lying on his stomach. The skeletons were covered in red ocher and fire lit atop the trio. As with the cave art and Venus figurines, several attempts have been made to interpret the meaning of this careful positioning—a birth gone wrong, human sacrifice for wrongdoing, and even evidence for homosexuality (known among some modern hunter-gatherers). Though we cannot say specifically what the burial positioning represents, it suggests an interest in what happens after death and possibly a belief in the afterlife. This behavior shows that Upper Paleolithic people were like us cognitively (mentally) and emotionally, fully capable of pondering the mysteries of life and death and acting on those beliefs with symbolic gestures.

Dog Domestication

Another important event associated with the Upper Paleolithic is dog domestication. Dogs were the first species to be domesticated by humans, plant, or animal. Dogs throughout the ages have provided much for humans including help in hunting, herding, guarding, warmth, food, hauling materials, sacrifices, and companionship. At the ice-age site of Predmosti, Moravia, a dog skull was found with a mammoth bone in its mouth suggesting dog domestication is very ancient. But what is domestication? Domestication has two meanings really, but both are defined with respect to humans. One simply means tame and friendly to humans. But it has a more technical meaning as well. Domestication means that traits are selected for by humans resulting in changes to the genome of an organism. Dogs were domesticated from wolves (*Canis lupus*). Some argue that wolves were kept as pets and the more docile ones bred. Others, like Ray Coppinger, disagree. Coppinger thinks that this manner of domestication was just not feasible for Paleolithic humans. Instead, he thinks more docile and "tame" wolves tended to hang around human settlements. The food these

animals obtained provided them with a selective advantage, thereby allowing them to survive and reproduce at a greater rate than wolves who did not venture near human settlements. Coppinger says that in effect, dogs were self-domesticated. In this regard, dogs both experienced a change in the genome and also became more friendly to humans. Recent research has begun to pinpoint the genes that make dogs so sociable. The genetic area affected also interestingly is affected in people with Williams-Beuren Syndrome. People with this syndrome tend to be indiscriminately friendly.

What Does the Fox Say...About Domestication?

One of the most fascinating studies that reflects on dog domestication is the silver-fox experiment. In 1959, Dmitry Belyaev conducted a study on silver foxes of Siberia who were being bred for their fur. Belyaev bred the docile foxes (1% of the population) with each other, being careful not to inbreed them. After just a few generations, not only did Belyaev have very friendly, even pet-worthy foxes (though they can be unpredictable), but he noticed other morphological changes as well. The fox's ears became floppier, their coats became patchier, their muzzles shortened, their teeth were smaller, their tails wagged, and they began to vocalize and play. In essence, they were retaining juvenile fox physical traits—called neoteny—just by selecting for friendly behavior. Other domesticated animals show similar neotenic, that is juvenile, traits in adulthood.

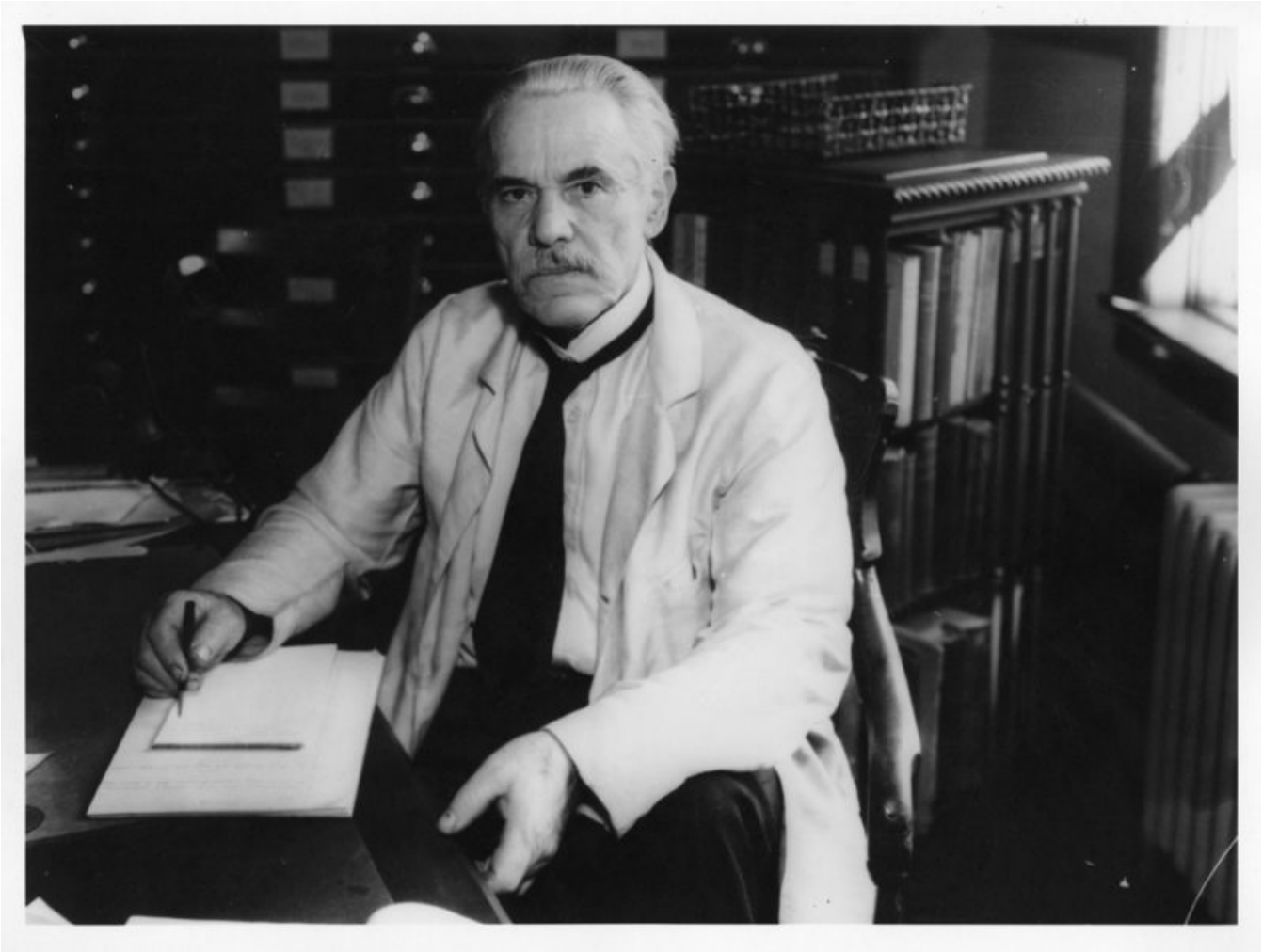
"A Russian domesticated red fox with Georgian White fur color" is licensed under CC BY 3.0

Something similar may have happened in dogs, whether the traits were selected by humans or a result of self-domestication. That is, dogs are essentially wolves that retain juvenile characteristics. Why are dogs so important to discuss in an anthropology class? Anthropologist Pat Shipman (2015) has argued that we humans owe dogs a lot. She proposes that it was dog domestication that allowed us to out-compete Archaic Humans like Neanderthals, who had complex tools, fire, and hunting prowess. What they lacked, she argues, was early dogs, "wolf dogs" as she calls them. Aside from companionship, dogs provide warmth, and protection, can haul items, help humans hunt, and in a pinch, can be eaten. Dogs would especially have been useful for hunting. Anthropologist Richard Lee noted that among the Bushmen, the man who owned a pack of dogs brought in 75 percent of the meat. Shipman describes humans (and their wolf dogs) as an invasive species, eventually out-competing the Archaics.

Not only do dogs provide a window into the success of early modern humans, but they might just be the key to understanding humans in a more general sense. Some scholars argue that humans, like dogs, self-domesticated. In effect, there was a selective advantage to neoteny in humans, retaining juvenile traits. Some think that it is our playful nature, our child-like curiosity that won the day over Archaic humans.

The Earliest New Mexicans

We know that people occupied Africa, the Middle East, Australia, and Asia during the Pleistocene. But what of the Western Hemisphere, the New World—a.k.a. the Americas? Were people here during the Pleistocene, or were the Americas empty continents? New Mexico, as it turns out, is famous for its pivotal role in answering this question. Influential osteologist Aleš Hrdlička was certain that people had only been in the Americas for a few thousand years. This issue, like so many in archaeology, was not purely academic. North American natives were depicted as relative newcomers to the Americas who cast out a former glorious “race”, who had built the earthen monuments that archaeologists encountered. You can see how this view of the recent peopling of the New World might fit nicely with the drive to colonize the American West.



Aleš Hrdlička. Public domain, via Wikimedia Commons

The site that changed the face of American archaeology and ran directly counter to Hrdlička's ideas is called the Folsom site of northeastern New Mexico. Like so many significant archaeological discoveries, the Folsom site was found not by an archaeologist, but by the keen eye of former slave turned cowboy, George McJunkin. Searching for lost cattle following a devastating flood near the town of Folsom in 1906, he discovered some odd-looking "cow" bones. These turned out to be a fossilized and extinct form of bison called *Bison antiquus* that lived during the Pleistocene. Later, in the 1920s, excavation revealed humanly made dart points in direct association with the bison. Using the Principle of Association, it became clear that people were indeed in the Americas during the Pleistocene. The Principle of Association is that objects in the same soil layer date to the same time period. The Principle of Superposition means that older layers are at the bottom and younger ones are at the top. Other Folsom-aged sites were subsequently discovered, and Hrdlicka goes down in history as being

completely wrong.

Bison antiquus was much larger than modern bison.Bison antiquus p1350717.jpg by David Monniaux CC-BY-SA-2.5

The Paleoindian Period

If you visit the New Mexico Museum of Natural History in Albuquerque, you can see a reconstruction of a Colombian mammoth, a camel, a saber cat, and dire wolves—Pleistocene mammals that were here in New Mexico. What is less obvious is the mural on the wall depicting people around a mammoth kill. In New Mexico there are numerous Paleoindian sites, referring to sites that date to the Pleistocene. Suffice it to say, people were here in the New World near the close of the Pleistocene.

Dire wolves, like mammoths, camels, and ground sloths, went extinct toward the end of the Pleistocene. New Mexico Museum of Natural History. Photo: Sue Ruth

The Paleoindian Period, as it's called, is divided into segments based on changes in tools. Two Paleoindian periods are especially important. These are the Clovis period and the Folsom period, both named after towns in New Mexico. Clovis age sites are about 13,000 years old and Folsom-aged sites are around 11,500 years old. A "Clovis site" is shorthand for "Clovis-aged site", and refers to any site that dates to the Clovis period. The same is true for Folsom sites. Clovis-aged sites date to the time when mammoth, horses, camel, dire wolves, and other Pleistocene animals roamed North America

Mammoth and bison, and to a lesser extent elk, were the primary targets of Clovis hunters. A distinct Clovis technology consisted of stone points that are grooved or fluted part way up the point. (Doric Greek columns are also fluted or grooved if that helps you remember the term). This fluted technology, as it is called, is unique to the Americas, and occurs nowhere else in the world. The bottom third of Clovis points are smoothed on the edges, likely because they

were hafted onto an atlatl dart.

Clovis points are diagnostic of the Clovis period, meaning they were unique to this time period. If you find a Clovis point, it is on the order of 13,000 years old. It is also a very rare find. Collectors seek out Clovis points because of their rarity and also because they represent mastery in flint knapping, or making stone tools. Unfortunately, collecting these points without recording provenience information or context, strips away the information potential.

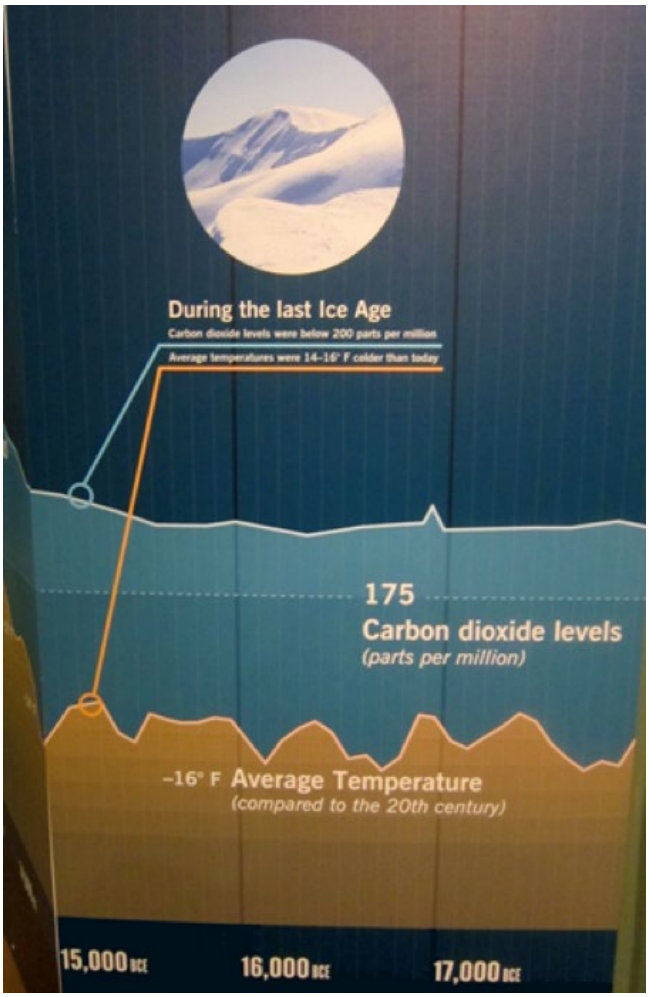
"Clovis point" by Same Wise is licensed under CC BY-NC-SA 2.0

What Happened to the Big Beasts?

Clovis people lived alongside Pleistocene megafauna. But what happened to these creatures? There are two main schools of thought: climate change and human predation. There is evidence for a massive drought during Clovis times. According to a recent study by scientists at UNM, this mass extinction appears to have been caused by a drought so severe that nothing like it had occurred for

at least 40,000 years that they examined. The site of Blackwater Draw in New Mexico also has the earliest human-made wells anywhere, associated with a prolonged drought during the Clovis period. Climate-change proponents argue that vast mammoth steppe habitats of the giant grazing mammals shrank, became fragmented, and the herds eventually dwindled to extinction through lack of sufficient forage. During the extinction event, fully 3/4 of all mammalian genera (35 genera) in North America disappeared, including mammoths and mastodons, all camelids (camel species), and horses—all within 1000 years of each other. About 40 percent of small mammals like voles and other rodents, mink, martens, and weasels went extinct, as did about 40 percent of mollusk species. Similar extinctions occurred in Europe, northern Asia, and Australia as well. Tropical areas like central Africa and south and Southeast Asia were much less affected—megafauna like elephants and rhinoceros still exist there, at least for the time being. Many larger Pleistocene mammals (including elephants in Africa) become smaller through time at the end of the Pleistocene, which is one adaptive response to a reduced food supply; this is also true of the Pleistocene bison in North America. This massive drought in North America appears in the stratigraphy at Clovis sites and is called The Black Mat, which represents the mud at the bottom of a dried-out water source. You can see it clearly at the Murray Springs site in Arizona. Below the mat, there are mammoths, horses, and other Pleistocene megafauna, and above the mat, only bison remain. There is an informative exhibit in the New Mexico Museum of Natural History that discusses Pleistocene climate change.

Another hypothesis for the massive extinction is the overkill hypothesis. The overkill hypothesis holds that Paleoindians were hunting specialists that concentrated on a few large species which could provide a huge return in meat and fat. Evidence for megafauna specialization includes, for example, the fact that of 14 known Clovis kill sites in western and central

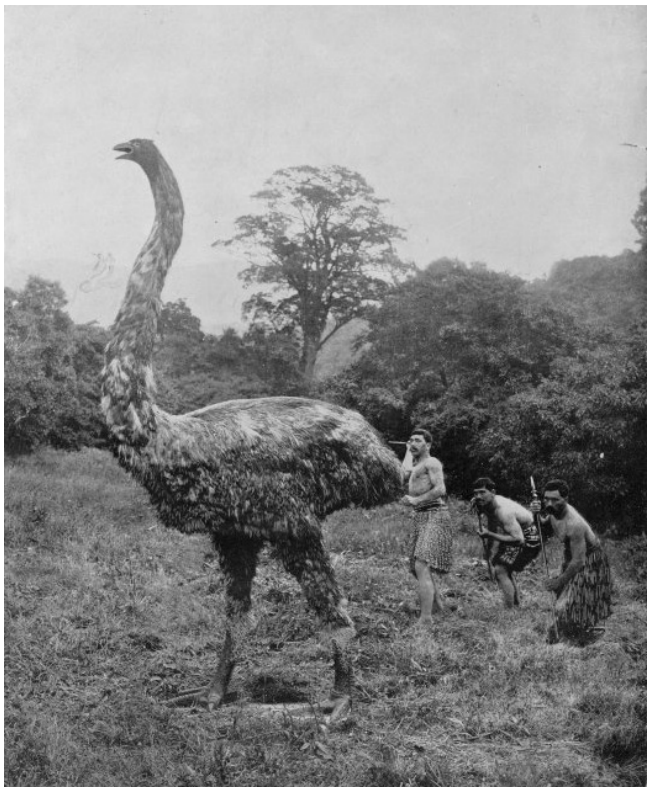


Climate change display at the New Mexico Museum of Natural History. Photo: Sue Ruth

North America, 11 contain the butchered bones of mammoth or mastodon. Archaeologist Todd Surovell argues that the number of Clovis elephant kill sites is exceptionally high if you look at elephant kill sites on a global scale. Surovell also argues that human colonization tracks mammoth extinction through human prehistory. Proponents of overkill also point to several other previously unoccupied land masses of the world where megafauna disappeared simultaneously with the colonization of humans. Australia, for example, was populated with a series of giant species of kangaroos and grazing marsupials that went extinct when humans first colonized the island-continent sometime between 40-60 kya. On Madagascar, the giant lemur Archaeoindris, about the size of a male gorilla, went extinct. New Zealand is another case in point. Several species of giant flightless birds called moas (Dinornithiformes)—some stood up to 12 feet tall and weighed up to 500 pounds—existed on the islands before the arrival of the first humans from Polynesia around AD 1250-1300, then abruptly became extinct within 200 years of their arrival from over-hunting. One reason for the swift demise is that the native species had no defensive fear of humans and could be easily approached and killed. The overkill hypothesis is similar to Pat

Shipman's hypothesis about humans and dog companions being the invasive species that wiped out Archaic Humans. And today, we see that humans are the main threat to other primates today.

In the Americas, a combination of the two factors contributing to the demise of megafauna—climate and human predation—is quite possible. Habitat loss due to climate change would have fragmented the large, interconnected populations of steppe animals. Indeed, we know that habitat fragmentation is a key factor in species extinction today. Human hunters could have delivered the final blow by overhunting the dwindling populations of megafauna that remained.



Moas were hunted to extinction (early reconstruction with upright neck). By Augustus Hamilton. Public domain.

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Chapter 12: Future Humans →

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Chapter 12: Future Humans (Preview)

The Long Now Foundation

"Human existence is about to get much better, much worse, or both." —Robby Berman

"As long as you have a ridiculously long view of things, things are getting better." —Robert Sapolsky

"How can we recognise the shackles that tradition has laid upon us? For when we recognise them, we are also able to break them."—Franz Boas

"I am not here for myself, rather for the future, all the kids that will come." —Nemonte Nenquimo, president of the Waorani Council of Pastaza

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In previous chapters, we talked about FOXP2, the only gene that we know of that influences language (though others are now emerging). All animals have this gene, but they have different versions compared to humans. Neanderthals as we know have the same version of FOXP2 as modern humans and so our version is fairly ancient. To find out more about this intriguing gene, geneticists used transgenic mice to test the in vivo functions of the human gene in another

species. *What does that mean*? They put a human FOXP2 gene in a fertilized mouse egg to see what would happen. It turned out the songs that the transgenic mice produced were different than their wild counterparts. Yes, male mice have courtship songs, and the human FOXP2 mice created songs with rhythmic distortions. Sadly, these little rodent Jimi Hendrixes* were labeled "abnormal" by the scientists, a typical response to artists ahead of their time.

In this chapter, we will consider the future of humans. We ask the question, in light of genetic editing and other technological advances, who and what will be considered a person in the future.

*Don't know Jimi Hendrix?

The Idea of a Human

We have discussed in this class what it means to be human—how we are different from and similar to other species. We have considered whether other species have language, or whether it is uniquely human. We have looked at how categories like "subsistence" and "race" have been used to justify treating people like non-humans or sub-humans. We have examined non-human primates and their similarities and differences to humans and discussed whether other species (or even rivers or trees) should have rights like humans do. We have looked at the ambiguity of humanness in the paleoanthropological record and considered whether Neanderthals and other hominins were human, and if so, why. And finally, we considered whether ancient human remains like Anzick Boy and Kennewick Man are people, and should be treated as such, or whether they are objects to be studied.

But the very definition of what it means to be human is changing. Historian Michael Bess explains: "But what we're on the verge of doing with bio-engineering technologies like CRISPR is going to be so qualitatively different and more powerful that I think it's going to force us to reassess who we are and

what it means to be human" (Illing 2018). Some have even suggested we are becoming less human-like and more god-like. Visual anthropologist Edmund Carpenter (1976:1) likened contemporary humans to angels, "a spirit freed from flesh." He explains, "The moment we pick up a phone, we are nowhere in space, everywhere in spirit…That is the Neo-Platonic definition of God: a being whose center is everywhere, whose borders are nowhere." More recently, Historian Yuval Noah Harari (2018) describes our species, not as *Homo sapiens*, *Homo spiritualis*, or *Homo fictus*, but as *Homo Deus*—god humans—given our unprecedented control over nature, over our biology, and our ability to create different kinds of intelligence.

Taking the Long View

In our busy and complicated lives, we often take the short view, thinking only about next week or, if we are really organized, we might have a five-year plan. The next generation or the next 100 or 1,000 years is typically not foremost in our minds. Thinking ahead, however, is essential for our own personal success and the future of the planet. The value of looking ahead is captured in the much-cited Iroquois principle of "seven-generation thinking" where one considers the effect of actions of generations living 140 or so years from now and acts accordingly. We are connected to the people of the past and are living in a world affected by their decisions and actions. The Long Now Foundation was created to promote long-term thinking on the scale of centuries and a sense of long-term responsibility. The Clock of the Long Now, designed to last 10,000 years and chime every century, exemplifies this extreme long view. In this chapter, we take the long view and consider the future of humans and our lasting impacts on the planet.

We have discussed the Anthropocene—the age of humans—in a previous chapter. Never before was there a single species that has made such an impact on the planet. We have transformed the planet through domestication, deforestation, urbanization, ocean acidification, changing biodiversity, and changes to our atmosphere. Even places noted for their isolation and endemic species—unspoiled lands—have huge numbers of invasive species as a result of

humans. The remote Galápagos Islands in Ecuador, famously visited by Charles Darwin in 1835, have an estimated 1,700 invasive species and about 20,000 human inhabitants. Given the current trends, we can ask: What will the future of the biosphere look like? How will our species have changed hundreds or even thousands of years from now? What new stories are yet to be told?

Hacking Humans

In this age of genetic research, we are on the threshold of something entirely new—directly adjusting the human genome. Gene editing has improved in recent years with a method called CRISPR/Cas-9. The technique delivers gene-editing components which target a section of DNA and snip out the mutation, which is then replaced with the desired version. Potentially, the method could be used to edit DNA t prevent diseases like sickle cell anemia or cystic fibrosis which are caused by a single SNP (Saey 2017). Currently, the Food and Drug Administration (FDA) is barred from clinical trials of editing embryos and the National Institutes of Health cannot fund such research. Scientists have used the technique to edit genes in a human embryo to repair a genetic mutation, but the embryos were not permitted to develop (Belleck 2017). One fear is that editing embryos—human genetic engineering—runs the risk of designer babies or "CRISPR babies" that are smarter, prettier, or more athletic.

China has already begun using CRISPR on terminal cancer patients. American trials are awaiting approval from the FDA. The head of those trials, Carl June, thinks of the CRISPR trials and research as a kind of biomedical Sputnik, spurring technological competition between the U.S. and China. A second concern is how CRISPR will be regulated. Who will have access to it? Will some be able to profit from it? The United States military is funding genetic research into gene editing, causing alarm over potential military uses (Nelson 2017).

CRISPR has implications beyond humans as well. It is theoretically possible, for instance, to wipe out mosquitoes that carry malaria or other disease-carrying vermin. Biochemist and CRISPR co-creator Jennifer Doudna (2017) discusses the potential dangers of releasing edited animals into the wild, including upsetting the balance of an ecosystem or unintentionally wiping out a species. There is also the talk of “de-extinction” of animals—bringing back some version of extinct species using CRISPR. Doudna points out that traits are created by the interaction of many genes, not to mention environmental conditions. And

so is not clear whether de-extinction could be a reality. Ethical and ecological questions would also have to be addressed in light of de-extinction.

Perhaps most disturbing is the threat of "super-bugs" that are engineered to cause a global pandemic (Bresler and Bakerlee 2018). Using gene-editing to produce artificial SNPs, bypasses the process of natural selection. While many of today's diseases are typically zoonotic, gene editing tools like CRISPR could bypass the processes of diseases leaping from one organism to another, but rather targeting a specific one instead by design. Whether caused by accidental release or intentional terrorism, the results of engineered pandemics are equally terrifying. With the threat of super-bugs, there is a call for developing infrastructure to develop vaccines to keep apace of the bio-hacked super-bug threat.

A New Intelligence

In addition to bio-hacking changing the human landscape, other kinds of technology like artificial intelligence (AI) are blurring the lines between computers and humans' minds. Computers are outpacing humans at tasks that were once considered the exclusive domain of the human brain. IBM's Deep Blue program beat Grandmaster Garry Kasparov at chess, and in 2016 AlphaGo beat the best in the world at the complex game of Go (Koch 2016). AlphaGo continuously plays itself, steadily improving its skill, a process called "machine learning." Learning is foundational to human and even animal culture. Machine learning is quite different from culture since it does not involve communication and coophumann between individuals. Philosopher Nick Bostrom thinks that the potential for artificial intelligence exceeds that of humans, what Bostrom calls "super-intelligence." That is, according to Bostrom, computers have the potential to be more "sapien", better thinkers, than humans. Bostrom says, "Think about it. Machine intelligence is the last invention that humanity will ever need to make. The machines will then be better at inventing than we are" (Bostrom 2015).

Nick Bostrom compares the potential of artificial intelligence and humans to

the very different pathways of humans and gorillas. One primate is on the verge of extinction, while the other has become a dominant species responsible for that annihilation (Khatchadourian 2017). What will happen to humans in the face of increasingly sophisticated artificial intelligence? The future, he suggests, would be shaped by the preferences of this AI, and consequently, we need to consider how to ensure that super-intelligence is aligned with human values. Who gets to decide what those values are?

Computer algorithms, a series of rules designed to accomplish a task, are becoming increasingly important to our daily lives. Today, the top investment managers don't look for fresh business models to invest in, as depicted on *Shark Tank*, rather they rely on computer algorithms to make important investment decisions (McGee 2016). Even our social lives have been infiltrated by algorithms. We've come a long way from arranged marriages—or have we? In the U.S., we don't typically entrust our village elders or parents to find a suitable mate, but many put trust in computer algorithms on sites like Tinder and Match.com. Some call centers are now using computer sensing to connect a caller with the most effective customer service person. This is accomplished by analyzing linguistic input like the caller's tone of voice and choice of words, to

match mood and personality with an agent. Even art is not outside the realm of computer algorithms, with computer-generated music based on the style of masters like Mozart or Beethoven (Adams 2010). Computers are beginning to do things that were formerly squarely in the realm of human culture—finding mates, making art, and using language.

Artificial Intelligence (AI) and machine learning will impact the future job market, with experts estimating that as many as 47% of all jobs will become automated in the next 25 years (Ratner 2017). Other estimates are not as dire, with an estimated 14 percent of jobs lost. Other concerns are that automation will not remove jobs entirely, but will result in lower pay. Jobs like grocery clerk, travel agent, and banker are already mostly automated. The comparison between humans and robots is daunting—hospital pharmacy robots make zero errors (Manjoo 2011). Driverless cars are being tested on roads, currently with a human backup, with the idea of creating safer transit (Thrun 2010). While autonomous cars do not get tired or experience road rage, other ethical questions arise. How would driverless cars evaluate a situation and determine whether to crash itself or strike a pedestrian or how might it decide which pedestrian to strike given a dire scenario? These choices would require

programming as a part of its algorithm and serious ethical deliberation.

The Inhabitat by Nissan-Autonomous-Drive CC BY-NC-ND

In the not-too-distant past, nearly all Americans were agriculturalists. With the onset of the Industrial Revolution, employment shifted to industry with a smaller number in service sectors. Today, as industry declines, more and more people work providing some kind of service—in health, education, and computer programming. The Department of Labor Statistics lists 102 million people in service jobs as of 2016. Will automation and AI cause another shift in the economy that eliminates the need for most service jobs? If so, what will be left for people to do, and how will they make a living? How much power will those who own algorithms have over those who have none? Google's subsidiary

DeepMind has created a research group, DeepMind Ethics, and Society, dedicated to studying the economic and social effects of artificial intelligence (Vincent 2017).

CNN Money

Robot Pharmacist Makes No Mistakes. Inside the robotic pharmacy

What Makes a Person?

The very idea of what is human, who has personhood, has changed over time and has been defined culturally. We saw that Ota Benga was considered less than human when he was housed alongside monkeys and apes in the Bronx Zoo. Enslaved African men in the U.S. were not considered "persons" before they obtained citizenry and the right to vote with the 14th and 15th amendments. Ponca Chief Standing Bear argued during the 1879 Standing Bear vs. Crook trial had to argue that he was a human. He stated, "That hand is not the color of yours, but if I pierce it, I shall feel pain. If you pierce your hand, you too will feel pain. The blood that will flow from mine will be the same color as

yours. I am a man." Standing Bear won his case, which granted rights of personhood and the right of *habeas corpus* (have to show cause for authorities to detain you) to native peoples. As late as 1971 the U.S. Supreme Court in Reed v. Reed agreed that women were "persons" and the 14th Amendment ("nor shall any state deprive any person of life, liberty, or property, without due process of law") applies to women.

Standing Bear won his case in court, winning rights of personhood.

Some animal species like dolphins and chimps have been represented in court with regard to personhood and rights, along with corporations, rivers, and other non-human entities. Germany has granted some rights to animals in its constitution, especially with regard to experimentation for cosmetics and pharmaceuticals (Connelly 2002). Ecuador's Constitution addresses the rights of the environment directly, stating that it has "the right to integral respect for its existence and for the maintenance and regeneration of its life cycles, structure, functions, and evolutionary processes." It is easy to see the connection here with animism, endowing natural phenomena with human-like qualities, a spirit, soul, or agency. Or, indeed, the reverse, that humans are a part of nature. These recent efforts to grant animals, rivers, and "Mother Earth" with human-like rights lies in stark contrast to viewing the earth as a resource only.

A blurring of what constitutes a person also appears in art. A photograph of Erica, dubbed the most realistic human robot, was shortlisted for the National Portrait Gallery's Taylor Wessing prize, even though technically the portrait is supposed to be of a living person (Warburton 2017).

The Future of the Past

Kennewick Man also known as The Ancient One is one of the earliest skeletons found in the Americas and dates to ca. 9,000 years ago, at the end of the Pleistocene and the beginning of the Holocene. Kennewick Man, like so many other remarkable finds, was found accidentally. Two college students found the skeletal remains while wading in the Columbia River in Washington on Army Corps of Engineers land (federal property) during a boat race. Thinking it was a forensic case, they called in the authorities. At first, it was thought to be an early European explorer given the skull morphology. The radiocarbon date, however, sparked a controversy that is still raging today. The problem is who owns or who has rights to Kennewick Man's remains? Is Kennewick Man a person or a thing? Some scientists argued that Kennewick man is a thing to be studied. Some tribal Nations, on the other hand, argued that Kennewick Man is a person, who required a proper burial.

The legislation called NAGPRA or Native American Graves Protection and Repatriation Act of 1990 stipulates that human remains and other culturally important items found on federal lands should be repatriated or returned to tribes that can demonstrate cultural affiliation. Most repatriations are non-controversial, and there is a clear link between ancient remains and modern people. With Kennewick Man, the link from past to present was so distant that scientists who wanted to study the remains questioned whether he should be repatriated and reburied. In addition, some suggested that Kennewick Man's cranial morphology resembled Europeans more than Native Americans. You can see how this debate had similarities to the Folsom site debate, where Hrlicka did not think Native Americans had been in the New World for very long. In 2015, a genetic analysis of Kennewick Man—comparing

his SNPs to worldwide populations—revealed he was more similar to Native Americans (both North and South) than any other modern population. Kennewick Man's mtDNA haplogroup (X2A) is found almost exclusively in Native Americans. (Haplogroup X, from which X2A is derived is found in the Americas, Europe, the Middle East, and Africa). This case also illustrates how attempts to place Kennewick Man into a category based on morphology were flawed as racial categories are also often flawed. In 2017, Kennewick Man was reburied in an undisclosed location on the Columbia Plateau by Native tribes.

The discussion over whether bodies are objects or people also applies to the exhibition of modern people, like the Bodies exhibit in which humans bodies are preserved and displayed in terms of different systems (digestive, skeletal, muscular). The bodies, which are Chinese in origin, have no clear provenance and may come from executed prisoners. Some have called for a ban on the exhibit and burial of the bodies.

Food for a Growing Planet

We have learned about foraging, horticulture, pastoralism, and agriculture, along with the concept of intensification. Today there are around 7 billion people on the planet and we expect to hit 9 billion by 2050. How will we feed everyone? Technically, there is enough food to feed the world's population, but the food is often wasted, fed to animals, converted to biofuel, or is not affordable by the people that need it most. Food prices are a major component of the problem. Prices have skyrocketed as a result of climate change, increasing oil prices, ethanol fuel, the rise of the middle class, and demand for better foods in places like China. People in poorer countries spend nearly 70 percent of their income on food alone. Given these factors, there is concern that a global food crisis will emerge by 2050. Scientists estimate that as much as 50 percent more food will be required by that time to feed the world.

Geographer Evan Fraser lays out four different actions that can be taken to

avoid a global food crisis. First, technology could help the impending global food crisis by providing Africa with materials for modern farming—seeds, fertilizers, and equipment— to maximize its food potential. This effort would have to play out at the local level with farmers and scientists working together, necessitating a deep understanding of local practices and cultures. Secondly, small farms around urban areas would provide a buffer in case world markets fail. Third, food aid organizations must have stockpiles of food and a plan of distribution when food shortages arise. Finally, Fraser argues that governmental regulation is needed to promote and ensure sustainable farming.

Sara Menker, CEO of Gro Intelligence, suggests that the crisis could happen much sooner than 2050. She predicts that by 2027 there will be a deficit of 214 trillion calories, an outcome of catastrophic proportions. She explains that some countries like the United States produce more food than they consume. South American countries like Brazil have flipped from being food importers to producers, at the loss of rainforest. Other regions, like China and Africa, are importers of food and will be hit hardest by a global food crisis. Menker argues that the commercialization of agriculture—intensification—in Africa could tip the balance back, making Africa a net producer that can sustain itself and provide food to food importers.

Making New Stories

We have looked at how humans are "swimming" in culture. Our own culture can be hard to see because we take it for granted or assume it is normal. Some of our most salient realities are created by people—everything from money to laws to some of our most cherished values. Even those who are not religious very often have deep-seated values that are sacred to them. Those values are in turn backed up by symbols and stories.

Nonetheless, our shared web of meaning, our sacred values, and the symbols and stories that accompany the can change in an instant. The Soviet Union can disappear with the signing of the Belavezha Accords, the Defense of Marriage Act can be overturned overnight, and once-illegal drugs like marijuana can

suddenly become legal. Even the ideals and values of our parents can seem quaint to us. The value system and worldview of our great-great-great grandparents, who may have lived through the American Civil War or the Mexican Revolution, would likely seem foreign to us. And technology is changing so fast, that people worry that our values system cannot keep pace with the changes. Historian Michael Bess cautions, "We need to sit down with ourselves and say, "As I look at my daily life, as I look at the past year, as I look at the past five years, what are the aspects of my life that have been the most rewarding and enriching? When have I been happiest? What are the things that have made me flourish?" If we ask these questions in a thoughtful, explicit way, then we can say more definitely what these technologies are adding to the human experience and, more importantly, what they're subtracting from the human experience." (Illing 2018) As we experience these new changes in technology and what it means to be human, people, especially young people, have much power in deciding the shape of a culture's values and the stories and symbols that support those values. The actions of your generation will shape the course of the future as we enter the Anthropocene. If we do this with eyes both on the past and the future, we stand to make better choices for our species and the natural environment.

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