The Secret of Our Success

How learning from others drove human evolution, domesticated our species and made us smart

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Chapter 3

Lost European Explorers

In June of 1845, under the command of Sir John Franklin, the HMS Erebus and the HMS Terror sailed away from the British Isles in search of the fabled Northwest Passage, a sea channel that could energize trade by connecting Western Europe to East Asia. This was the Apollo mission of the mid-19th century, as the British raced the Russians for control of the Canadian Arctic, and to complete a global map of terrestrial magnetism. The British admiralty outfitted Franklin, an experienced naval officer who'd faced Arctic challenges before, with two field-tested, re-enforced ice breaking ships equipped with state of the art steam engines, retractable screw propellers, and detachable rudders. With cork insulation, coal-fired internal heating, desalinators, five years of provisions including tens of thousands of cans of food (canning was a new technology), and a 1,200 volume library, these ships were carefully prepared to explore the icy north and endure long Arctic winters.[24]

As expected, the expedition's first season of exploration ended when the sea ice inevitably locked them in for the winter around Devon and Beechney Islands, 600 miles north of the Arctic Circle. After a successful ten-month stay, the seas opened and the expedition moved south to explore the seaways near King William Island, where in September they again found themselves locked in by ice. This time, however, as the next summer approached, it soon became clear that the ice was not retreating, and that they'd remain imprisoned for another year. Franklin promptly died, leaving his crew to face the coming year in the pack ice with dwindling supplies of food and coal (heat). In April of 1948, after 19 months on the ice, the second in command, an experience Arctic officer named Crozier, ordered the 105 men to abandon ship and setup camp on King William Island.

The details of what happened next are not completely known, though what is clear is that everyone gradually died. Both archaeological evidence and reports from Inuit locals gathered by the many explorers sent to rescue the expedition indicate that the crew fragmented, moved south, and cannibalism ensured. In one report, an Inuit band encountered one of the crew's parties. They gave the hungry men some seal meat, but quickly departed when they noticed the crew transporting human limbs. Remains of the expedition have been located on several different parts of the island. There is also a rumor, never confirmed, that Crozier made it far enough south that he fell in with the Chippewa, where he lived out his days hiding from the shame of sustained and organized cannibalism.[25]

Why couldn't these men survive, given that some humans do just fine in this environment? King William Island lies at the heart of Netsilik territory, an Inuit population that spent its winters out on the pack ice, and their summers on the island, just like Franklin's men. In the winter, they lived in snow houses and hunted seals using harpoons. In the summer, they lived in tents, and hunted caribou, musk ox and birds using complex compound bows and kayaks, and caught salmon using leisters (3-prong fishing spears, see Figure 3.1[26]). The Netsilik name for the main harbor on King William Island is *Uqsuqtuuq,* which means “lots of fat” (seal fat).[27] For the Netsilik, this island is rich in resources, for food, clothing, shelter, and resources (drift wood).

Franklin’s men were 105 big-brained and highly-motivated primates facing an environment that humans have lived in, as foragers, for over 30,000 years. They’d had three years in the Arctic, and 19 month stuck in the ice with their supplies slowly dwindling, to experience the environment and put those big brains to work. The men were all well-known to each other after all this time, having worked together on the ship, so we should have a highly cohesive group with a shared goal. At 105 people, this group had roughly the same number of mouths to feed as a large Netsilik encampment, without the children or elderly to worry about. Yet, they vanished, defeated by the hostile environment, only to be remembered in Inuit stories.

FIGURE 3.1 HEAD OF A NETSILIK LEISTER USED FOR FISHING. THE TEETH ARE MADE FROM REINDEER HORN. ROALD AMUNDSEN COLLECTED THIS BY ON KING WILLIAM ISLAND DURING HIS VISIT 1903-06.

The reason Franklin’s men could not survive is that humans don’t adapt to novel environments the way other animals do, or by using our individual intelligence. None of the 105 big brains figured out how to use driftwood, available on King William Island’s west coast where they camped, to make the re-curve composite, bows that Inuit use when stalking Caribou. They further lacked the vast body of cultural know-how about building snow houses, creating fresh water, hunting seals, making kayaks, spearing salmon and tailoring cold-weather clothing.

Let’s briefly consider just a few of the Inuit cultural adaptations that you would need to figure out to survive on King William Island. To hunt seals, you first have to find their breathing holes in the ice. It’s important that the area around the hole be snow-covered—otherwise the seals will hear you and vanish. You then open the hole, smell it to verify it’s still in use (what do seals smell like?), and then assess the shape of the hole using a special curved piece of caribou antler. The hole is then covered with snow, save for a small gap at the top that is capped with a down indicator. If the seal enters the hole, the indicator moves, and you must blindly plunge your harpoon into the hole using all your weight. Your harpoon should be about 1.5 meters (5ft) long, with a detachable tip that is tethered with a heavy braid of sinew line. You can get the antler from the previously noted caribou, which you brought down with your driftwood bow. The rear spike of the harpoon is made of extra-hard polar bear bone (yes, you also need to know how to kill polar bears; best to catch them napping in their dens). Once you’ve plunged your harpoon’s head into the seal, you’re then in a wrestling match as you reel him in, onto the ice, where you can finish him off with the aforementioned bear-bone spike.[28]

Now you have a seal, but you have to cook it. However, there are no trees at this latitude for wood, and driftwood is too sparse and valuable to use routinely for fires. To have a reliable fire, you’ll need to carve a lamp from soapstone (you know what soapstone looks like, right?), render some oil for the lamp from blubber, and make a wick out of a particular species of moss. You will also need water. The pack ice is frozen salt water, so using it for drinking will just make you dehydrate faster. However, old sea ice has lost most of its salt, so it can be melted to make potable water. Of course, you need to be able to locate and identify old sea ice by color and texture. To melt it, make sure you have enough oil for your soapstone lamp.

These few examples are just the tip of an iceberg of cultural know-how that's required to live in the Arctic. I have not even alluded to the know-how for making baskets, fishing weirs, sledges, snow goggles, medicines or leisters, not to mention all the knowledge of weather, snow, and ice conditions required for safe travel using a sledge.

Nevertheless, while the Inuit are impressive, perhaps I am asking too much, and no one could have survived getting stuck in the ice for two years in the Artic. After all, we are a tropical primate and average temperatures during the winters on King William Island range between -25°C (-13°F) and -35°C (-31°F), and were even lower in the mid-19th century. It happens, however, that two other expeditions have found themselves also stranded on King William Island, both before and after Franklin's Expedition. Both crews, despite being much smaller and less well-equipped than Franklin's men, not only survived but went on to future explorations. What's the secret of their success?[29]

Fifteen years before the Franklin Expedition, John Ross and a crew of 22 had to abandon the *Victory* off the coast of King William Island. During three years on the island, Ross not only survived, but managed to explore the region, including locating the magnetic pole. The secret of Ross's success is not surprising; it's the Inuit. Though not known as a 'people-person', he managed to befriend the locals, establish trading relations, and even fashioned a wooden leg for lame Inuit man. Ross marveled at Inuit snow houses, multi-use tools, and amazing attire, and learned about hunting, sealing, dogs, and traveling by dog sledge. In return, the Inuit learned from Ross's crew the proper use of a knife and fork while dining. Ross is credited with gathering a great deal of ethnological information, though in part this was driven by the practical need to obtain survival-crucial information and to maintain good relations. Over their stay, Ross worried in his journals when the Inuit disappeared for long stretches, and looked forward to the bounty they would return with—including packages such as 180 lbs. of fish, 50 sealskins, bears, musk ox, venison and fresh water. He also marveled at the health and vigor of the Inuit. Ross's sledge expeditions during this time always included parties of Inuit, who acted as guides, hunters, and shelter-builders. After four years, during which time he was presumed dead by the British Admiralty, Ross managed to return to England with 19 of his 22 men. Years later, in 1848, Ross would again deploy lightweight sledges, based on Inuit designs, in an overland search for Franklin's lost expedition. These sledge designs were adopted by many future British expeditions.

A little over a half century later, Roald Amundsen spent two winters on King William Island and three in the Arctic. In his refurbished fishing sloop, he went on to be the first European to successfully traverse the North West passage. With knowledge of both Ross and Franklin, Amundsen immediately sought out the Inuit and learned from them how to make skin clothing, hunt seals and manage dog sleds. Later, he would put these Inuit skills and technologies—clothing, sledges and houses—to good use in beating Robert Scott to the South Pole. In praising Inuit clothing at -63°F (-53°C), the Norwegian Amundsen wrote, "Eskimo dress in winter in these regions is far superior to our European clothes. But one must either wear it all or not at all; any mixture is bad…you feel warm and comfortable the moment you put it on [by contrast with wool].” Amundsen makes similar comments about Inuit snow houses (more on those in Chapter 7). After finally deciding to replace the metal runners on his sledge with wooden ones, he writes, “One can’t do better in these matters than copy the Eskimo, and let the runners get a fine covering of ice; then they slide like butter.”[30]

The Franklin Expedition is our first example from the *Lost European Explorer Files*.[31] The typical case goes like this: Some hapless group of European or American explorers find themselves lost, cutoff, or otherwise stuck in some remote and seemingly inhospitable place. They eventually run out of provisions, and increasingly struggle to find food and sometimes water. Their clothing gradually falls apart, and their shelters are typically insufficient. Disease often follows, as their ability to travel deteriorates. Cannibalism frequently occurs, as things get desperate. The most instructive cases are those in which fate permits the explorers to gain exposure and experience in the ‘hostile’ environment they will have to (try to) survive in before their supplies totally run out. Sadly, these explorers generally die. When some do survive, it’s because they fallen in with a local indigenous population, who provides them with food, shelter, clothing, medicine and information. These indigenous populations have typically been surviving, and often thriving, in these ‘hostile’ environments for centuries or millennia.

What these cases teach us is that humans survive neither by our instinctual abilities to find food and shelter, nor by our individual capacities to improvise solutions on the fly to local environmental challenges. We can survive because, over generations, the selective processes of cultural evolution have assembled packages of cultural adaptations—including tools, practices and techniques—that cannot be devised in a few years, even by a group of highly motivated and cooperative individuals. Moreover, the bearers of these cultural adaptations themselves often don’t understand much of how or why they work, beyond the understanding necessary for effectively using them. The next chapter will lay out the foundations of the processes that build cultural adaptations over generations.

Before moving on, however, let’s again dip into the Lost European Explorer Files just to make sure the Arctic isn’t a special case of an excessively challenging environment.

The Burke and Wills Expedition

In 1860, while returning from the first European trip across the interior of Australia, from Melbourne north to the Gulf of Carpentaria, four explorers found they had nearly used up three months’ worth of provisions, and were increasingly forced to live off the land. The expedition leader, Robert Burke (a former police inspector) and his second in command, William Wills (a surveyor), along with Charles Gray (a 52-year-old sailor) and John King (a 21-year-old soldier), soon had to begin eating their pack animals, which included six camels that had been imported especially for this desert trip. The horse and camel meat extended their provisions, but also meant they had to abandon their equipment as they traveled. Gray got increasingly weak, stole food, and soon died of dysentery. The remaining trio eventually made it back to their rendezvous point, an expedition depot at Coopers Creek, where they expected the rest of their large expedition party to be waiting with fresh supplies and provisions. However, this waiting party, who were also sick, injured, and running short on food, had departed earlier the same day. Burke, Wills and King had just missed them, but the trio did manage to access some buried provisions. Still weak and exhausted, Burke decided not to try to catch the rest of their party by heading south, but instead to follow Coopers Creek toward Mount Hopeless (yes, really, Mount Hopeless), where there was a ranch and police outpost about 150 miles away. While traveling along Coopers Creek, not long after departing the depot, both of their two remaining camels died. This left them stuck along Coopers Creek because, without either the camels to carry water or some knowledge of how to find water in the outback, the trio could not traverse the last open stretch of desert between the creek and the outpost at Mount Hopeless.[32]

Stranded, and now with their recent infusion of provisions running low, the explorers managed to make peaceful contact with a local aboriginal group, the Yandruwandrha. These aboriginal hunter-gatherers gave them gifts of fish, beans, and some cakes, which the men learned were made from a "seed" called nardoo (technically, it's a sporocarp, not a seed). Our trio clearly paid some attention when they were with the Yandruwandrha, but this didn't improve their success in fishing or trapping. However, impressed by the cakes, they did start searching for the source of the nardoo seeds, which they believed to be from a tree. After much searching, and running on empty, the trio finally wandered across a flat covered with nardoo—which turned out to be a clover-like, semi-aquatic fern, not a tree. Initially, the men just boiled the sporocarp, but later they found (not made) some grinding stones and copied the Yandruwandrha women that they had observed preparing the cakes. They pounded the seeds, made flour, and baked nardoo bread.

This was an apparent boon in the men's plight, as it finally seemed they had a reliable source of calories (see Figure 3.2). For over a month, the men collected and consumed nardoo, as they all became increasingly fatigued, and suffered from massive and painful bowel movements. Despite consuming what should have been sufficient calories (4-5 lbs. per day, according to Wills' journal), Burke, Wills and King all just got weaker. Wills writes about what was happening to them by first describing the bowel movements caused by the nardoo:

> *I cannot understand this nardoo at all; it certainly will not agree with me in any form. We are now reduced to it alone, and we manage to get from four to five pounds per day between us. The stools it causes are enormous, and seem greatly to exceed the quantity of bread consumed, and is very slightly altered in appearance from what it was when eaten. …starvation on nardoo is by no means unpleasant, but for the weakness one feels and the utter inability to move oneself, for as far as appetite is concerned, it gives me the greatest satisfaction.*[33]

Burke and Wills died within a week of this journal entry. Alone, King managed to continue by appealing to the Yandruwandrha, who took him in, fed him, and taught him to construct a proper shelter. Three months later King was found by a relief expedition, and returned to Melbourne.

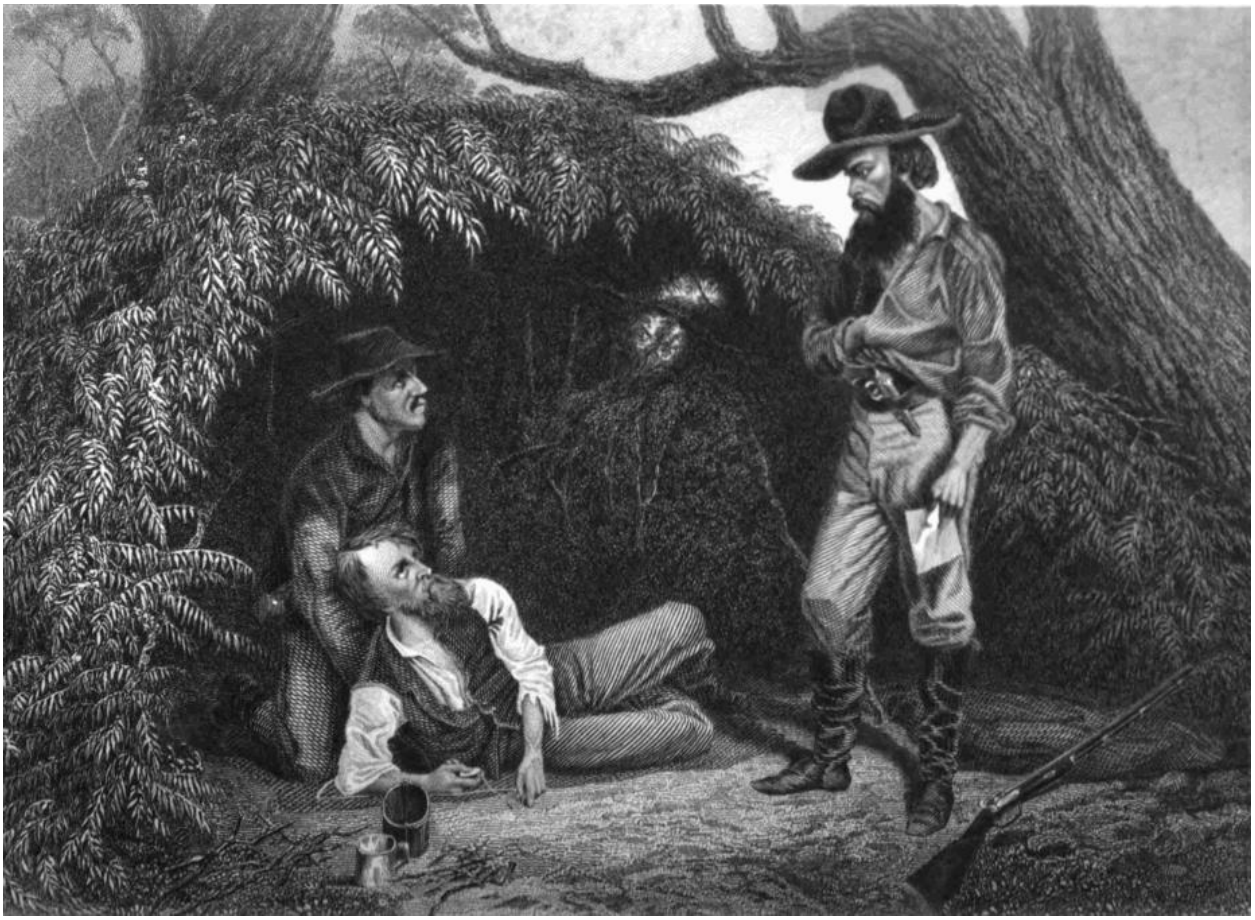


FIGURE 3.2. PAINTING OF BURKE, WILLS AND KING AS THEY STRUGGLED TO SURVIVE ALONG COOPERS CREEK. PAINTED BY SCOTT MELBOURNE AND PUBLISHED IN WILL'S DIARY (WILLS, WILLS, AND FARMER 1863).

Why did Burke and Wills die?

Like many plants used by hunter-gatherers, nardoo is indigestible, and at least mildly toxic, unless properly processed. Unprocessed nardoo passes through only partially digested, and contains high levels of thiaminase, which depletes the body's store of thiamine (vitamin B1). Low levels of thiamine cause the disease Beriberi, resulting in extreme fatigue, muscle wasting and hypothermia. To address this problem, the customary nardoo processing practices of aborigines appear to have multiple elements built in that make nardoo edible and non-toxic. First, they grind and leach the flour with copious amounts of water, which increases digestibility and decreases concentrations of the vitamin B1-destroying thiaminase. Second, in making cakes, the flour is directly exposed to ash during heating, which lowers its pH and may break down the thiaminase. Third, nardoo gruel is consumed using only mussel shells, which may restrict the thiaminase's access to an organic substrate that is needed to fully initiate the B1-destroying reaction. Failure to deploy these local practices meant that our unfortunate trio managed to starve and poison themselves while keeping their stomachs full.[34] Such subtle and nuanced detoxification practices are common in small-scale societies, and in in later chapters we will see additional examples.

The effect of the nardoo, coupled with their lack of clothing, which were falling apart, and their inability to make a proper shelter, meant the trio suffered greatly during the cold June winters. The effects of exposure likely accelerated their weakness and eventual demise. Their chances of learning from the locals, like Ross and Amundsen did, was diminished by Burke's flights of anger and impatience with the Yandruwandrha. At one point, in response to their requests for gifts, he fired a shot over their heads, and they disappeared. Bad move.

If the Australian desert still seems too extreme, maybe our intelligence and/or evolved instincts might serve us better in subtropical climates. Let's dip into the Lost European Explorer files again.

THE NARVÁEZ EXPEDITION

In 1528, just north of Tampa Bay (Florida), Pánfilo Narváez made a crucial mistake. He split up his expedition, taking 300 conquistadors inland in search of the fabled cities of gold, while sending his ships further up the coast for a later rendezvous at a new location. After wandering around the swamps and scrublands of northern Florida for 2 months (with no luck in finding the golden cities), and dealing treacherously with the locals, the mighty conquistadors attempted to head south to meet their ships. However, despite great efforts through swampy terrain, they couldn't travel overland to their ships. Missing the rendezvous date, the remaining 242 men (50 some already dead) constructed five boats and planned to paddle along the Gulf coast to a Spanish port in Mexico.

Unfortunately, the conquistadors had dramatically underestimated the distance to Mexico, and the crude boats they constructed gradually stranded their crews on the barrier islands along the Gulf Coast. These now scattered Spanish parties starved, sometimes engaging in cannibalism, until they were aided by peaceful Karankawa hunter-gatherers, who had long lived along the Texas coast. Accounts suggest that, with the Karankawa's help, the surviving parties were able to resume their journey to Mexico until starvation again marooned them in a wretched state. However, at least one of these groups got better at finding food, having learned from the locals to harvest seaweed and oysters. Interestingly, the floundering Spaniards, as well as later European travelers, always described the Karankawa as particularly tall, robust and healthy-looking. So, this was a rich and bountiful environment for hunter-gatherers, if you know what you are doing.

Though most died, a handful of Spaniards and one Moorish slave, did reach the more densely populated heart of Karankawa territory. Having barely survived to reach this point, the remaining adventurers were promptly enslaved by these fiercer Karankawa, and may have been forced into a female gender role. Among North American aboriginal populations, this male-to-female gender role switching was not uncommon. For our conquistadors, it meant a lot of toilsome work, such as carrying water, gathering firewood and other unpleasant duties.

After several years of living among these scattered hunter-gatherer populations, four members of Narváez's crew were brought together by the annual prickly pear harvest season, during which time many local groups would congregate, feast and celebrate. In the excitement, the foursome managed to slip away. After a long and rather circuitous route, staying among many different peoples in Mexico, Texas and Arizona while operating as healers and shamans, they eventually found their way back to New Spain (colonial Mexico), eight years after they had begun in Florida.[35] Thus, the foursome had managed to survive by adopting a valued social role in these aboriginal American societies.

THE LONE WOMAN

We can contrast these Lost European Explorer accounts, in which intrepid bands of hardy and experienced explorers find themselves struggling in novel environments, to another account, of a lone young woman who found herself stranded for 18 years in the place she grew up. Seventy miles off the coast of Los Angeles, and 30 miles from the nearest land, the foggy, barren, and windswept San Nicolas Island was once inhabited by a thriving aboriginal society, linked by trade to the other Channel Islands and the coast. However, by 1830 the island's population was dwindling, in part due to a massacre by Kodiak hunter-gatherers from the then Russian-controlled Aleutian Islands who had set up camp on San Nicolas to hunt otters. In 1835, Spanish missionaries from Santa Barbara sent a ship to transport the remaining island inhabitants to the mainland missions. During a rushed evacuation, one young native woman in her mid-twenties dashed off to search for her missing child. To evade a looming storm, the ship ended up leaving her behind on the island, and due to some unlucky quirks of fate she was largely (though not entirely) forgotten.

Surviving for eighteen years, this lone castaway ate seals, shellfish, sea birds, fish and various roots. She deposited dried meats on different parts of the island, for times of sickness or other emergencies. She fashioned bone knives, needles, bone awls, shell fishhooks and sinew fishing lines. She lived in whalebone houses, and weathered storms in a cave. For transporting water, she wove a version of the amazing watertight baskets that were common among California Indians. For clothing, she fashioned waterproof tunics by sewing together seagull skins, with the feathers still on, and wore sandals woven from grasses. When finally found, she was described as being in "fine physical condition" and attractive, with an "unwrinkled face." After overcoming an initial scare at being suddenly found, the lone woman promptly offered the search party dinner, which she was cooking at the time they arrived.[36]

The contrast with our lost European explorers could hardly be starker. One lone woman equipped with only the cumulative know-how of her ancestors survived for 18 years while fully provisioned and well-financed teams of experienced explorers struggled in Australia, Texas and the Arctic. These diverse cases testify to the nature of our species' adaptation. Over eons of relying on large bodies of cumulative cultural knowledge, our species has become addicted to this cultural input—without culturally-transmitted knowledge about how to locate and process plants, fashion tools from available materials, and avoid dangers, we don't last long as hunter-gatherers. Despite the intelligence we acquire from having such big brains, we can't survive in the kinds of environments so commonly inhabited by our hunter-gatherer ancestors over our evolutionary history. While our attention, cooperative tendencies and cognitive abilities have likely been shaped by natural selection to life in our ancestral environments, these genetically evolved psychological adaptations are entirely insufficient for our species. Neither our intelligence nor domain-specific psychological abilities fire up to distinguish edible from toxic plants or to construct watercraft, whale-bone houses, snow houses, canoes, fishhooks or wooden sledges. Despite the critical importance of hunting, clothing and fire in our species' evolutionary history, no innate mental machinery delivered information on locating snow-covered seal holes, making projectiles or starting fires to our explorers.

Our species' uniqueness, and our ecological dominance, arises from the manner in which cultural evolution, often operating over centuries or millennia, can assemble cultural adaptations. In the cases above, I've emphasized those cultural adaptations that involve tools and know-how about finding and processing food, locating water, cooking and traveling. But, as we go along, it will become clear that cultural adaptations also involve how we think and what we like, as well as what we can make.

In the next chapter, I show how evolutionary theory can be successfully applied to build an understanding of culture. Once we understand how natural selection has shaped our genes and our minds to build and hone our abilities to learn from others, we will see how complex cultural adaptations, including tools, weapons, and food-processing techniques, as well as norms, institutions and languages, can emerge gradually without anyone fully apprehending how or why they work. In Chapter 5, we examine how the emergence of cultural adaptations began driving our genetic evolution, leading to an enduring culture-gene coevolutionary duet that took us down a novel pathway, eventually making us a truly cultural species.

Chapter 4

How to make a cultural species

To understand why European explorers couldn't survive as hunter-gatherers while locals—even when stranded alone—could, we need to understand how populations generate cultural adaptations, the suites or packages of skills, beliefs, practices, motivations and organizational forms that permit them to survive, and often thrive, in diverse and challenging environments. The process is—in some crucial sense—smarter than we are. Over-generations, often outside of conscious awareness, individuals' choices, learned preferences, lucky mistakes and occasional insights aggregate up to produce cultural adaptations. These often complex packages contain subtle and implicit insights that impress modern engineers and scientists (see Chapter 7). We have glimpsed some of these cultural adaptations, from Inuit clothing to nardoo detoxification, and will study other such adaptations, ranging from food taboos that protect pregnant women from marine toxins to religious rituals that galvanize greater prosociality. Before getting to these, however, we need to build an understanding of cultural evolution, from the ground-up, that can explain how it is that human populations end up with complexes of tools, tastes and techniques that are honed to local environmental challenges.

This brings us to a central insight. Rather than opposing 'cultural' with 'evolutionary' or 'biological' explanations, researchers have now developed a rich body of research showing how natural selection, acting on genes, has shaped our psychology in a manner that generates *non-genetic evolutionary processes* capable of producing complex cultural adaptations. Culture, and cultural evolution, is then a consequence of genetically evolved psychological adaptations for learning from other people. That is, natural selection favored genes for building brains with abilities to learn from other people. These learning abilities, when operating in populations and over time, can give rise to subtly adaptive behavioral repertoires, including those related to fancy tools and large bodies of knowledge about plants and animals. These emergent products arise initially as unintended consequences of the interaction of learning minds in populations, over time. With this intellectual move, 'cultural explanations' become but one type of 'evolutionary explanation', among a potential host of other non-cultural explanations.

In their now classic treatise, *Culture and the Evolutionary Process*, Rob Boyd and Pete Richerson laid the foundations of this approach by developing a body of mathematical models that explore our capacities for cultural learning as genetically-evolved psychological adaptations. Once cultural learning is approached as a psychological adaptation, or as a suite of adaptations, we can then ask how natural selection has shaped our psychology and motivations so as to allow us to most effectively acquire useful practices, beliefs, ideas and preferences from others.[37] These are questions about *who* we should learn from, and *what* we should attend to and infer, as well as *when* input from cultural learning should overrule our own direct experience or instincts.

Evidence from diverse scientific fields is now revealing how finely tuned our psychological adaptations for cultural learning are. Natural selection has equipped our species with a wide range of mental abilities that allow us to effectively and efficiently acquire information from the minds and behaviors of other people. These learning instincts emerge early, in infants and young children, and generally operate unconsciously and automatically. In many circumstances, as we saw in the Matching Pennies Game and Rock Paper Scissors, we find it difficult to inhibit our automatic imitative instincts. As we'll see below, even when getting 'right answers' is important, our cultural learning mechanisms fire up, to influence our practices, strategies, beliefs and motivations. In fact, sometimes, the more important getting the right answer is, the more we rely on cultural learning.

As a point of departure, it is worth considering how pervasive the effects of cultural learning are on our behavior and psychology. Box 4.1. lists just some of the domains where cultural learning's influence has been studied.[38] The list includes domains of distinct evolutionary importance, such as food preferences, mate choice, technological adoptions and suicide, as well as social motivations related to altruism and fairness. As we'll see in later chapters, cultural learning reaches directly into our brains and changes the *neurological values* we place on things and people, and in doing so, it also sets the standards by which we judge ourselves. One classic set of experiments shows that children acquire the performance standards by which they are willing or unwilling to reward themselves.[39] Children saw a demonstrator rewarding himself or herself with M&Ms only after exceeding either a relatively higher score in a bowling game or a relatively lower score. The children copied the rewarding standards of the demonstrator such that the kids exposed to the "high standards" model tended not to eat the M&Ms unless their score exceeded the higher threshold. As will become clear, culturally acquired standards or values guide our efforts and persistence at individual learning, training, and trial and error learning.

<u>Box 4.1: Domains of Cultural Learning</u>

- Food preferences and quantity eaten
- Mate Choices (individual & their traits)
- Economic strategies (investments)
- Artifact (tool) functions and use
- Suicide (decision & method)
- Technological adoptions
- Word meanings and dialect
- Categories ("dangerous animals")
- Beliefs (e.g., about gods, germs, etc.)
- Social norms (taboos, rituals, tipping)
- Standards of reward & punishment
- Social motivations (altruism and fairness)
- Self-regulation
- Judgment heuristics

Let's begin by exploring how thinking of our cultural learning abilities as genetically-evolved psychological adaptations deepens our understanding of both how we adapt to our worlds as individuals, and how populations adapt to their environments over generations. Our first question is: how should individuals figure out *whom* to learn from? This question is crucial because it will illuminate how cultural adaptations can emerge.

Suppose you are a boy living in a hunter-gatherer band. To survive, the men in your community hunt a wide range of game. How should you go about hunting? You could just start experimenting. Maybe try throwing rocks at gazelles, or chasing some zebras. Or, you could wait for some evolved instincts for hunting to fire up, and tell you what to do. If you go this route, you'll probably wait a long time, as this is the situation that Franklin, Burke, and Narváez found themselves in. Franklin's men lived for 18 months on the pack ice with starvation looming, but no one figured out how to harpoon a seal. In fact, since you are a member of a cultural species, your instincts will fire up, but instead of supplying specialized hunting instincts, they will cause you to start looking for people to copy—but, not just any people. Aspiring young hunters first glean as much as they can from those to whom they have ready access, like their brothers, fathers and uncles. Later, perhaps during adolescence, learners update and improve their earlier efforts by focusing on and learning from the older, most successful, and most prestigious hunters in their community. That is, learners should use three cultural learning cues to target their learning: age, success and prestige. You might also use 'being male' as a cue, since, let's assume, hunting is predominantly a male activity. These cues will not only help you zoom in on those in your community most likely to possess adaptive practices, routines, beliefs and skills related to hunting, but will also allow you to gradually scaffold your abilities and know-how up, while making the most of what those who care about you know. Moreover, since particular individuals may be successful or prestigious for idiosyncratic reasons (like possessing good genes), you'll want to sample several of the top hunters, and use only those practices preferred by a plurality of them.[40]

More broadly, evolutionary reasoning suggests that learners should use a wide range of cues to figure out whom to selectively pay attention to, and learn from. Such cues allow them to target those people most likely to possess information that will increase the learner's survival and reproduction. In weighting the importance of those they can potentially learn from (hereafter their *models*), individuals should combine cues related to the models' health, happiness, skill, reliability, competence, success, age and prestige, as well as correlated cues like displays of confidence or pride. These cues should be integrated with others related to self-similarity, such as sex, temperament, or ethnicity (cued by, e.g., language, dialect or dress). Self-similarity cues help learners focus on those likely to possess cultural traits (e.g., practices or preferences) that will be useful to the learner in their future roles. Same-sex cues, for example, reduce the time spent by teenage boys attending to the details of nursing, such as how to latch an infant, or what to do when a viscous, yellowish secretion first emerges from the nipple after birth (colostrum). Together, all of these cues provide input to "model-based" cultural learning mechanisms because they help individuals figure out from whom to learn. Let's take a closer look at our selective cultural learning.

Skill and Success

Since many model-based cues, such as success and prestige, are only loosely tied to particular domains of behavior, such as hunting or golf, we expect them to influence learning about a broad spectrum of cultural traits, ranging from preferences for food, mates, wine and linguistic labels to beliefs about invisible agents or forces, like gods, germs, angels, karma and gravity. This is not to say that we should expect the same cues to have the same size impact on very different domains. What makes someone a successful hunter or basketball player is surely better predicted by their arrow-making techniques or their jump-shot form, respectively, but may also be impacted by the practice of eating carrots or by saying a brief prayer before heading out to hunt or play basketball. Eating carrots might improve a shooter's vision while a prayer ritual might calm and focus the mind (or, possibly bring supernatural aid).

Let's begin by looking more deeply at the impact of cues related to skill, including competence or reliability, and success. Skill cues are those that relate most directly to competence in a domain. For example, one might assess a writer's skill by reading his books. In a foraging society, an aspiring hunter might watch an older hunter adeptly stalk a giraffe, crouch in a tree's shadow, and fluidly release an accurately-targeted arrow. By contrast, success cues are more indirect, but potentially more useful, as they aggregate information. Using success cues, you might evaluate a writer on the number of copies that his book sells, and a hunter by the frequency with which he brings home big game. Since many hunting societies have practices that facilitate easy accounting of prior kills, you might be able to look at how many monkeys' teeth a hunter has on his necklace or at the number of pig mandibles hung outside of his house.[41]

To see the power and pervasiveness of the use of success cues in cultural learning, consider the following experiment. MBA students participated in two different versions of an investment game. In the game, they had to allocate their money across three different investment options, labeled A, B and C. They were told each investment's average monetary returns, and its variation (sometimes you get more than average, other times, less). They were also told the relationships or correlations among the investments: e.g., if investment A's value goes up, then B's value tends to go down. Participants could borrow money to invest. During each round of the game, each player would make his or her allocations, and receive the returns. After each round, players could alter their investment allocations for the next round, and this went on for 16 rounds. At the end of the game, each player's portfolio performance ranking relative to the other players heavily influenced their grade in the course, moving it up or down. If you know any MBAs, you'll know this is a serious incentive, and these players were thus strongly motivated to make the most money in the game.

The experimenters randomly assigned players to one of two different versions, or treatments. In one version, the MBAs made their decisions in isolation, receiving only the individual experience derived from their own choices over the 16 rounds. The other version was identical, except the allocations chosen and performance rankings of all participants were posted between each round, using anonymous labels.

The difference in the results from each version surprised the economists who designed the experiment (though, admittedly, many economists are pretty easily surprised by human behavior[42]). Three patterns are striking. First, the MBAs didn't use the additional information available in the second treatment (with posted performances) in the complex and sophisticated way economic theory assumes. Instead, careful analysis shows that many participants were merely copying ("mimicking") the investment allocations made by the top performers in the previous round. Second, the environment of this experiment is simple enough that one can actually calculate the profit-maximizing investment allocation. This optimal allocation can be compared with where participants actually ended up in round 16, for each of the two versions. Left only to their own individual experience, the MBAs ended up very far away from the optimal allocation—thus, poor overall performance. However, in the second treatment when they mimicked each other's investments, the group zeroed in on the optimal allocation by the end of the game. Here, the whole group made more money, which is interesting since there were no incentives for group performance, as grade assignments were all based on relative rankings. Finally, while opportunities to imitate each other had a dramatic effect on improving the overall group performance, it also led to some individual catastrophes. Sometimes top performers had taken large risks, which paid off in the short-run—they got lucky. But, their risky allocations, which often included massive borrowing, were copied by others. Since you can't copy the luck along with the allocation choices, an inflated number of bankruptcies resulted as a side-effect.[43]

The central finding of this experiment, that people are inclined to copy more successful others, has been repeatedly observed in an immense variety of domains, both in controlled laboratory conditions and in real world patterns.[44] In experiments, undergraduates rely on *success-bias* learning when real money is on the line—when they are paid for correct answers or superior performance. In fact, the more challenging the problem or the greater the uncertainty, the more inclined people are to rely on cultural learning, as predicted by evolutionary models. This tells us something about *when* individuals will rely on cultural learning over their own direct experience or intuitions.[45]

Interestingly, if you are a real stock market investor, this is now a formal strategy: you can purchase Exchange-Traded Funds (ETFs) that match the picks of the market gurus (GURU), billionaire investors (iBillionaire) or the top money managers (ALFA).[46] (but, remember, you can't copy their luck)

Experimentally, economists have also shown that people rely on this skill- or success-biased cultural learning to (1) infer and copy others' beliefs about the state of the world, even when others have identical information, and (2) adapt to competitive situations, where copying others is far from the optimal strategy. In the real world, farmers from around the globe adopt new technologies, practices and crops from their more successful neighbors.[47]

Running in parallel with the work in economics, decades of work by psychologists have also shown the importance of success and skill biases. This work underlines the point that these learning mechanisms operate outside conscious awareness, and with or without incentives for correct answers.[48] One set of recent experiments by Alex Mesoudi and his collaborators are particularly relevant for our focus here on complex technologies.[49] In his arrowhead design task, participants engaged in repeated rounds of trial and error learning, using different arrowhead designs to engage in virtual hunting on a computer. Whenever the opportunities were made available, students readily used success-biased cultural learning to help design their arrowheads. When cultural information was available, this rapidly led the group to the optimal arrowhead design, and was most effective in more complex, more realistic environments.

In the last fifteen years, an important complementary line of evidence has become available, as developmental psychologists have returned to focusing on cultural learning in children and infants. With new evolutionary thinking in the air, they have zoomed in on testing specific ideas about the *who*, *when* and *what* of cultural learning. It's now clear that infants and young children use cues of competence and reliability, along with familiarity, to figure out from whom to learn. In fact, by age one, infants use their own early cultural knowledge to figure out who tends to know things, and then use this performance information to focus their learning, attention and memory.

Infants are well-known to engage in what developmental psychologist call "social referencing". When an infant, or young child, encounters something novel, say when crawling up to a chainsaw, they will often look at their mom, or some other adult in the room, to check for an emotional reaction. If the attending adult shows positive affect, they often proceed to investigate the novel object. If the adult shows fear or concern, they back off. This occurs even if the attending adult is a stranger. In one experiment, moms brought one year olds to the laboratory at Seoul National University. The infants were allowed to play, and get comfortable in the new environment, while mom received training for her role in the experiment. The researchers had selected three categories of toys, those to which infants typically react (1) positively, (2) negatively, and (3) with uncertain curiosity (an ambiguous toy). These different kinds of toys were each placed in front of the infants, one at a time, and the infant's reactions were recorded. Mom and a female stranger sat on either side of the baby, and were instructed to react either with smiling and excitement or with fear.

The results of this study are strikingly parallel to studies of cultural learning among both young children and university students. First, the babies engage in social referencing, looking at one of the adults, four times more often, and more quickly, when an ambiguous toy was placed in front of them. That is, under uncertainty, they used cultural learning. This is precisely what an evolutionary approach predicts for *when* individuals should use cultural learning. Second, when faced with an ambiguous toy, babies altered their behavior based on the adults' emotional reactions: when they saw fear, they backed off, but when they saw happiness, they approached the toy and changed to regard it more positively. Third, infants tended to reference the stranger more than their moms, probably because mom herself was new to this environment and was thus judged less competent by her baby.[50]

By 14 months, infants are already well beyond social referencing, and already showing signs of using skill or competence cues to select models. After observing an adult model acting confused by shoes, placing them on his hands, German infants tend not to copy his unusual way of turning on a novel lighting device, using his head. However, if the model acts competently, confidently putting shoes on his feet, babies tend to copy the model, and used their heads to activate the novel lighting device.[51]

Later, by age 3, a substantial amount of work shows that kids not only track and use competence in their immediate cultural learning but in many domains, including for learning both tools and words. For example, young children will note who knows the correct linguistic labels for common objects (like "ducks"), use this information for targeting their learning about novel tools or words, and retain this competence information for a week, using it to preferentially learn new things from the previously competent model.[52]

PRESTIGE

By watching whom others watch, listen to, defer to, hang-around and imitate, learners can more effectively figure out from whom to learn. Using these "prestige cues" allows learners to take advantage of the fact that other people also are seeking, and have obtained, insights about who in the local community is likely to possess useful, adaptive, information. Once people have identified a person as worthy of learning from, perhaps because they've learned about their success, they necessarily need to be around them, watching, listening and eliciting information through interaction. Since they are trying to obtain information, learners defer to their chosen models in conversation, often giving them 'the floor.' And, of course, learners automatically and unconsciously imitate their chosen models, including by matching their speech patterns (see Chapter 8). Thus, we humans are sensitive to a set of ethological patterns (bodily postures or displays), including visual attention, 'holding the floor', deference in conversation and vocal mimicry, as well as others. We use these prestige cues to help us rapidly zero in on whom to learn from. In essence, prestige cues represent a kind of second-order cultural learning in which we figure out who to learn from by inferring from others' behavior who they think are worthy of learning from—that is, we culturally learn from whom to learn.

Despite the seeming ubiquity of this phenomenon in the real world, there is actually relatively little direct experimental evidence that people use prestige-cues. There is an immense amount of indirect evidence which shows how the prestige of a person or source, such as a newspaper or celebrity, increases the persuasiveness of what they say, or the tendencies of people to remember what they say. This occurs even when the prestige of a person comes from a domain, like golf, far removed from the issue they are commenting on (like automobile quality). This provides some evidence, though it does not get a the specific cues that learners might actually use to guide them, aside from being told that someone is an "expert" or "the best".[53]

To address this in our laboratory, Maciej Chudek, Sue Birch and I tested this prestige idea more directly. Sue is a developmental psychologist and Maciej was my graduate student (he did all the real work). We had preschoolers watch a video in which they saw two different potential models use the same object in one of two different ways. In the video, two bystanders entered, looked at both models, and then preferentially watched one of them—the "prestigious model". Then, participants saw each model select one of two different types of unfamiliar foods and one of two differently colored beverages. They also saw each model use a toy in one of two distinct ways. After the video, the kids were permitted to select one of the two novel foods and one of the two colorful beverages. They could also use the toy any way they wanted. Children were 13 times more likely to use the toy in the same manner as the prestige-cued model, compared to the other model. They were also about 4 times more likely to select the food or beverage preferred by the prestige-cued model. Based on questions asked at the end of the experiment, the children had no conscious or expressible awareness of the prestige cues or their effects. These experiments show that young children rapidly and unconsciously tune into the visual attention of others, and use this to direct their cultural learning. We are prestige-biased, as well as being skill- and success-biased.[54]

Chapter 8 expands on these ideas to explore how selective cultural learning drove the evolution of a second form of social status in humans called Prestige, which in our species resides alongside Dominance status, which we inherited from our primate ancestors. We'll see why, for example, it is possible to become famous for being famous in the modern world.

Self-similarity: sex and ethnicity

Automatically and unconsciously, people also use cues of self-similarity, like sex and ethnicity, to further hone and personalize their cultural learning. Self-similarity cues help learners acquire the skills, practices, beliefs and motivations that are, or were in our evolutionary past, most likely to be suitable to them, their talents, or their likely roles later in life. For example, many anthropologists argue that the division of labor between males and females is hundreds of thousands of years old in our species' lineage. If true, we should expect males to preferentially hang around, attend to, and learn from other males—and vice-versa for females. This will result in novices learning the skills and expectations required for their likely roles later in life, as mothers, hunters, cooks and weavers. Similarly, since individual differences like height or personality might influence one's success in various endeavors, learners may preferentially attend to those who they are similar to along these dimensions. In Chapter 11, I will further detail the evolutionary logic underpinning the prediction that learners should preferentially attend to, and learn from, those who share their ethnic-group markers, such as language, dialect, beliefs and food preferences. In short, these cues allow learners to focus on those most likely to possess the social norms, symbols, and practices that the learners will need over their life course, for successful and coordinated social interactions.

There is ample evidence from psychological experiments—going back 40 years—that both children and adults preferentially interact with, and learn from, same-sex models over opposite-sex models. In young children, this occurs even before they develop a gender identity, and influences their learning from parents, teachers, peers, strangers and celebrities. In fact, children learn their sex roles because they copy same-sex models, not vice-versa. Evidence indicates that this learning bias influences diverse cultural domains, including musical tastes, aggression, postures and object preferences. Later, we'll see that in the real world, it influences both students' learning (and performance) as well as patterns of copycat suicide.[55]

Recent work by brain scientist Elizabeth Reynolds Losin, a former student of mine, and her colleagues at UCLA has begun to illuminate the neurological underpinnings of sex-biased cultural learning. Using fMRI technology, Liz focused on the difference between people's brains when they imitated a same-sex model vs. an opposite-sex model. She asked both men and women in Los Angeles to first watch and then imitate arbitrary hand gestures either of a same-sex or opposite sex model. By comparing the same individuals' brain activity while watching vs. watching-and-imitating both same and opposite sex models, Liz shows that women find mimicking other women more rewarding—neurologically speaking—than mimicking men. Men showed the opposite pattern: firing activity was higher in the nucleus accumbens, dorsal and ventral striatum, orbital frontal cortex and left amygdala when people copied the gestures of same-sex models. Their analysis of the existing database of brain studies reveals that this pattern of brain activity emerges when people receive a reward, such as money, for getting the correct answer. This finding suggests that we experience copying same-sex others as internally more rewarding than copying opposite sex others. We like it more, so naturally we are inclined to do it more.

While research on ethnicity biases in cultural learning are more limited, it's increasingly clear that infants, young children and adults preferentially learn from co-ethnics—meaning that people attend to and selectively learn from those who share their ethnic markers. Young children preferentially acquire both food preferences and learn the functions of novel objects from those who share their language or dialect. This is true even when the potential models speak jabberwocky—English-sounding speech composed of nonsense words. That is, kids prefer to learn from those speaking nonsense *in their own dialect* over someone speaking nonsense in a different dialect (suddenly, I'm reminded of much American political discourse). Infants preferentially copy the unusual and more difficult action—turning on a lamp with their head—of someone who speaks their language (German) as opposed to an unfamiliar language (Russian). And, children and adults prefer to learn from those who already share some their beliefs.[56]

These laboratory findings suggest that cues related to sex and ethnicity fire up our cultural learning psychology in ways that spark our interest in what the model is doing, or talking about, and focus our attention and memory. If true, students may learn more effectively from teachers or professors who match them on these dimensions, which may impact a person's grades, choice of major, or career preferences. Formal education is, after all, primarily an institution for intensive cultural transmission. Of course, identifying this learning bias as a causal influence is tricky in the real world because teachers have biases too, which may lead them to preferentially assist or reward those who share their sex or ethnic markers. Isolating causality in the real world is what economists are best at, so let's bring in some economists.

By exploiting large datasets of students, courses and instructors, my UBC colleague Florian Hoffman and his collaborators unearthed real-world evidence consistent with the experimental findings discussed above: being taught by instructors that you match on ethnicity/race reduces your dropout rate and increases your grades. In fact, for African-American students at a community college, being taught by an African-American instructor reduced class dropout rates by 6 percentage points and increased the fraction attaining a B or better by 13 percentage points. Similarly, using data from freshman (first years) at the University of Toronto, Florian's team has also shown that getting assigned to a same-sex instructor increased students' grades a bit.

Unlike many efforts before them, Florian and his colleagues addressed concerns that these patterns are created by the instructors' biases, in part, by focusing on large undergraduate lectures where students (1) could not influence which instructors they got, (2) were anonymous to the professor, and (3) were graded by teaching assistants, not by the professors.[57] All this points to biases in who learners readily tune in to, and learn from.

Our cultural learning biases are why role models matter so much.

OLDER INDIVIDUALS OFTEN DO KNOW MORE

Both as an indirect measure of competence or experience, and as a measure of self-similarity, age cues may be important for cultural learning for two separate evolutionary reasons. For children, focusing on and learning from older children allows them to learn from more experienced individuals while at the same time providing a means of self-scaffolding, allowing them to bridge gradually from less to more complex skills. The idea here is that while a learner may be able to locate, and sometimes learn from the most successful or skilled person in his community (say, the best hunter, in a foraging band), many young learners will be too inexperienced or ill-equipped to take advantage of the nuances and fine points that distinguish the top hunters. Instead, by focusing instead on older children, young learners can isolate models who are operating at an appropriate increment of skill and complexity above their own. This creates a smoother and more continuous process of gradual skill acquisition, as learners move back and forth from observing older models to practicing, and repeat the process as they grow up. This is why, for example, younger children are often so desperate to hang around their "big cousins" or older siblings, and why mix-age playgroups are the standard in small-scale societies.

Consistent with this evolutionary expectations, young children do assess the age of potential models, perhaps by assessing physical size. Young children often prefer older models unless these individuals have proven unreliable. They trade-off *age* against *competence* and in some cases will prefer younger but more competent models to older, less competent ones. For example, in one experiment second graders preferentially imitated the fruit choices of their fellow second graders over kindergarten models. However, when shown that some kindergarteners and second graders were superior puzzle solvers, many second graders shifted to the fruit choices of these good puzzle solvers, even if they were sometimes kindergarteners. In general, children and infants shift their food preferences in response to observing older, same-sex, models enjoying certain foods. Even infants, as young as 14 months, are sensitive to age cues.[58]

At the other end of the age spectrum, merely getting to be old was a major accomplishment in the societies of our evolutionary past. By the time ancient hunter-gatherers reached 65, and some did, natural selection had already filtered many out of their cohort. This means not only were the senior members of a community the most experienced, but they had emerged from decades of natural selection acting selectively to shrink their age cohort. To see how this works, imagine you have a community with 100 people between the ages of 20 and 30. Of these 100, only 40 people routinely prepare their meat dishes using Chili peppers. Suppose that using Chili peppers, by virtue of their antimicrobial properties, suppresses food-borne pathogens and thereby reduces a person's chances of getting sick. If, year after year, the impact of this practice increases a person's chances of living past 65 from 10% to 20%, then a majority of this cohort, 57%, will be chili pepper eaters by the time they reach 65. If learners preferentially copy the older cohort, instead of the younger cohort, they will have a greater chance of acquiring this survival increasing cultural trait. This is true even if they have no idea that chili peppers have any health impacts (see Chapter 7). Age-biased cultural learning here can thus amplify the action of natural selection, as it creates differential mortality.[59]

WHY CARE WHAT OTHERS THINK? CONFORMIST TRANSMISSION

Suppose you are in a foreign city, hungry, and trying to pick one of ten possible restaurants on a busy street. You can't read the menus because you don't know the local language, but you can tell that the prices and atmospheres of each establishment are identical. One place has 40 diners, six have 10 diners, and three are empty, except for the wait staff. If you would pick the restaurant with 40 people (out of the 100 you've observed), *more than* 40% of the time, then you are using conformist transmission—you are strongly inclined to copy the most common trait—the majority or the plurality.

Evolutionary models, built to mathematically capture the logic of natural selection, predict that learners ought to use what's called *conformist transmission* to tackle a variety of learning problems. As long as individual learning, intuitions, direct experience and other cultural learning mechanisms tend to produce adaptive practices, beliefs and motivations, than conformist transmission can help learners aggregate the information that is distributed across a group. For example, suppose long experience fishing will tend to cause an experienced angler to prefer the blood knot to other potential knots (for connecting monofilament line) because the blood knot is objectively the best. However, individual experiences will vary, so suppose that long experience alone leads to only a 50% chance of an angler converging on the blood knot, a 30% chance of using the fisherman's knot, and a 20% chance of using one of five other knots. A conformist learner can exploit this situation, and jump directly to the blood knot without experience. Thus, the wisdom of crowds is built-in to our psychology.

There is some laboratory evidence for conformist transmission, both in humans and sticklebacks (a fish), though there is not nearly as much as for the model-based cues discussed above. Nevertheless, when problems are difficult, uncertainty is high or payoffs are on the line, people tend to use conformist transmission.[60]

Of course, we should expect learners to combine the learning heuristics I've described. For example, with regard to chili peppers, a learner who applies conformist transmission to only the older cohort (sorting with age cues) will increase his or her chances of adopting this adaptive practice. If they are strong conformist learners, they will get the adaptive answer 100% of the time.

CULTURALLY-TRANSMITTED SUICIDE

You probably know that committing suicide is prestige-biased: when celebrities commit suicide there is a spike in suicide rates (celebrities: keep this in mind!). This pattern has been observed in the U.S., Germany, Australia, South Korea and Japan, among other countries. Alongside prestige, the cultural transmission of suicide is also influenced by self-similarity cues. The individuals who kill themselves soon after celebrities tend to match their models on sex, age and ethnicity. Moreover, it's not just that a celebrity suicide vaguely triggers the suicide of others. We know people are imitating because they copy not only the act of suicide itself, but also the specific methods used, such as throwing oneself in front of a train. Moreover, most celebrity-induced copycat suicides are ***not*** *tragedies that would have occurred anyway*. If that were the case, there would be an eventual dip in suicide rates, below the long-run average at some point after the spike, but there is not.[61] These are extra suicides that otherwise would not have occurred.

These effects can also be seen in suicide epidemics. Beginning in 1960, a striking pattern of suicide rippled through the pacific islands of Micronesia for about 25 years. As the epidemic spread, the suicides assumed a distinct pattern. The typical victim was a young male between 15 and 24 (modal age of 18) who still lived with his parents. After a disagreement with his parents or girlfriend, the victim experienced a vision in which past victims beckoned for him to come to them (we know this from attempted suicides). In heeding their call, the victim performed a "lean hanging", sometimes in an abandoned house. In a lean hanging, victims lean into the noose from a standing or kneeling position. This gradually depletes the victim's supply of oxygen, resulting in a loss of consciousness and then death. These suicides occurred in localized and sporadic outbreaks among socially interconnected adolescents and young men, a pattern common elsewhere. Sometimes these epidemics could be traced to a particular spark, such as the suicide of a 29-year-old prominent son of a wealthy family. In 75% of the cases, there was no prior hint of suicide or depression. Interestingly, these epidemics were restricted to only two ethnic groups within Micronesia, the Trukese and Marshallese.[62] Here we see that prestige and self-similarity, including both sex and ethnicity, shape the diffusion of suicide.

While most people don't copy suicide, this domain illustrates just how potent our cultural learning abilities can be, and how they influence broad social patterns. If people will acquire suicidal behavior via cultural learning, it's not clear what the boundaries are on the power of culture in our species. Copying suicide highlights the potency of our imitative tendencies, and means that under the right conditions we can acquire practices via cultural learning that natural selection has directly acted to eliminate under most conditions. If humans will imitate something that is so starkly not in our self-interest, or that of our genes, imagine all the other less costly things we are willing to acquire by cultural transmission.

In addition to using model-based mechanisms for cultural learning, we should also expect natural selection to have equipped us with psychological abilities and biases for learning about certain predictable content domains, such as food, fire, edible plants, tools, social norms and reputations (gossip), which have likely been important over long stretches of our species' evolutionary history. Here, natural selection may have favored attention and interest in these domains, as well as inferential biases, leading to ready encoding in memory and greater learnability. In the coming chapters, we'll explore how culture-gene coevolution drove the emergence of some of these specialized cognitive abilities or *content biases*. We'll see evidence for content biases for learning about fire, throwing, plants, animals, artifacts, social norms and ethnic groups.

What's Mentalizing for?

If humans are a cultural species, then one of our most crucial adaptations is our ability to keenly observe and learn from other people. Central to our cultural learning is our ability to make inferences about the goals, preferences, motivations, intentions, beliefs and strategies in the minds of others. These cognitive abilities relate to what is variously termed *mentalizing* or *theory of mind*. Any learner who misses the boat on mentalizing and cultural learning, or gets started too late, will be at a serious disadvantage because they won't have acquired all the norms, skills, and know-how necessary to compete with other, better, cultural learners. This suggests that the mental machinery we need for cultural learning ought to fire-up relatively early in our development. It's this mental machinery that we will rely on to figure out what to eat, how to communicate, who to avoid, how to behave, which skills to practice, and much more.

Evidence from young children and infants in Western populations combined with recent cross-cultural work in Fiji, Amazonia and China suggests that these mentalizing abilities begin to develop early and reliably across diverse human societies. By roughly eight months, infants in at least some societies have developed an ability to infer intentions and goals, and recognize who likely has knowledge and who does not. Infants, for example, will copy a model's goals or intentions, such as grasping a toy, even when the model fails to achieve his goal, but they won't copy unintentional actions that create the same physical results. By the time they are toddling, children are already making sophisticated judgments about others' mental states, recognizing for example that a potential model mislabeled a familiar object and then subsequently devaluing what that model has to say. Similarly, toddlers can figure out what aspects of context are new for their model, and use this to better target their learning, even when those same aspects are familiar to the learner.[63]

Though they agree mentalizing is important, many evolutionary researchers argue that these cognitive abilities evolved genetically in our lineage so we can better trick, manipulate and deceive other members of our group—this is part of the *Machiavellian Intelligence Hypothesis*. The idea is that if Robin can infer Mike's goals, motivations or beliefs, then Robin can exploit or manipulate Mike. He can out think him, and then outmaneuver him.[64]

However, another possibility is that mentalizing first evolved in our lineage, or perhaps was re-tasked away from trickery, deception and manipulation, so that we could better learn from others, by more effectively inferring our models' underlying goals, strategies and preferences for the purpose of copying them. Mentalizing also may help us teach more effectively, since good teaching requires us to assess what learners need to know. This flows from the *Cultural Intelligence Hypothesis*.[65]

In my psychology laboratory at UBC, our team has sought to allow these two hypotheses to face-off against each other. In a novel situation, we gave young children the opportunity to deploy their mentalizing abilities either to copy the strategies of others or to exploit a hapless opponent. The results are stark: children strongly favor cultural learning over Machiavellian exploitation, even when their payoffs and personal experience point them away from copying others.

Of course, this doesn't mean that mentalizing isn't also deployed for social strategizing, as it clearly is in chimpanzees.[66] But, what it does imply is that in humans you first need to acquire the social norms and rules governing the world you are operating in, and only then is strategic thinking useful. In our world, even successful Machiavellians must first be skilled cultural learners. You can't bend, exploit and manipulate the rules until you first figure out what the rules are.

Learning to learn, and to teach

The evidence from infants and young children now suggest that humans rapidly develop a heavy reliance on carefully attending to, and learning from, other people, often using their mentalizing skills, and that they readily begin using cues such as success and prestige to figure out who to learn from. However, it seems likely that both our degree of reliance on cultural learning over our own experience or innate intuitions, as well as how heavily we weight cues of prestige or gender vis-à-vis other cues may be itself tuned by both our own direct experience and our observations of others. That is, we need to be able to calibrate these systems for the contexts we encounter in the world.[67]

The importance of both direct experience and the observation of others is particularly clear for developing teaching abilities. Teaching is the flip side of cultural learning. It occurs when the model becomes an active transmitter of information. Later, I'll discuss some evidence that suggests natural selection has operated to improve our transmission or communicative abilities, especially since the evolution of languages. Nevertheless, most people are still not particularly great teachers especially of complex tasks, concepts or skills, so cultural evolution has produced a wide range of strategies and techniques adapted for more effectively transmitting particular types of content, such as judo, algebra or cooking. This is one way cultural transmission increases its own fidelity—learners acquire both the skills themselves as well as techniques for transmitting them.

In the early days, when our species was just beginning to rely on cultural learning, as cultural evolution was cranking up, it may be that attending to and copying others was acquired by experience, perhaps through trial and error learning, because it tended to get the best answer compared to other learning strategies.[68] Consistent with this, apes reared by humans, sometimes in human families, seem to be better at imitation compared to other apes. Importantly, however, though they improve relative to chimpanzees not reared by humans, they still pale in comparison to human children reared in the identical environments for the same time periods. Such evidence suggests that cultural learning may have initially developed as a response to the enriched environments created by the very earliest accumulations of cultural evolution (see Chapter 16).[69] This learned increase in cultural learning would have permitted a greater accumulation of cultural know-how and further driven genetic evolution to make us better cultural learners. Now, the vast differences we observe between apes and human infants raised in the same environments suggests that the emergence of cultural learning is relatively canalized and rapid in our species, though of course it can still be modified by experience.[70]

Chapter 5

What are big brains for? Or, how culture stole our guts

By selectively attending to certain types of cultural content, like food, sex and tools, and to particular models based on cues related to prestige, success and health, individuals can most efficiently equip themselves with the best available cultural know-how. This culturally acquired repertoire can then be honed and augmented by an individual's experience in the world. Crucially, however, these individually adaptive pursuits have an unintended consequence, which we saw when the MBAs were allowed to copy each other—the whole group gradually zeroed in on the optimal investment allocation. As individuals go about their business of learning from others in their group, the overall body of cultural information contained and distributed across the minds in the group can improve and accumulate over generations.

To see more precisely how cumulative cultural evolution works, imagine a small group of forest-dwelling primates. Figure 5.1 represents this group along the top row, labeled Generation 0, with individuals represented by circles. One member of this generation has, on her own, figured out how to use a stick to extract termites from a termite mound (this trait is labeled T). Figuring this out is plausible for our ancestors, since modern chimpanzees do it. In Generation 1 (row 2), two of the offspring from Generation 1 copy the elder termite fisher because they note her success and are generally interested in 'things related to food'. However, while copying this termiting technique, one member of Generation 1 mistakenly infers that the stick his model was using had been sharpened (though actually, it just broke funny when the model grabbed it). When the learner made his stick, he used his teeth to sharpen it to match his model's stick (In Figure 5.1 T* marks the sharpened stick). Elsewhere, another member of Generation 1 realizes he can use hollow reeds to drink from the water that gathers deep in the troughs of large trees (this 'straw' is labeled T2 in Figure 5.1). He uses this technique to obtain water when he crosses the savannah, between patches of forest. In Generation 2, both the possessors of T2 and T* were preferentially copied, so their practices spread a bit. One member of Generation 2 even managed to pick up both T2 and T*, so she became particularly successful and was copied by three members of Generation 3. Then, one day an inattentive member of Generation 3 plunged his fishing stick into an old, abandon termite mound, not realizing the termites had long departed. Fortuitously, he happened to spear a rodent who had moved in after the termites left. Suddenly, the 'termite fishing stick' became a general-purpose 'hole-spear' (now labeled T**), which allowed this lucky fellow to tap new food sources, as he started plunging his spear into every hole he could find. His success as a hole-spearer meant that several members of Generation 4 attended to and learned from him. Meanwhile, another member of Generation 3, while goofing off, just happened to notice a rabbit enter his hole, after a rain. While looking at the rabbit's tracks in the mud, and thinking how tasty that rabbit would be, it struck her that she could look for tracks like these and follow them to locate active rabbit holes ('rabbit tracking': is labeled T3). This was interesting, but not immediately useful since she had no way to get the rabbit out of the hole. Nevertheless, years later, this mom showed the tracks to her daughter, after they saw a rabbit. This happenstance was crucial, as the daughter had already learned T** ('hole-spear'). Now, she could locate active rabbit holes and deploy her spear—a very useful technique. In Generation 5, while no one invented or lucked into anything, three members had learned T**, T2 and T3. This package—a cultural adaptation—permitted them to spend more time on the savannah tracking rabbits to their holes, since they could also access water with T2 (the 'straw'). Soon, these primates began living at the edge of the forests, so they could hunt on the savannah. I'll call the combination of traits T**, T2 and T3 the 'savannah hunting package'.

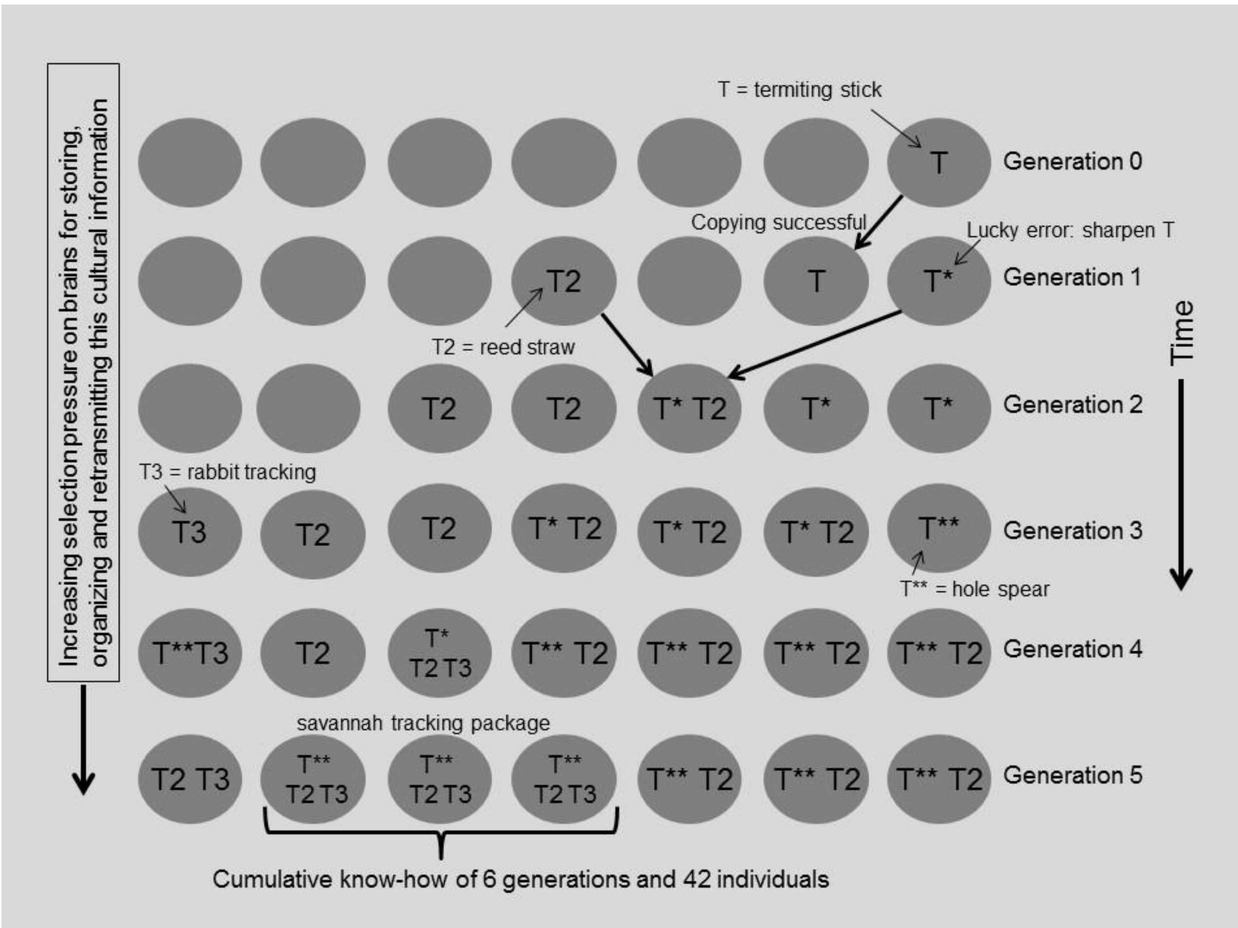


FIGURE 5.1. HOW LEARNING FROM OTHERS GENERATES CUMULATIVE CULTURAL EVOLUTION

Keep in mind that this is a toy example meant to illustrate how selective cultural learning can generate a cumulative evolutionary process that generates cultural packages that are smarter than their bearers. My imaginary primates are better cultural learners than any living primate, except us. Nevertheless, even if I had made them worse learners I could have achieved the same endpoint with a larger population or more generations. Like us (or at least me), these primates were just bumbling myopically around their daily lives. Sometimes their mistakes led to innovations, and sometimes a rare circumstance thrust an insight upon someone who was otherwise goofing off. The key is that these occasional insights and lucky errors were preferentially passed on, persisted and were eventually recombined with other traits to create a savannah hunting package. Now consider this question: is Generation 5 smarter than Generation 0? They have better tools, and can obtain food more efficiently. Later, we will see a variety of evidence suggesting that Generation 5 may in fact be smarter than Generation 0, if "smartness" is defined as an individual's ability to solve novel problems. Of course, there will be caveats and cautions.

This imaginary ancestral primate crossed a crucial evolutionary threshold as it entered a regime of *cumulative cultural evolution*. This threshold is the point at which culturally transmitted information begins to accumulate over generations, such that tools and know-how get increasingly better fit to the local environments—this is the "ratchet effect".[71] It's this process that explains our cultural adaptations, and ultimately, the success of our species. As we'll see in Chapter 7, individuals reliant on cultural adaptations often have little or no understanding of how or why they work, or even that they are "doing" anything adaptive.

The central argument in this book is that relatively early in our species' evolutionary history, perhaps around the origins of our genus (*Homo*) about 2 million years ago, we first crossed this evolutionary *Rubicon*, at which point cultural evolution became the *primary driver of our species' genetic evolution*. This interaction between cultural and genetic evolution generates a process that can be described as *autocatalytic*, meaning that it produces the fuel that propels it. Once cultural information begins to accumulate and produce cultural adaptations, the main selection pressure on genes will revolve around improving our psychological abilities to acquire, store, process and organize the array of fitness-enhancing skills and practices that became increasingly available in the minds of the others in one's group. As genetic evolution improved our brains and abilities for learning from others, cultural evolution spontaneously generated more and better cultural adaptations, which kept the pressure on for brains that were better at acquiring and storing this cultural information. This process will continue until halted by an external constraint.

I call the threshold between typical genetic evolution and the regime of autocatalytic culture-driven genetic evolution *the Rubicon*. During the Roman Republic, the muddy red waters of the river Rubicon marked the boundary between the province of Cisalpine Gaul and Italy proper, which was administered directly by Rome itself. Provincial governors could command Roman troops outside of Italy, but under no circumstances could they enter Italy at the head of an army. Any commander who did this, and any soldier who followed him, were immediately considered outlaws. This rule had served the old republic well until, in 49 BC, Julius Caesar crossed the Rubicon at the head of the loyal Legio XII Gemina. For Caesar and this legion, there was no turning back after crossing the Rubicon; civil war was inevitable and Roman history would be forever altered. Similarly, in crossing our evolutionary Rubicon, the human lineage embarked down a novel evolutionary path from which there was no turning back.

To see why there's no turning back, imagine being a member of Generation 6 in Figure 5.1. Should you focus on inventing a new trait, or on making sure you accurately locate and copy those individuals with T**, T2 and T3? You might invent a good trait, as adaptive as T, but you'll never invent something as good as the savannah hunting package of T**+ T2 + T3. Thus, if you don't focus on cultural learning, you will lose out to those who do.

As the process continues over generations, the selection pressures only increase: the more culture accumulates, the greater the selection pressures on genes for making one an adept cultural learner with a bigger brain capable of harnessing the ever-spiraling body of cultural information. Figure 5.1 illustrates the point. Consider the memory—or brain storage space—required by our six different generations. In Generation 0, at most, you could invent one trait in your lifetime, so you only need brain space for one trait. However, by Generation 5, you'd better have storage space in your brain for T**, T2 and T3—and you'd best know how they fit together. The memory space demanded in Generation 5, if one wants any chance of out surviving and reproducing others in the population, has increased three-fold in only six generations. If genes spread that expand the brains of Generation 6, the selection pressure for bigger and better brains won't abate because cultural evolution will continue to expand the size of the cultural repertoire—of the body of know-how one could learn, if one were sufficiently well-equipped. This culture-gene coevolutionary ratchet made us human.

Table 5.1. Examples of how cultural evolution, and it products, have shaped human genetic evolution

Chapters Covered	Culturally-transmitted selection pressure	Coevolved Genetic Consequences	Other Implications
2-5, 7-8, 16	Cumulative Culture Accumulating body of cultural knowledge creates dependence	Specialized cultural learning abilities for selectively acquiring adaptive information from others Long childhoods and larger brains, prepared for cultural learning and practice, with extensive brain 'wiring' over decades	Selection pressure for greater sociality. Difficult child birth, due to oversized heads Demands for more childcare
5-7, 12, 15	Food Processing Cooking, leaching, pounding, chopping	Increasing dependence on processed food, including cooked foods. Results in small teeth, gapes, mouths, colons and stomachs; possible interest in fire during childhood	Frees energy for brain building and favors the sexual division of labor
5	Persistence Hunting Tracking, water containers & animal behavioral know-how	Distance running facilitated by springy arches, slow-twitch muscle fibers, shock enforced joints, a nuchal ligament, & innervated eccrine sweat glands	Human lineage becomes high level predator
5, 7	Folkbiology Spiraling knowledge about plants and animals	Folk biological cognition: hierarchical taxonomies with essentialized categories, category-based induction and taxonomic inheritance	Universal tree-like taxonomies for categorizing the natural world
5, 12, 13, 15	Artifacts Increasingly complex tools and weapons	Anatomical changes to hands, shoulders and elbow. Direct cortical connections into spinal cord. Artifact cognition: functional stance	Greater manual dexterity and throwing abilities. Increased physical weakness
4, 5, 8, 12, 15, 16	Wisdom of Age Opportunities to use and transmit culture gleaned over a lifetime	Changes in human life history: an extended childhood, adolescence, and a longer-post reproductive lifespan (menopause)	Cooperation in child investment and rearing
4, 7, 12, 13	Complex Adaptations Pressure for high fidelity cultural learning	Sophisticated abilities to infer others mental states—theory of mind or mentalizing over-imitation	Dualism: a preparedness to understand minds without bodies
4, 8	Information Resources Variation skill or know-how among individuals	Prestige status: suite of motivations, emotions, and ethological patterns that produce a second type of status	Prestige-based leadership and greater cooperation
9-11	Social Norms enforced by reputations and sanctions	Norm psychology: concerns with reputation, internalization of norms, prosocial biases, shame and anger at norm violators, cognitive abilities for detecting violations	Strengthens effect of intergroup competition on cultural evolution
11	Ethnic Groups Culturally-marked membership across social groups	Folksociology: in-group vs. out-group psychology that cues off phenotypic markers, which influence cultural learning and interaction	Tribal/ethnic groups, later nationalism and parochial religions
13	Languages Transmitted gestures & vocalizations	Changes in throat anatomy, audio processing, specialized brain regions, and tongue dexterity	Massive increase in the rate of cultural transmission
13	Teaching Opportunities to facilitate cultural transmission	Communicative or pedagogical adaptations: white sclera (whites of the eyes), eye-contact, pedagogical inclinations, etc.	Higher fidelity transmission and more rapidly cultural evolution

We've already seen some of the evidence that culture drove human evolution. In Chapter 2, we saw that when toddlers competed against other apes in a variety of cognitive tasks, the only domain in which they kicked ass was Social Learning. Otherwise, for Quantities, Causality and Space, it was pretty much a tie. That's precisely what you'd expect if culture drove the expansion of our brains, honed our cognitive abilities and modified our social motivations. In Chapter 3, by accompanying various hapless explorers, we saw that our species ability to live as hunter-gatherers depends on acquiring the local cultural knowledge and skills. Chapter 4 explored how natural selection has shaped our psychology to allow us to selectively target and extract adaptive information from our social milieu.

Moving forward, Table 5.1 summarizes some of the products of culture-gene coevolution that I cover in this book. To begin, here I first examine five ways in which cultural evolution has influenced, and interacted with, genetic evolution, to shape our bodies, brains and psychology. To understand Table 5.1 look first at the column labeled "Culturally transmitted selection pressure". These are features of the world that were created by cultural evolution, but subsequently had consequences for genetic evolution (given in the column "Coevolved Genetic Consequence"), and sparked a coevolutionary duet between genes and culture.

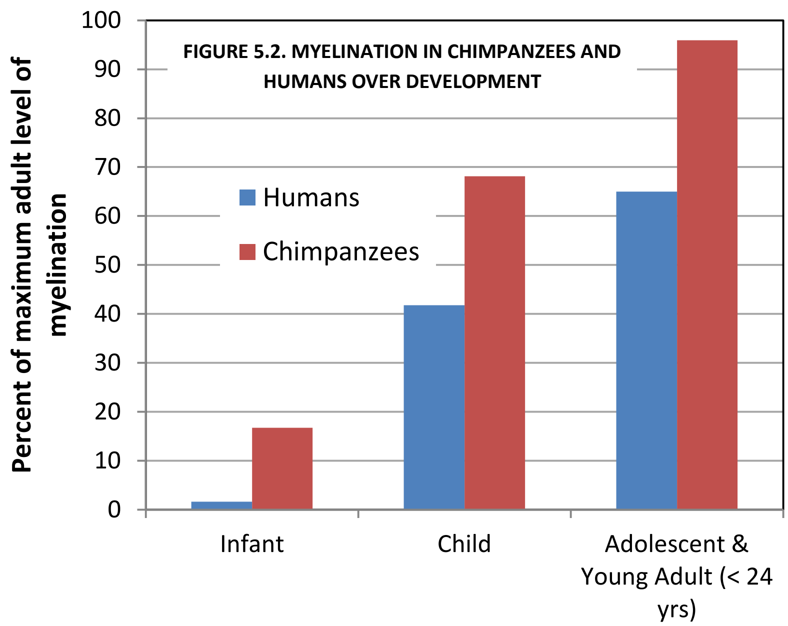
Now, let's examine how crossing the evolutionary Rubicon into a regime of cumulative cultural evolution helps explain several of our species' characteristics.

Big Brains, Fast Evolution and Slow Development

Compared to other animals, our brains are big, dense and groovy. While we don't have the biggest brains in the natural world—whales and elephants beat us—we do have the most cortical interconnections and the highest degree of cortical folding. Cortical folding produces that 'crumpled wad of paper' (groovy) appearance that particularly characterizes human brains. But, that's just the beginning of our oddities. Our brains evolved from the size of a chimpanzee's, at roughly $350cm^3$, to $1350cm^3$ in about five million years. Most of that expansion, from about $500cm^3$ upward, took place only in about the last 2 million years. That's fast, in genetic evolutionary terms.

This expansion was finally halted about 200,000 years ago, probably by the challenges of giving birth to babies with increasingly bulbous heads. In most species, the birth canal is larger than the newborn's head, but not in humans. Infant skulls have to remain unfused in order to squeeze through the birth canal in a manner that isn't seen in other species. It seems our brains only ceased expanding because we hit the stops set by our primate body plan; if babies' heads got any bigger, they wouldn't be able to squeeze out of mom at birth. Along the way, natural selection came up with numerous tricks to circumvent this *big-headed baby problem*, including intense cortical folding, high-density interconnections (which permit our brains hold more information without getting bigger) and a rapid post-birth expansion. Specifically, newborn human brains continue expanding at the faster pre-birth gestational rate for the first year, eventually tripling in size. By contrast, newborn primate brains grow more slowly after birth, eventually only doubling in size.[72]

After this initial growth spurt, our brains continue adding more connections for holding and processing information (new glial cells, axons, and synapses) over the next three decades of life and even beyond, especially in the neocortex. Consider our white matter, and specifically the process of myelination. As vertebrate brains mature, their white matter increases as the (axonal) connections among neurons are gradually 'burned in', and wrapped in a performance-enhancing coating of fat called myelin. This process of myelination makes brain regions more efficient, but less plastic and thus less susceptible to learning. To see how human brains are different, we can compare our myelination with our closest relatives, chimpanzees. For the cerebral cortex, Figure 5.2 shows the fraction of myelination (as a percentage of the adult level) during three different developmental periods: (1) infancy, (2) childhood (called the "juvenile period" in primates), and (3) adolescence and young adulthood. Infant chimpanzees arrive in the world with 15% of their cortex already myelinized while humans start with only 1.6% myelinized. For the neocortex, which has evolved more recently and is massive in humans, the percentages are 20% and 0%, respectively. During adolescence and young adulthood, humans still have only 65% of their eventual myelination complete, while chimpanzees are almost done, at 96%. These data suggest that, unlike chimpanzees, we continue substantial 'wiring up' into our third decade of life.[73]



Human brain development is related to another unusual feature of our species, our extended childhoods and the emergence of that memorable period called adolescence. Compared to other primates, our gestational and infancy periods (birth to weaning) have shortened while our childhoods have extended and a uniquely human period of adolescence has emerged, prior to full maturity. Childhood is a period of intensive cultural learning, including playing and the practicing of adult roles and skills, during which time our brains reach nearly their adult size while our bodies remain small. Adolescence begins at sexual maturity, after which a growth spurt ensues. During this time, we engage in apprenticeships, as we hone the most complex of adult skills and areas of knowledge, as well as building relationships with peers and looking for mates.[74]

The emergence of adolescence and young adulthood has likely been crucial over our evolutionary history, since in hunting and gathering populations, hunters do not produce enough calories to even feed themselves (let alone others) until around age 18, and won't reach their peak productivity until their late 30s. Interestingly, while hunters reach their peak strength and speed in their 20s, individual hunting success does not peak until around age 40, because success depends more on know-how and refined skills than on physical prowess. By contrast, chimpanzees—who also hunt and gather—can obtain enough calories to sustain themselves immediately after infancy ends, around age 5.[75] Consistent with our long period of wiring up, this pattern and contrast with chimpanzees reveals the degree to which we humans are dependent on learning for our survival as foragers.

Our unusually big brains, with their slow neurological and behavioral development but rapid evolutionary expansion, is precisely what you'd expect if cumulative cultural evolution had become the driving selection pressure in the evolution of our species. Once cumulative cultural evolution began to produce cultural adaptations, like cooking and spears, individuals whose genes have endowed them with the brains and developmental processes that permit them to most effectively acquire, store and organize cultural information will be most likely to survive, find mates, and leave progeny. As each generation gets brains that are a little bigger and a little better at cultural learning, the body of adaptive know-how will rapidly expand to fill any available brain space. This process will shape the development of our brains, by keeping them maximally plastic and "programmed to receive", and our bodies, by keeping them small (and calorically inexpensive) until we've learned enough to survive. This culture-gene coevolutionary interaction creates an autocatalytic process such that no matter how big brains get, there will always be much more cultural information in the world than any one individual could learn in his lifetime. The better our brains got at cultural learning, the faster adaptive cultural information accumulated, and the greater the pressure on brains to acquire and store this information.

This view also explains three puzzling facts about human infants. First, compared to other species, babies are physically altricial, meaning that they are weak, undermuscled, fat and uncoordinated (sorry babies, but its true). By contrast, some mammals exit the womb ready to walk, and even primates rapidly figure out how to hang onto mom. Meanwhile, above the neck, human babies' brains are developmentally advanced at birth compared to other animals, having passed more of the mammalian neurological landmarks than other species. Fetuses are already acquiring aspects of language in the womb (see Chapter 13), and babies arrive ready to engage in cultural learning. Before they can walk, feed themselves or safely defecate, infants are selectively learning from others based on cues of competence and reliability (Chapter 4), and can read others' intentions in order to copy their goals.[76] Third, despite being otherwise developmentally and cognitively advanced, babies' brains arrive highly plastic (unmylenized) and continue to expand at their gestational rate. In short, while otherwise nearly helpless, babies and toddlers are sophisticated cultural learning machines.

Natural selection has made us a cultural species by altering our development in ways that (1) slow the growth of our bodies through a shortened infancy and extended childhood, but added a growth spurt in adolescence, and (2) altered neurological development in complex ways that make our brain advanced at birth, yet both highly expandable and enduringly plastic. As we go along, I consider how our fast genetic evolution, big adult brains, slow bodily development, and gradual wiring up are made possible only as part of a larger package of features that include the sexual division of labor, intensive parental investment in children and the long post-reproductive lives we associate with menopause. These features of our species will interact in crucial ways with cultural evolution.

FOOD PROCESSING EXTERNALIZES DIGESTION

Compared to other primates, humans have an unusual digestive system. Starting at the top, our mouths, gapes, lips and teeth are oddly small, and our lip muscles are weak. Our mouths are the size of a squirrel monkey's, a species that weighs less than 3 pounds. Chimpanzees can open their mouths twice as wide as we can, and hold substantial amounts of food compressed between their lips and large teeth. We also have puny jaw muscles that reach up only to just below our ears. Other primates' jaw muscles stretch to the tops of their heads, where they sometimes even latch onto a bony central ridge. Our stomachs are small, having only a third of the surface area that we'd expect for a primate of our size, and our colons are too short, being only 60 percent of their expected mass. Our bodies are also poor at detoxifying wild foods. Overall, our guts—stomachs, small intestines, and colons—are much smaller than they ought to be for our overall body size. Compared to other primates, we lack a substantial amount of digestive power all the way down the line, from our mouth's (in)ability to breakdown food to our colon's capacity to process fiber. Interestingly, our small intestines are about the size they should be, an exception that we'll account for below.[77]

How can culture explain this strange physiological feature of humans?

The answer is that our bodies, and in this case our digestive systems, have coevolved with culturally-transmitted know-how related to food processing. People in every society process food, with techniques including cooking, drying, pounding, grinding, leaching, chopping, marinating, smoking and scraping using techniques that have accumulated over generations. Of these, the oldest are probably chopping, scraping and pounding with stone tools. Chopping, scraping and pounding meat can go a long way, as it tenderizes by slicing, dicing and crushing the muscle fibers, which begins to replace some of the functions of teeth, mouths and jaws. Similarly, marinades initiate the chemical breakdown of foods. Acidic marinades, such as that used for the coastal South American dish *ceviche*, begin literally breaking down meat proteins before they reach your mouth, mimicking the approach taken by your stomach acid. And, as we saw with nardoo, leaching is one of a host of techniques hunter-gatherers have long used to process food and remove toxins.

Of all these techniques, cooking is probably the most important piece of cultural know-how that has shaped our digestive system. The primatologist Richard Wrangham, has persuasively argued that cooking (and therefore fire) has played a crucial role in human evolution. Richard and his collaborators lay out how cooking, if done properly, does an immense amount of digestion for us. It softens and prepares both meat and plant foods for digestion. The *right* amount of heating tenderizes, detoxifies and breaks down fibrous tubers and other plant foods. Heating also breaks down the proteins in meat, dramatically reducing the work for our stomach acids. Consequently, by contrast with meat-eating carnivores (e.g., lions), we do not often retain meat in our stomachs for hours, because it typically arrives partially digested by pounding, scraping, marinating and cooking.

While all this food processing reduces the digestive workload of our mouths, stomachs and colons, it does not alter the need to actually absorb nutrients, which is why our small intestines are about the right size for a primate of our stature.

What is often underemphasized in this account is that food processing techniques are primarily products of cultural evolution. Cooking, for example, is not something we instinctually know how to do, or even can easily figure out. If you don't believe me, go outside and make a fire without using any modern technology. Rub two sticks together, make a fire drill, find naturally occurring flint or quartz, etc. Put that big brain to work. Maybe some fire instincts, designed by natural selection to solve this recurrent dilemma of our ancestral environments, will kick in and guide you.

…

No luck? Unless you've had training—that is, received cultural transmission—it's very unlikely you were successful. Our bodies have been shaped by fire and cooking, but we have to learn from others how to make fire and cook. Making fire is so 'unnatural' and technically difficult that some foraging populations have actually lost the ability to make fire. These include the Andaman Islanders (off the coast of Malaysia), Siriono' (Amazonia), Northern Ache' and perhaps Tasmanians. Now, to be clear, they couldn't have survived without fire; they retained fire, but lost the ability to start new fires on demand. When one band's fire was inadvertently extinguished, say during a fierce storm, they had to head off to locate another band whose fire had not gone out (hopefully).[78] However, living in small and widely scattered groups in frosty Paleolithic Europe, the fires of our bigger-brained Neanderthal cousins probably sometimes went out, and weren't be reignited for thousands of years.[79] In Chapter 12, we'll see how and why such important losses are not surprising.

It's likely that our species reliance on fire began with the *control of fire*, perhaps obtained from naturally occurring sources. Nevertheless, just capturing, sustaining and controlling fire requires some know-how. Keeping a fire going may sound easy, but you have to keep it going all the time, during rain storms, high winds and while traveling over long distances. I learned something about this while living in the Peruvian Amazon among an indigenous group called the Matsigenka. After transporting what looked like a dead, charred, log to her distant garden, I saw a Matsigenka woman breathe life back into a hidden ember using a combination of thermal reflection from other logs, kindling and dried moss, which she brought with her. I was also embarrassed when another young Matsigenka woman, with the requisite infant slung at her side, stopped by my house in the village to re-arrange my cooking fire. Her adjustments increased the heat, created a convenient spot for my pot, reduced the smoke (and my choking) and eliminated much of the need for my constant tending.[80]

Cooking is also difficult to learn through individual trial and error learning. For cooking to provide a digestive aid, it has to be done right. Bad cooking can actually make food harder to digest, and increase its toxins. And, what constitutes effective cooking depends on the type of food. With meat, doing the most obvious thing (to me) of placing pieces right in the flames can lead to a hard, charred outside and a raw interior—exactly what you don't want. Consequently, small-scale societies have complex repertoires of food processing techniques, which are specific to the food in question. For example, the best cooking technique for some foods involves wrapping them in leaves and burying them in the fire's ash for a long time (how long?). Meanwhile, many hunters eat the liver of their kill raw, on the spot. Livers, it turns out, are energy rich, soft and delicious when eaten raw—except for those species in which eating the liver can be deadly (do you know which those are?).[81] Inuit hunters don't eat polar bear livers raw because they believe such livers are toxic (and they are correct, according to laboratory research on the question). The rest of the kill is typically butchered, sometimes pounded, possibly dried, and then cooked—though different parts of the kill are cooked in different ways.

The impact of this culturally-transmitted know-how about fire and cooking has had such an impact on our species' genetic evolution that we are now, essentially, addicted to cooked food. Wrangham reviews the literature on the ability of humans to survive by eating only raw foods. His review includes historical cases in which people had to survive without cooking as well as studies of modern fads, such as the "raw foods movement". The long and short of all this is that it's very difficult to survive for months without cooking. Raw-foodists are thin and often feel hungry. Their body fat drops so low that women often stop menstruating, or menstruate only irregularly. This occurs despite the supermarket availability of a vast range of raw foods, the use of powerful processing technologies like blenders, and the consumption of some pre-processed foods. The upshot is that human foraging populations could never survive without cooking; meanwhile, apes do just fine without cooking, though they do love cooked foods.[82]

Our species' increasing dependence on fire and cooking over our evolutionary history may have also shaped our cultural learning psychology in ways that facilitated the acquisition of know-how about fire-making. This is a kind of content bias in our cultural learning. The UCLA anthropologist, Dan Fessler, argues that during middle childhood (ages 6-9) humans go through a phase in which we are strongly attracted to learning about fire, by both observing others and manipulating it ourselves. In small-scale societies, where children are free to engage this curiosity, adolescents have both mastered fire and lost any further interest in it. Interestingly, Fessler also argues that modern societies are unusual because so many children never get to satisfy their curiosity, so their fascination with fire stretches into the teen years and early adulthood.[83]

The influence of socially learned food processing techniques on our genetic evolution probably occurred very gradually, perhaps beginning with the earliest stone tools. Such tools had likely begun to emerge by at least 3 million years ago (see Chapter 15), and were likely used for processing meat—pounding, chopping, slicing and dicing.[84] Drying meat or soaking plant foods may have emerged at any time, and probably repeatedly. By the emergence of the genus *Homo*, it's plausible that cooking began to be used sporadically, but with increasing frequency especially where large fibrous tubers or meat were relatively abundant.

Our repertoire of food processing techniques altered the genetic selection pressures on our digestive system by gradually supplanting some of its functions with cultural substitutes. Food processing techniques such as cooking actually increase the energy available from foods, and make them easier to digest and detoxify. This allowed natural selection to save substantial amounts of energy by reducing our gut tissue, the second most expensive tissue in our bodies (next to brain tissue), and reduce our susceptibility to various diseases associated with gut tissue. The energy savings from the externalization of digestive functions by cultural evolution became one component in a suite of adjustments that permitted our species to build and run bigger and bigger brains.

HOW TOOLS MADE US FAT WIMPS

Responding to posters that read, "Wanted, athletic men to earn $5 per second by holding 85-pound ape's shoulders to the floor," beefy linebacker types would line up at *Noell's Ark Gorilla Show*, part of a circus that travelled up and down the eastern seaboard of the U.S. from the 1940s to the 1970s. Inspired to impress the crowds at this star attraction, no man in 30 years ever lasted more than five seconds pinning down a juvenile chimpanzee. Moreover, the chimpanzees had to be seriously handicapped, as they wore "silence of the lambs" masks to prevent them from using their preferred weapon, their large canine teeth. Later, the show's apes were forced to wear large gloves because a chimp named "Snookie" had rammed his thumbs up an opponent's nose, tearing the man's nostrils apart. The organizers of Noell's Ark Gorilla Show were wise to use young chimps, as a full-grown male chimpanzee (150 lbs.) is quite capable of breaking a man's back. The authorities did finally put an end to this American spectacle, but it wasn't clear whether they were concerned about the young apes, or the brawny wrestlers who voluntarily entered the ring with them.[85]

How did we become such wimps?

It was culture. As cumulative cultural evolution generated increasingly effective tools and weapons, like blades, spears, axes, snares, spear-throwers, poisons and clothing, natural selection responded to the changed environment generated by these cultural products by shaping our genes to make us weak. Manufactured from wood, flint, obsidian, bone, antler and ivory, effective tools and weapons can replace big molars, for breaking down seeds or fibrous plants, and big canines, strong muscles and dense bones for fighting and hunting.

To understand this, realize that big brains are energy hogs. Our brains use between a fifth and a quarter of the energy we take in each day, while the brains of other primates use between 8% and 10%. Other mammals use only 3-5%. Even worse, unlike muscles, you can't shut a brain down to save energy, as it takes almost as much energy to sustain a resting brain as it does an active one. Our cultural knowledge about the natural world combined with our tools, including our food processing techniques, allowed our ancestors to obtain a high energy diet with much less time and effort than other species. This was crucial for brain expansion in our lineage. However, since brains need a constant supply of energy, periods of food scarcity, initiated by floods, droughts, injuries and disease, pose a serious threat to humans. To deal with this threat, natural selection needed to trim our body's energy budget and create a storehouse for times of scarcity. The emergence of tools and weapons allowed natural selection to trade expensive tissues for fat, which is cheaper to maintain and provides an energy storage system crucial for sustaining big brains through scarcity.[86] This is why infants, who devote 85% of their energy to brain building, are so fat—they need the energy buffer to sustain neurological development and optimize cultural learning.

So, if you are challenged to wrestle a chimpanzee, I recommend that you decline, and instead suggest a contest based on (1) threading a needle (a sewing contest?), (2) fast ball pitching or (3) long-distance running.[87] While natural selection traded strength for fat, increasingly complex tools and techniques for use drove another key genetic change. The human neocortex sends corticospinal connections deeper into the motor neurons, spinal cord and brain stem than in other mammals. It is the depth of these connections—in part—that facilitates our fine dexterity for learned motor patterns (recall the plasticity of the neocortex mentioned above). In particular, these motor neurons directly innervate our hands, allowing us to thread a needle or throw accurately, and our tongues, jaws, and vocal cords, facilitating speech (see Chapter 13). Improved motor control was favored once cumulative cultural evolution began delivering more and finer tools. Such tools also created genetic evolutionary pressures that shaped the anatomy of our hands, giving us wider fingertips, more muscular thumbs and a "precision grip". Cultural evolution may also have produced packages for throwing, including techniques, artifacts (wooden spears and throwing clubs) and strategies, suitable for using projectiles in hunting, scavenging, raiding or community policing. The emergence of these, along with the ability to learn to practice throwing by observing others, may have fostered some of the anatomical specializations in our shoulders and wrist, while at the same time explaining why many children are so keenly interested in throwing (more on this in Chapter 15).[88]

Alongside these anatomical changes, our species long history with complex tools has also likely shaped our learning psychology. We are cognitively primed to categorize 'artifacts' (e.g., tools and weapons) as separate from all other things in the world, like rocks and animals. Unlike plants, animals and other non-living things like water, we think about function when we think about artifacts. For example, when young children ask about artifacts they ask "what's it for" or "what does it do?" instead of the "what kind is it?" that they first question when seeing a novel plant or animal. This specialized thinking about artifacts, as opposed to other non-living things, requires that there be some complex artifacts with non-obvious or *causally opaque* functions in the world first, that one needs to learn about.[89] Cumulative cultural evolution will readily generate such cognitively opaque artifacts, a point I'll make in spades in the next chapter.

How water containers and tracking made us endurance runners

Traditional hunters throughout the world have shown that we humans can run down antelopes, giraffes, deer, steenboks, zebras, waterbucks and wildebeests. These pursuits often take three or more hours, but eventually the prey animal drops over, either from fatigue or heat exhaustion. With the exception of domesticated horses,[90] which we have artificially selected for endurance, our species' main competition for the mammalian endurance champion comes from some of the social carnivores, like African wild dogs, wolves and hyenas that also engage in persistence hunting, and habitually run 10-20km per day.

To beat these species, we only need to turn up the heat, literally, as these carnivores are much more susceptible to warmer temperatures than we are. In the tropics, dogs and hyenas can only hunt at dawn and dusk, when it's cooler. So, if you want to race your dog, plan a 25km race on a hot summer day. He'll conk out. And, the hotter it is, the more you'll beat him by. Chimpanzees aren't even in our league in this domain.[91]

Comparisons of human anatomy and physiology with other mammals, including both living primates and hominins (our ancestor species and extinct relatives), reveals that natural selection has likely been at work shaping our bodies for serious distance running for over a million years. We have a full suite of specialized distance running adaptations, from toe to head. Here's a sampling:

- Our feet, unlike other apes, possess springy arches that store energy and absorb the shock of repeated impacts. This is provided we learn proper form, which avoids landing on our heels.
- Our comparatively longer legs possess extended spring-like tendons, including the crucial Achilles, that connect to short muscle fibers. This setup generates efficient power and provides us with the ability to increase speed by taking longer, energy-saving, strides.[92]
- Unlike animals built for speed, which possess mostly fast-twitch muscle fibers, frequent distance running can shift the balance in our legs up from 50% slow-twitch muscle fibers to as high as 80%, yielding much greater aerobic capacity.
- The joints in our lower body are all re-enforced to withstand the stresses of endurance running.
- To stabilize our trunk while running, our species sports a distinctively enlarged *gluteus maximus*, along with substantial muscles—the erector spinae—that run up our backbone.
- Coupled with our notably broad shoulders and short forearms, arm swinging creates a compensatory torque that balances us while running. And, unlike other primates, the musculature in our upper back allows our head to twist independently from our torso.
- The nuchal ligament, connecting our heads and shoulders, secures and balances our skulls and brains against running-related shocks. Other running animals also have a nuchal ligament, but other primates do not.

Perhaps most impressive of all are our thermoregulatory adaptations—we are certainly the sweatiest species. Mammals must maintain their body temperature in a relatively narrow range, from roughly 36°C (96.8°F) to 38°C (100°F). The lethal core temperature of most mammals ranges from 42°C (107.6°F) to 44°C (111.2°F). Since running can generate a tenfold increase in heating, the inability of most mammals to run long distances arises from their inability to manage this heat build-up.

To overcome this adaptive challenge, natural selection favored the (1) nearly complete loss of hair, (2) proliferation of eccrine sweat glands, and (3) emergence of a 'head cooling' system. The idea here is that sweat coats and cools the skin through evaporation, which is fostered by the airflow generated by running. To appreciate what happened, note that sweat glands come in two varieties, apocrine and eccrine. At puberty, apocrine glands start producing a viscous pheromone-containing secretion, which is often processed by bacteria to create a strong aroma. These glands are confined to our armpits, nipples, and groin (guess what they are for?). By contrast, eccrine glands, which secrete clear salty water and some other electrolytes, can be found all over our bodies and are much more numerous on us than on other primates. The highest densities of these glands occur in the scalp and feet, the two locations most in need of cooling during running. Measured over body surfaces, no other animal can sweat faster than us. Moreover, our eccrine glands are 'smart-glands', as they contain nerves that may permit centralized control from the brain (in other animals sweating is controlled locally). It was these innervated eccrine glands, and not the apocrine glands, that proliferated to cover our bodies during human evolution.

Because brains are particularly susceptible to overheating, natural selection also engineered a special *brain cooling system* in our ancestors. This system involves a network of veins that run near the surface of the skull, where they are first cooled by the ample sweat glands on the face and head. They then flow into the sinus cavity where they absorb heat from the arteries responsible for transporting blood to the brain. This cooling system may be why humans, unlike so many mammals, can sustain core temperatures above the 44°C (111.2°F) limit.[93]

At this point, you might be thinking that all these features of our bodies are clearly adaptive, so why would I think that it was cultural evolution that created the conditions that led to the evolution of our species' running adaptations. To get at this, let's look at three aspects of this adaptive design more closely. First, really putting our endurance abilities into action, where they give us the biggest survival advantage, requires running for hours in the heat of the day, in the tropics. When our evaporative cooling system kicks into overdrive, a prime athlete will begin sweating out 1-2 liters per hour, with 3 liters being well within our bodies' capacity. This system can run, and keep us running, for many hours provided it doesn't run short of a critical ingredient—water. So, where's the genetically evolved water storage system or tank?

Horses, who as I mentioned can compete with us for distance, do have the ability to store large amounts of water. By contrast, not only are humans unable to consume and store large amounts of water, but we are actually relatively poor hydrators compared to other animals. While a donkey can drink 20 liters in 3 minutes, we top out at 2 liters in 10 minutes (camels do 100 liters in the same time). How can this crucial element be missing from our thermoregulatory system? Is our otherwise elegant running design fatally flawed?[94]

The answer is that cultural evolution supplied water containers and water-finding know-how. Among ethnographically-known foraging populations, hunters carry water in gourds, skins, and ostrich eggs. Such containers are used in conjunction with detailed, local, culturally-transmitted knowledge about where and how to locate water. In the Kalahari Desert of southern Africa, foragers use ostrich eggs as 1-liter canteens, which keep the water refreshingly cool, or occasionally the stomach sacs of small antelopes. They also use long reed straws to suck water from hollow tree trunks, where it collects, and they can readily locate water-bearing roots by spotting certain dry wispy vines. In Australia, hunter-gatherers created water containers using a technique that involved turning small mammals 'inside-out' (see Figure 5.3). Like the Kalahari foragers, they also used surface signs to locate hidden underground water sources. These are non-obvious: recall that Burke and Wills became trapped along Coopers Creek for want of such know-how.

FIGURE 5.3. WATER CONTAINERS USED BY HUNTER-GATHERERS IN AUSTRALIA (FROM THE SOUTH AUSTRALIA MUSEUM, 2013. PHOTO BY THE AUTHOR).

This all suggests that the evolution of our fancy sweat-based thermoregulatory systems can only take off *after* cultural evolution has generated the know-how for making water containers and locating water sources in diverse environments. The suite of adaptations that make us stunning endurance runners is actually part of a coevolutionary package into which culture delivers a critical ingredient, water.

Supplied with water, any good marathoner probably has the endurance to chase down a zebra, antelope or steenbok. However, there's more to persistence hunting than endurance, a lot more. Endurance hunters need to be able to recognize specific target prey, and then track that specific individual over long distances. Almost any animal we might want to pursue is much faster than we are in a sprint, and will immediately disappear into the distance. To exploit our endurance edge, we need to be able to track a specific individual for several hours, by identifying and reading their spoor and anticipating their actions. The ability to distinguish the target, say a zebra, from other zebras is crucial since many herd animals have a defensive strategy in which they circle back to their herd and try to disappear, by blending back into the group. If you can't selectively target the one you've been chasing—the tired one—then you could end up chasing a fresh zebra (a disaster). Thus, persistence hunters must be able to track and identify individuals.

Though many species engage in some form of tracking, no other animal tracks the way we do. Studies of tracking among modern hunter-gatherers reveal that it is an arena of intensive cultural knowledge that is acquired through a kind of apprenticeship, as adolescents and young men watch the best hunters in their group interpret and discuss spoor. From the spoor, skilled trackers can deduce an individual's age, sex, physical condition, speed and fatigue level, as well as the time of day it passed by. Such feats are accomplished, in part, by knowledge of particular species' habits, feeding preferences, social organization and daily patterns.[95]

A number of culturally-transmitted tricks aid persistence hunters. The most interesting of these bits of strategy highlights the subtle, adaptive edge that culture-gene coevolution has isolated and exploited. This is a little complicated, so stay with me.

Many four-legged animals are saddled with a design disadvantage. Game animals thermoregulate by panting, like a dog. If they need to release more heat, they pant faster. This works fine unless they are running. When they run, the impact of their forelimbs compresses their chest cavities in a manner that makes breathing during compressions inefficient. This means that, ignoring oxygen and thermoregulation requirements, running quadrupeds should breathe only once per locomotor-cycle. But, since the need for oxygen goes up linearly with speed, they will be breathing too frequently at some speeds and not frequently enough at other speeds. Consequently, a running quadruped must pick a speed that (1) demands only one breath per cycle, but (2) supplies enough oxygen for his muscle-speed demands (lest fatigue set in), and (3) delivers enough panting to prevent a meltdown (heat stroke), which depends on factors unrelated to speed such as the temperature and breeze. The outcome of these constraints is that quadrupeds have a discrete set of optimal or preferred speed settings (like the gears on a stick-shift car) for different styles of locomotion (e.g., walking, trotting and galloping). If they deviate from these preferred settings, they are operating less efficiently.

Humans lack these restrictions because (1) our lungs do not compress when we stride (we're bipedal) so (2) our breathing rates can vary independent of our speed, and (3) our thermoregulation is managed by our fancy sweating-system, so the need to pant does not constrain our breathing. Because of this, within our range of aerobic running speeds (not sprinting), energy use doesn't vary too much. That means we can change speeds within this range without paying much of a penalty. As a result, a skilled endurance hunter can strategically vary his speed in order to force his prey to run inefficiently. If his prey picks an initial speed just faster than the hunter, to escape, the hunter can speed up. This forces the prey to 'shift-up' to a much faster speed, which will cause rapid overheating. The animal's only alternative is to run inefficiently, at a slower speed which will exhaust his muscles more quickly. The consequence is that hunters force their prey into a series of sprints and rests that eventually result in heat stroke. The overheated prey collapses, and is easily dispatched. Tarahumara, Paiute and Navajo hunters report that they then simply strangle the collapsed deer or pronghorn antelope.[96]

Persistence hunters can also take advantage of a wide range of other tricks that increase their edge. In the Kalahari, where this has been most studied, hunters tend to pursue game during mid-day when temperatures are hottest, between 39°C (102°F) and 42°C (107.6°F). They adjust their prey choice depending on the seasonally varying health status of their target species, pursuing duiker, steenbok and gemsbok in the rainy season and zebra and wildebeest in the dry season. They hunt in the morning after a bright full moon (no clouds) because many species will be tired after remaining active on well-lit nights. When chasing a herd, hunters watch for 'drop-outs', since these will be the weakest members. Non-human predators tend to follow the herd, not the loners, since they rely on scent, not sight and spoor. Perhaps not surprisingly, foragers can spot heat stroke in other people, and know how to treat it, as they did with one anthropologist who tried to keep up with the locals (an occupational hazard).[97]

Finally, to achieve a running form that maximizes both performance and freedom from injury, humans need to rely on some cultural learning, on top of much individual practice. The evolutionary biologist and anatomist, Dan Lieberman, has studied long-distance barefoot and minimally shod running in communities around the globe. When he asks runners of all ages how they learned to run, they never say they "just knew how." Instead, they often name or point to an older, highly skilled, and more prestigious member of their group or community, and say they just watch him, and do what he does. We are such a cultural species that we've come to rely on learning from others even to figure out how to run in ways that best harness our anatomical adaptations.[98]

Thinking and learning about plants and animals

Over generations, cultural evolution has generated a large, and potentially ever expanding, body of knowledge about plants and animals. This knowledge, as we saw with our lost European explorers, is crucial for survival. Given the criticality of this knowledge, we should expect humans, from a young age, to be equipped with psychological abilities and motivations to acquire, store, organize, extend (via inference) and retransmit this information. In fact, we humans have an impressive *folkbiological cognitive system* for dealing with information about plants and animals. Much research by anthropologists and psychologists, such as the dynamic duo of Scott Atran and Doug Medin, working in diverse human populations have shown that these cognitive systems have several interesting properties. Children rapidly organize information about plants and animals into (1) *essentialized categories* (e.g., "cobras" and "penguins") embedded in (2) *hierarchical (tree-like) taxonomies* that permit inferences using (3) *category-based induction* and (4) *taxonomic inheritance*.

These are fancy cognitive science terms for rather intuitive ideas. In using *essentialized categories*, learners implicitly assume that membership in a category (say, "cats") results from some hidden essence that all members share, deep inside. This essence cannot be removed by superficial changes to an individual. For example, suppose you operate on a cat, and then paint it, so that this individual now looks exactly like a skunk. Is it a cat or a skunk? Or, something new, like a "skat" or "cunk". Children and adults will typically say that it is still a cat, which currently looks like a skunk. By contrast, if a table is dismantled and re-constructed as a chair, no one thinks it's still a table. It 'is' what it 'does'. Using *category-based induction* learners can readily extend information learned about one particular cat to all cats—if you see Felix go crazy over catnip, you readily infer that all cats will likely similarly respond to catnip. These essentialized categories are assembled, over development and cultural evolution, into increasingly complex hierarchical taxonomies, as shown in Figure 5.4. With such taxonomies in mind, category-based induction allows people to use their knowledge of one category, say "chimpanzees", to make inferences about other categories. The confidence one puts in these inferences depends on the relationship in one's mental taxonomy. For example, knowing a fact about chimpanzees (e.g., that they nurse their infants), one can readily infer that wolf moms also probably nurse baby wolves, since both are types of mammals. The tree of relationships also allows individuals to use *taxonomic inheritance*: learners may find out that one of their higher level categories, like "birds", possesses particular traits, such as laying eggs or having hollow bones. When they encounter a new type of bird, say a robin, they can readily infer that it likely lays eggs and has hollow bones, without explicitly learning these facts about robins.[99]

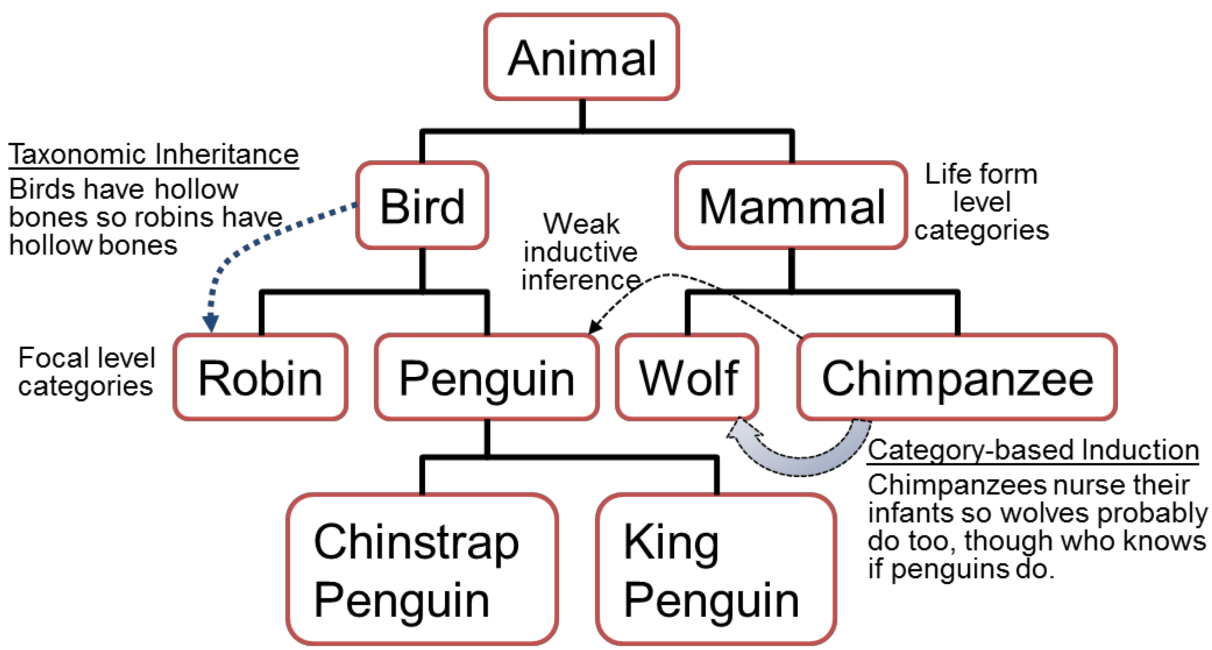


FIGURE 5.4. ILLUSTRATING OUR FOLKBIOLOGICAL COGNITIVE SYSTEM

Though these patterns of thinking are quite consistent across diverse small-scale societies, it's worth noting that Western, urban populations appear to have some anomalies in their folkbiological psychology. In small-scale societies people typically use, and children first learn, focal level categories (see Figure 5.4) like "robin", "wolf" and "chimpanzee". But, the urban-living children and university students that psychologists typically study use what are called "life-form" level categories, like "bird" and "fish". Moreover, these urban people seem to preferentially reason from what they know about humans to other species, rather than just positioning humans within the taxonomy and treating them like any other animal. Comparative studies with Maya children, as well as Americans living in rural areas, have suggested why: urban children receive very little cultural input on plants and animals; thus, the only critter they know much about are humans. In essence, urbanized Western folkbiological systems are malfunctioning due to a poverty of input during cognitive development.[100]

This powerful cognitive system organizes the vast body of information that individuals gradually pick up via both cultural transmission and individual experience over their lives.[101] Of course, most of the knowledge that people have about plants and animals comes to them via cultural transmission.

To see this system in operation, let's consider how infants respond to unfamiliar plants. Plants are loaded with prickly thorns, noxious oils, stinging nettles and dangerous toxins, all genetically evolved to prevent animals like us from messing with them. Given our species wide geographic range and diverse use of plants as foods, medicines and construction materials, we ought to be primed to both learn about plants and avoid their dangers. To explore this idea in the lab, the psychologists Annie Wertz and Karen Wynn first gave infants, who ranged in age from eight to eighteen months, an opportunity to touch novel plants (basil and parsley) and artifacts, including both novel objects and common ones, like wooden spoons and small lamps.

The results were striking. Regardless of age, many infants flatly refused to touch the plants at all. When they did touch them, they waited substantially longer than they did with the artifacts. By contrast, even with the novel objects, infants showed none of this reluctance. This suggests that well before one year of age infants can readily distinguish plants from other things, and are primed for caution with plants. But, how do they get past this conservative predisposition?

The answer is that infants keenly watch what other people do with plants, and are only inclined to touch or eat the plants that other people have touched or eaten. In fact, once they get the 'go ahead' via cultural learning, they are suddenly interested in eating plants. To explore this, Annie and Karen exposed infants to models who both picked fruit from plants and also picked fruit-like things from an artifact of similar size and shape to the plant. The models put both the fruit and the fruit-like things in their mouths. Next, the infants were given a choice to go for the fruit (picked from the plant) or the fruit-like things picked from the object. Over 75% of the time the infants went for the fruit, not the fruit-like things, since they'd gotten the 'go ahead' via cultural learning.

As a check, the infants were also exposed to models putting the fruit or fruit-like things behind their ears (not in their mouths). In this case, the infants went for the fruit or fruit-like things in equal measure. It seems that plants are most interesting if you can eat them, but only if you have some cultural learning cues that they aren't toxic.[102]

After Annie first told me about her work while I was visiting Yale in 2013, I went home to test it on my 6-month-old son, Josh. Josh seemed very likely to overturn Annie's hard empirical work, since he immediately grasped anything you gave him and put it rapidly in his mouth. Comfortable in his mom's arms, I first offered Josh a novel plastic cube. He delighted in grapping it and shoving it directly into his mouth, without any hesitation. Then, I offered him a sprig of arugula. He quickly grabbed it, but then paused, looked with curious uncertainty at it, and then slowly let it fall from his hand while turning to hug his mom.

It's worth pointing out how rich the psychology is here. Not only do infants have to recognize that plants are different from objects of similar size, shape and color, but they need to create categories for types of plants, like basil and parsley, and distinguish 'eating' from just 'touching'. It does them little good to code their observation of someone eating basil as 'plants are good to eat' since that might cause them to eat poisonous plants as well as basil. But, it also does them little good to narrowly code the observation as 'that particular sprig of basil is good to eat' since that particular sprig has just been eaten by the person they are watching.[103] This another content bias in cultural learning.

The genetic evolution of our big brains, long childhoods, short colons, small stomachs, tiny teeth, flexible nuchal ligaments, long legs, arched feet, dexterous hands, lightweight bones and fat-laden bodies were all driven by cumulative cultural evolution, by the growing pool of information available in the minds of other people. Beyond our bodies, culture has also shaped the genetic evolution of our minds and psychology, as we've just seen in how people learn about artifacts, animals and plants. In chapter 7, we'll examine how eons of adapting to a world full of complex and nuanced cultural adaptations, including tools, practices and recipes, has led our species to be capable of placing immense faith on cultural information, often trumping our own direct experience or innate intuitions. Later chapters will then explore how cultural evolution shaped the genetic evolution of our status psychology, communicative abilities and eventually domesticated us, making us the only ultra-social mammal. However, before departing on this journey, I want to alleviate any doubts you have that culture can really drive genetic change.

Chapter 6

Why some people have blue eyes

If you create a global map of eye color, but put aside the migrations of peoples in the last few hundred years, you will see that light eyes—blue and green—are common only in a region centered on the Baltic Sea in Northern Europe. Meanwhile, almost everyone else in the world has brown eyes, and there's good reason to believe that brown eyes were universal, or nearly so, prior to the emergence of this pattern of eye color. Here's the puzzle: why are light eyes distributed in this peculiar way?[104]

To understand this, we need first to consider how culture has shaped genes for skin color over the last 10 millennia. Much evidence now indicates that the shades of skin color found among different populations—from dark to light—across the globe represent a genetic adaptation to the intensity and frequency of exposure to ultraviolet light, including both UVA and UVB. Near the equator, where the sun is intense year round, natural selection favors darker skin, as seen in populations near the equator in Africa, New Guinea and Australia. This is because both UVA and UVB light can dismantle the folate present in our skin, if not impeded or blocked by melanin. Folate is crucial during pregnancy, and inadequate levels can result in severe birth defects like spina bifida. This is why pregnant women are told by their physicians to take folic acid. In men, folate is important in sperm production. Preventing the loss of this reproductively valuable folate means adding protective melanin to our epidermis, which has the side effect of darkening our skin.[105]

The threat from intense UV light to our folate diminishes for populations farther from the equator. However, a new problem pops up, as darker skinned people face a potential vitamin D deficiency. Our bodies use UVB light to synthesize vitamin D. At higher latitudes, the protective melanin in dark skin can block too much of the UVB light, and thereby inhibit the synthesis of vitamin D. This vitamin is important for the proper functioning of the brain, heart, pancreas and immune system. If a person's diet lacks other significant sources of this vitamin, then having dark skin and living at high latitudes increases one's chances of experiencing a whole range of health problems, including most notably rickets. A terrible condition especially in children, rickets causes muscle weakness, bone and skeletal deformities, bone fractures and muscle spasms. Thus, living at high latitude will often favor genes for lighter skin. Not surprising for a cultural species, many high latitude populations of hunter-gatherers (above 50-55° latitude), such as the Inuit, culturally evolved adaptive diets based on fish and marine animals, so the selection pressures on genes to reduce the melanin in their skin were not as potent as they would have been in populations lacking such resources. If these resources were to disappear from the diet of such northern populations, selection for light skin would intensify dramatically.

Among regions of the globe above 50-55° latitude (e.g. much of Canada), the area around the Baltic Sea was almost unique in its ability to support early agriculture. Starting around 6,000 years ago, a cultural package of cereal crops and agricultural know-how gradually spread from the south, and was adapted to the Baltic ecology. Eventually, people became primarily dependent on farmed foods, and lacked access to the fish and other vitamin D-rich food sources that local hunter-gatherer populations had long enjoyed. However, being at particularly high latitudes, natural selection kicked in to favor genes for really light skin, so as to maximize whatever vitamin-D could be synthesized using UVB light.

Natural selection would have operated on many different genes to favor very light skin among cereal-eating Baltic peoples, because there are many genetic routes to reduce melanin in our skin. One of those genes is called HERC2, which is located on chromosome 15. HERC2 inhibits or suppresses the production of a protein by a nearby gene called OCA2. Suppression of the synthesis of this protein, through a long and complicated set of biochemical pathways, results in less melanin in people's skin. However, unlike other genes that influence skin color at other places in those pathways, HERC2 usually causes light eyes because it also reduces the melanin in irises. Blue and green eyes, then, are a side effect of natural selection favoring genes for lighter skin among cereal-dependent populations living at high latitudes. If cultural evolution hadn't produced agriculture, and specifically techniques suitable for higher latitudes, than there would be no blue or green eyes.[106] In all likelihood then, this genetic variant only started spreading within the last six millennia, after agriculture arrived in the Baltic region.

The point of this example is: cultural evolution can shape our environments, and consequently it, can drive genetic evolution. In cases of recent culture-gene coevolution, in which the relevant genes have not spread to replace all or most competing genetic variants, we can isolate the causes and effects, and sometimes even finger the specific genes being favored. This is important because some researchers have argued that culture could never be strong enough, for long enough, to drive genetic evolution. Recently, however, new mathematical models and mounting evidence from the human genome provide a clear, if only preliminary answer. Not only has culture driven specific genes to high frequency in some populations in the last ten millennia, but in fact, sometimes cultural evolution can create selection pressures *more* powerful than seen elsewhere in nature. Sometimes, culture catalyzes and drives more rapid genetic evolution.

To be clear, this book is about how culture drove genetic evolution during the emergence of our species. It's about human nature, *not about the genetic differences among current populations* in our species now. However, I'm going to use the fact that culture-gene coevolution continues today, with many culture-gene interactions still in progress in our species, to illustrate the power of culture to shape the genome. Aside from this chapter, I'll only occasionally be able to link specific genes to the culture-gene coevolutionary processes described. This is for several reasons. First, many of the coevolutionary processes I'm focused on are 'completed', such that the traits under selection don't vary across our species. This means that we can't exploit the variation among populations, or what is known about the movements of populations around the world, to infer the underlying causes of the spread of particular genetic variants. Second, many human traits are influenced by many genes at different locations in our chromosomes. This makes it quite difficult to finger specific genetic variants, since any one variant contributes only tiny effects. Finally, this enterprise is really just beginning, so while the broad outlines can be discerned, much work needs to be done.

Let's consider another example.

RICE WINE AND ADH1B

In mammals, the alcohol from rotting fruit and other sources is broken down by enzymes produced by alcohol dehydrogenase genes (ADH) and eventually processed into energy and metabolites in the liver. However, if the rate of inflow of alcohol (ethanol) into the liver is too high, than it 'overflows', goes into the heart, and then spreads throughout the body. Intoxication ensues. Most primates aren't particularly good at processing alcohol. However, about 10 million years ago, when our common ancestor with gorillas came down from the trees to spend more time on the ground, rotting fruit probably became a more important food source, so our ape lineage evolved a higher tolerance for consuming alcohol.[107] This ancient adaptation appears to have set the stage for much more recent culture-gene coevolution, as humans have experienced a great deal of evolutionary action on various alcohol-processing genes since the origins of agriculture.

Let's consider just one of those genetic changes. Between 7,000 to 10,000 years ago the DNA code on one of these ADH genes on Chromosome 4 flipped a bit, causing it to code for the amino acid Histidine instead of Arginine. The evidence seems to suggest that this new version of the ADH1B gene metabolizes alcohol much more efficiently in the liver. Perhaps, more importantly, the rapid breakdown of alcohol produces high levels of acetaldehyde, which causes dizziness, increased heart rate, nausea, weakness, overheating and a flushing of the skin. The unpleasantness of this "flushing reaction" reduces people's susceptibility to alcoholism, and parallels the effects created by drugs used to treat alcoholism. Estimates vary, but possessing the booze-inhibiting variant of ADH1B reduces the likelihood of alcohol dependence by a factor of between two to nine times, and both heavy and excessive drinking by a factor of about five. The *more efficient* alcohol breakdown performed by this variant also likely protects the body against drinking binges, but may make hangovers worse.[108] Have you ever noticed anyone flushing after drinking a relatively small amount of alcohol? Who was it?

Data on ADH1B has been gathered from around the world. It turns out that the booze-inhibiting variant of this gene is distributed rather non-randomly. Check out Figure 6.1. The hottest spot is in southeastern China, with a weak second hot spot in the Middle East. In southeastern China, the frequency of the booze-inhibiting gene goes as high as 99%, with several populations in the 70% to 90% range. In the Middle East, the rates are more in the 30% to 40% range.[109]

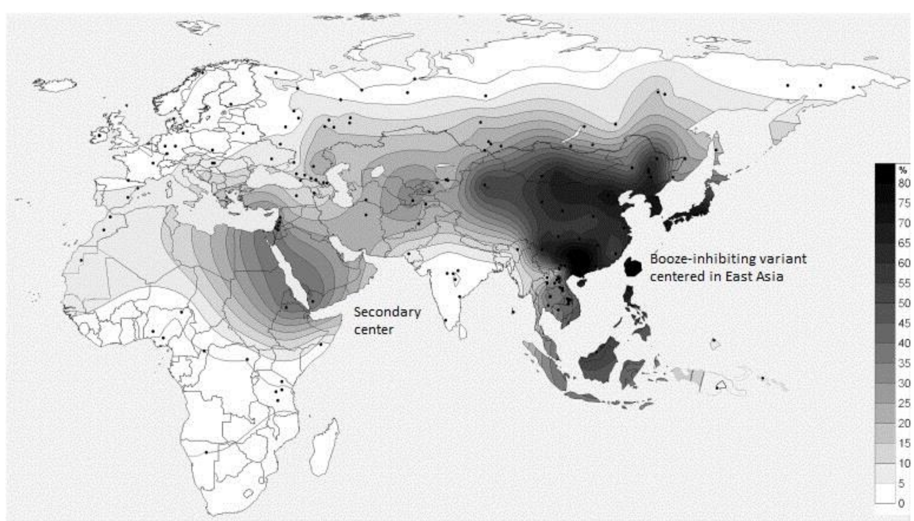


FIGURE 6.1 DISTRIBUTE OF BOOZE-INHIBITING ADH1B GENE ACROSS THE GLOBE. ADAPTED FROM (BORINSKAYA ET AL., 2009).

Bing Su and his colleagues have brought these findings together with archeological data on the origins of rice agriculture in East Asia—the transition from hunting and gathering to agriculture. The earlier rice agriculture started in a region, the higher the frequency of the booze-inhibiting variant of ADH1B in the populations now inhabiting those regions. Knowing the date at which rice agriculture began then allowed them to account for 50% of the variation in this gene's frequencies in Asian populations, which is amazingly high given the uncertainty in archaeological dates and all the other factors at work on these populations over thousands of years.[110]

Okay, fine, but what's the link from agriculture to alcohol? Well, broadly speaking, agriculture and the making of fermented beverages go together. Most hunter-gatherer populations do not have the means, know-how or resources (e.g., cereals) to make beer, wine or spirits. Yet, agricultural populations usually do, even small-scale semi-nomadic slash-and-burn agriculturalists.

In China, the first alcoholic beverages date back almost to the very origins of rice agriculture, along the Yellow River. About 9,000 years ago in the ancient farming village of Jaihu, chemical analyses indicate that someone had stored away 13 pottery jars of a fermented rice-based beverage that probably also contain honey and fruit.[111] It seems that as soon as people domesticated rice, they quickly figured out how to make rice wine. Based on other historical episodes, this probably created alcohol-related problems for rice farmers, which favored the ADH variants that make drinking less fun. Without the cultural evolution of, first, rice agriculture and second, rice wine, there might be no booze-inhibiting variant of ADH1B.

WHY SOME ADULT HUMANS CAN DRINK MILK

Like most mammals, drinking milk does little or nothing for the nutrition of 68% of the adults in the world. If you are a milk drinker, you are in the minority. Of course, whether they are humans or other mammals, all healthy babies come fully equipped with the enzyme lactase, which allows them to breakdown lactose milk sugars in their small intestines, and thereby access the nutritional bounty in milk. Milk is a bonanza of calcium, vitamins, fat, proteins, carbs, and even water. In most people, the production of lactase wanes after nursing ends. By age 5, most people can no longer break down the lactose sugars in milk. Even worse, drinking milk often—though not always—causes diarrhea, cramping, gas, nausea and even vomiting. This is lactose intolerance. In populations without access to medical care, such diarrhea can be deadly.[112]

However, in scattered populations around the world, including groups in Europe, Africa and the Middle East, people can digest milk throughout adulthood. This *lactase persistence* allows older children, adolescents and adults to access milk's nutrition. Figure 6.2 shows the global distribution of lactase persistence. Among indigenous populations from the British Isles and Scandinavia, over 90% of people are lactase persistent, while rates in eastern and southern Europe range from 62% to 86%. In India, the rate is 63% in the north but 23% in the south. In Africa, the patterns are strikingly patchy. Some groups have high frequencies of lactase persistence while neighboring groups do not. In the Sudan alone, rates range from around 20% to 90%, depending on the ethnic group. In East Asia, lactase persistence is rare and often non-existent.

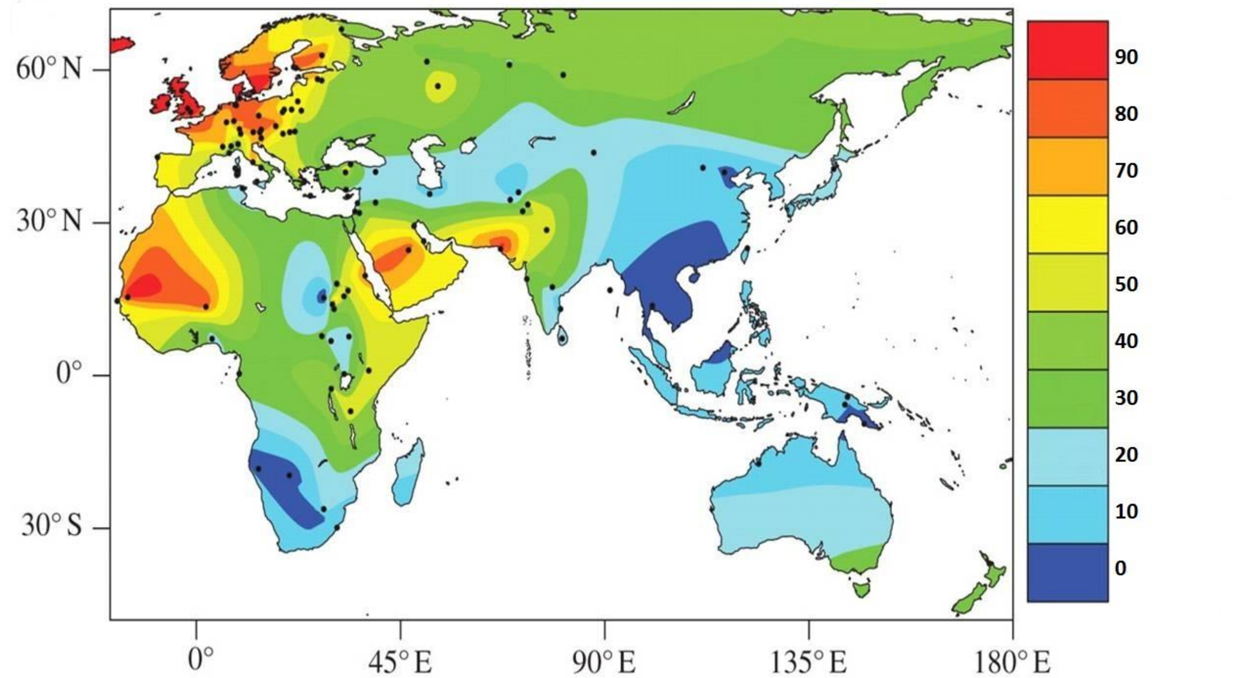


FIGURE 6. 1 DISTRIBUTION OF LACTASE PERSISTENCE. ADAPTED FROM (GERBAULT ET AL., 2011). THE COLORS INDICATE THE PERCENTAGES OF PEOPLE IN THOSE REGIONS WHO CAN DIGEST MILK IN ADULTHOOD. HTTP://WWW.UCL.AC.UK/MACE-LAB/RESOURCES/GLAD/LP_MAPS

Lactase persistence is under fairly direct genetic control, and involves genes that inhibit the typical mammalian shutdown of the production of lactase after nursing ends. Though many factors have shaped the distribution of these regulatory genes, there are two key culturally-evolved packages that have driven this bit of genetic evolution. First, it's only in the last 12 millennia that humans have domesticated animals like cows, sheep, camels, horses and goats, which can potentially provide milk for adults to drink. So, some populations adopted cultural practices that permitted them to keep animals, and milk them. Such animals provide meat and hides, if nothing else. Initially, the extra milk would have only been useful for young children and infants. However, its presence would have created a genetic selection pressure for extending this lactose-processing ability into middle childhood and beyond. Herding and milking are the first elements in the cultural package that selects for these genes.

Crucially, these populations must also have persisted with herding and milking *but not have* adopted the practices, or culturally evolved the know-how, for turning milk into cheese, yogurt and kumis. Kumis is a fermented beverage made from mare's milk. While fresh whole milk from cows is 4.6% lactose by weight, cheddar cheese is 0.1% and Tzatziki is 0.3% (Tzatziki is a traditional Middle Eastern yogurt-based dish). Some fancy cheeses like Gouda and Brie have only trace amounts of lactose. Thus, cheese and yogurt making are, at least in part, cultural adaptations for reducing lactose, which permit everyone to access much of the otherwise unavailable nutrition from milk. If populations developed these bodies of technical know-how too soon, the selection pressure on genes for doing the same job would have been weakened. Thus, understanding who is, and is not, lactase persistent requires understanding both how cultural evolution can drive, and how it can inhibit, genetic evolution.

Of course, many other factors influence when and where people can engage in herding, and thereby influence the strength of selection for lactase persistence genes. As with blue eyes, the region of northern Europe suitable for agriculture, but with limited UVB, may have created an especially strong selection pressure because of the calcium, proteins and small amounts of vitamin D in milk. Calcium may inhibit the breakdown of vitamin D in the liver. And, where it's cold, fresh milk can be stored for longer periods without having to turn it into cheese.

Elsewhere, such as in the arid deserts of the Middle East and Africa, selection pressures for lactose persistence may have been increased by the water available in milk. Herders capable of drinking camel's milk, for example, might have had an advantage in travelling through arid regions or in surviving droughts. In some African regions, where herding might otherwise be rare or impossible due to extreme temperatures and diseases that plague herd animals, some societies developed cultural adaptations that involved systematically moving the animals to avoid temperature extremes and spacing their herds to suppress pathogen transmission. These populations, despite living in regions full of challenges to a herding lifestyle, are lactose persistent too, perhaps because of their locally specialized herding packages.[113]

Particularly interesting in this case is that natural selection found different ways to create lactase persistence in different populations. It appears that as herding animals became a centerpiece of economies around Eurasia and Africa, natural selection independently found five different genetic variants to suppress the shutdown of lactase production in different populations. In Europe, there was a flip on Chromosome 2 just a short distance upstream from the gene that codes for the protein lactase (LCT). The DNA base Cytosine got swapped for Thymine. This flip may simply throw a monkey wrench into the otherwise mammalian standard 'off-switch' for the making of lactase proteins after weaning. Elsewhere, in Africa and the Middle East, the DNA swaps are different, though they are all between 13,000 and 15,000 bases upstream from LCT.[114]

Dating of the spread of these genes suggests that one of the African variants may be the oldest, with the European variants in the middle, dating to between 7,450 and 10,250 years ago. The variant centered in the Arabian Peninsula is probably more recent, between 2,000 and 5,000 years old. This timing suggests that the domestication of the Arabian camel may have created the selection pressures that favored this particular variant. The speed of this culture-driven genetic evolution is noteworthy. These selection pressures drove genes for lactose persistence to 32% of the global population in less than 10 millennia. That's really fast compared to the rates observed elsewhere in nature, and even in the human genome.

Before moving on, it's worth highlighting the downside to not recognizing that such culture-gene coevolutionary processes have occurred, and are occurring. The ill effects of promoting milk drinking among peoples without lactase persistence didn't begin to dawn on American researchers until 1965. Prior to this, Americans assumed that if drinking cow's milk was good for "our" children it must be good for everyone's children. In 1946, the National School Lunch program required that fluid milk be part of any student lunch funded by the program. Despite the growing scientific literature, government efforts continued to promote milk drinking for everyone into the 1990s. As late as 1998, the then Secretary of Health and Human Services even appeared in the well-known "Got Milk" commercials. Over the years, many of the famous sports and music stars who appeared in these commercials donning milk moustaches were not, in all likelihood, actually able to digest the very beverage they were promoting.[115]

CULTURE-GENE REVOLUTIONS

These cases of culture-driven genetic evolution are three of the best documented examples we have, though there's every reason to suspect that they represent only the tip of an iceberg. The evolutionary biologist Kevin Laland and his collaborators have already fingered over 100 genes that have likely been under selection, based on analyses of the genome, and have at least plausible cultural origins. These genes influence an immense range of traits ranging from dry earwax and malaria resistance to skeletal development and the digestion of plant toxins.[116] What these cases illustrate for our purposes is:

1. Culture can exert a powerful force on genes, driving genetic evolution. Gene-culture packages emerge and spread rapidly, as with milk-drinking, blue eyes and booze avoidance.
2. In fact, the selection pressures created by culture can be among the most powerful observed in nature, and broad genetic sweeps can occur in tens of thousands of years. Culture-gene coevolution can be remarkably fast.
3. We can point to specific genes on particular chromosomes, and sometimes even know which molecular base changed. Once hypothetical genes have now been pinpointed.
4. Once cultural evolution creates the selection pressures, natural selection often manages to find and favor several different genetic variants to address the challenge.
5. However, sometimes, cultural evolution can sap the strength of selection as we saw for populations who rapidly developed cheese- and yogurt-making technology.

One concern with the above examples is that all stem from the emergence of food production—from agriculture and animal domestication. Perhaps, this major revolution in human history is a unique event from which we cannot draw general conclusions. To the contrary, my view is that the agricultural revolution just happens to be the best-timed revolution for us to detect its causes and effects in our genome. The industrial revolution is too recent, and the revolutions that preceded food production are older and thus harder to study. Nevertheless, there's every reason to suspect that there was a cooking-and-fire revolution, a projectile weapons revolution and a spoken language revolution, among many others. And, as you will see in later chapters, technologically-driven revolutions are likely underpinned by revolutions in forms of social organization or institutions. The agricultural revolution is just the one in the temporal sweet spot for today's science.

To see something of this, consider that chimpanzees have two copies of the AMY1 gene, but humans have on-average 6 copies. AMY1 codes for a protein, amylase, found in salvia that helps breakdown starch. The extra copies mean that humans, on-average, end up having 6 to 8 times more amylase in their salvia than chimpanzees. All other things equal, this means we are better at starch processing than chimps. So, after you beat that chimp in a marathon, you should challenge him to a potato digesting contest.

Human populations, however, vary in the number of AMY1 copies they have. Populations who have long been dependent on eating high-starch diets have between 6.5 and 7 copies, on-average. The Hadza, African hunter-gatherers who live in savannah-woodlands and rely on starchy roots and tubers, have the most at almost 7 copies, on-average, and some Hadza have as many as 15 copies. European-Americans and Japanese are not far behind at 6.8 and 6.6 AMY1 copies. By contrast, populations long dependent on low-starch diets have copy counts around 5.5. These include other African hunter-gathers who live in the tropical forest of the Congo basin, and herders in both Africa and central Asia, who depend primarily on some combination of meat, blood, fish, fruit, insects, seeds and honey.[117]

These differences are likely part of a long and meandering evolutionary story, as our ancestors shifted to a heavy reliance on underground roots and tubers over a million years ago. However, just how much populations have depended on starch since then has been influenced by a combination of ecology and cultural evolution, including the practices, preferences, technologies and know-how of different populations. As we see from the examples above, groups can live relatively close by, in similar ecologies, but still maintain different numbers of AMY1 copies because they operate with different economic packages.

There is also evidence that culturally-prescribed forms of social organization can shape our genome. This is important since some have argued that the forms of social organization created by cultural evolution are too weak or unstable to affect our genes. One important aspect of human social organization is what anthropologists call *post-marital residence*. In many human societies, especially until recently, local norms specified that a newly married couple went to live either with the husband's family or with the wife's family. The first is called *patrilocal residence* and the second *matrilocal residence*. Working in three patrilocal and three matrilocal farming populations in Northern Thailand, Hiroki Oota and his colleagues examined the variation in people's mitochondrial DNA and Y-chromosomes. Both sons and daughters get their mitochondrial DNA from mom, and only mom. Sons get their Y-chromosomes from dad, while daughters don't get Y-chromosomes at all. If social organization is stable enough to influence the genome, than patrilocal communities should have relatively low variation in their Y-chromosomes compared to mitochondrial DNA because sons always stick with their fathers. Similarly, because daughters stick with their moms, matrilocal communities should show the opposite pattern, low variation in mitochondrial DNA and higher variation in Y-chromosomes. This is precisely what Oota's team found, showing that culturally-evolved social norms can shape the genome.[118]

Overall, cultural evolution can, and has, powerfully shaped the human genome in a variety of important ways. As we saw in the last chapter, this culture-gene coevolutionary interaction goes well back into our species' history, where culturally-transmitted know-how about fire, water containers, tracking and projectiles were some of the key selection pressures favoring aspects of our anatomy and physiology. Moving forward, I'll begin to focus on how culture created selection pressures on genes influencing our psychology and sociality. In the next chapter, we'll take another step by going deeper into the subtle and nuanced ways cultural evolution can build adaptations without the culture-bearers themselves having any idea what's going on.

GENES AND RACE

Before moving on, it's worth highlighting a point about genes and race. Anthropologists have long argued that race is not a "biological concept". What we mean by this is that the racial categories developed historically by Europeans—such as Caucasian, Negroid, and Mongoloid—do not convey or contain much if any useful genetic information, aside from capturing something of the migration patterns of ancient peoples.[119] Detailed studies of the genome, including the research highlighted above, has only served to further underline this point. As we saw, skin color genes are heavily influenced by a combination of UV radiation and diet, as they effect vitamin D and folate. This means that people in New Guinea and Africa are both very dark skinned despite being from opposite ends of our species' family tree. And, really light-skinned Europeans are evolutionarily recent, being mostly a product of agriculture at high latitudes. Other genes have quite different distributions for distinct reasons. For example, we saw that lactase persistent genes are common among indigenous populations in Britain and some African groups, exist at moderate frequencies among Eastern Europeans and Middle Easterners, and at low frequencies in other African groups and many Asian populations. Similarly, amylase genes are more common among Japanese, European-Americans and Tanzanian foragers, but less common among Congo forgers and herders in both Tanzania and Central Asia. What does 'race' tell us about these genetic differences?

Nothing. Traditional racial categories just don't tell us anything about this important variation. In fact, the processes I've described above actually make classical racial categories even less informative, since they operate in diverse and non-concordant ways *within* 'races' to make local groups less similar (e.g., lactase persistent and non-persistent Africans) while at the same time making different continental "races" more similar (e.g. amylase genes in Japanese and Americans). The current evidence indicates that natural selection operates in diverse ways on scales much smaller than 'races' but simultaneously on different continents.

Moreover, Figures 6.1 and 6.2 show that even using *categories*, racial or otherwise, often distorts the picture. The genetic distributions on these maps vary continuously, so it's best to forget about discrete boundaries. Overall, traditional racial categories capture only about 7% of the total genetic variation in our species, which reveals that races are nothing like the subspecies found in chimpanzees.[120] Given our global distribution and range of environments, our species genetic variation is rather limited. Of course, this is not surprising when you realize that in addition to sometimes driving genetic evolution, cultural evolution can also inhibit genetic responses by more rapidly generating cultural adaptations, of the kind discussed in the next chapter.[121]

For good historical reasons, many people are sensitive to scientific and evolutionary research on genetic variation, especially variation among populations. In the last century, pseudo-scientific efforts to formalize folk concepts of race were used to justify much violence, oppression and even genocide. However, two rapidly developing areas of research ought to (somewhat) allay concerns about the return of pseudo-scientific racism. First, our understanding of human genetic variation, derived from studying actual genes, completely dismantles any remaining shreds of the old racial notions, as the examples above show. The best antidote for pseudo-science is real science. Second, psychologically-oriented researchers have come to increasingly understand how and why humans are susceptible to lumping people together in labeled groups and sticking stereotypes to those groups. As you'll see in Chapter 11, racial and ethnic categories arise when cultural evolution taps our human-universal tribal psychology, to carve up the social world in particular ways. Though these categories are not usually rooted in any important genetic variation, these categories are learned unconsciously and can affect our perceptions, automatic intuitions, and rapid judgments. Increasingly, we understand what triggers prejudice and what the implications of this are for health, education, economics, conflict and social life.[122] What we need is more evolutionarily-grounded science on genes, culture, ethnicity and race, not less.

These insights will continue to fuel the spread of a new social construct, the view that all people, and perhaps some other species as well, are endowed with certain inalienable rights—we call these *Human Rights*. No new facts about genes, biology or culture can alienate a person from these rights.

Chapter 7

On the origin of faith

As one of the world's staple crops, manioc (or cassava) is a highly productive starch-rich tuber that has permitted relatively dense populations to inhabit drought-prone tropical environments. I've lived on it, both in Amazonia and in the South Pacific. It's tasty and filling. However, depending on the variety of manioc and the local ecological conditions, the tubers can contain high levels of cyanogenic glucosides, which release toxic hydrogen cyanide when the plant is eaten. If eaten unprocessed, manioc can cause both acute and chronic cyanide poisoning. Chronic poisoning, which emerges only gradually after years of consumption, is particularly dangerous and has been linked to neurological problems, developmental disorders, paralysis in the legs, thyroid problems (e.g., goiters) and immune suppression. These so called "bitter" manioc varieties remain highly productive even in infertile soils and ecologically marginal environments, in part due to their cyanogenic defenses against insects and other pests.[123]

In the Americas, where manioc was first domesticated, societies who have relied on bitter varieties for thousands of years show no evidence of chronic cyanide poisoning. In the Colombian Amazon, for example, indigenous Tukanoans use a multi-step, multi-day, processing technique that involves scraping, grating and finally washing the roots, in order to separate the fiber, starch and liquid. Once separated, the liquid is boiled into a beverage, but the fiber and starch must then sit for two more days, when it can be baked and eaten. Figure 7.1 shows the percentage of cyanogenic content in the liquid, fiber and starch remaining through each major step in this processing.[124]

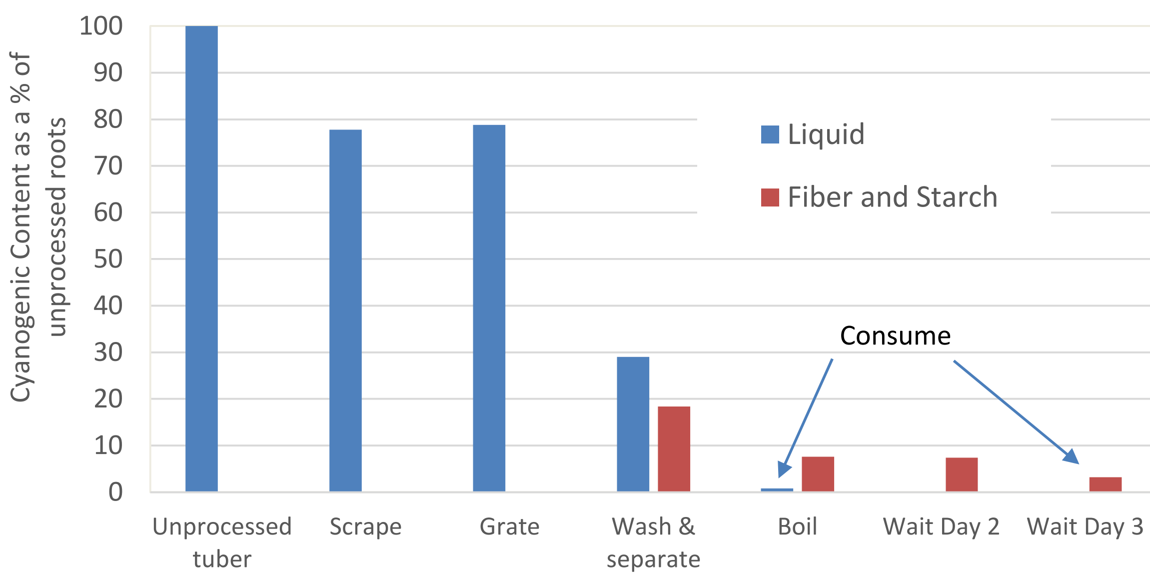


FIGURE 7. 2. EFFECTS OF EACH MAJOR STEP IN THE TUKANOAN MANIOC PROCESSING TECHNIQUE. PERCENTAGES ARE RELATIVE TO THE RAW TUBER (LEFTMOST BAR). DATA ARE DRAWN FROM DUFOUR (1994).

Such processing techniques are crucial for living in many parts of Amazonia, where other crops are difficult to cultivate and often unproductive. However, despite their utility, one person would have a difficult time figuring out the detoxification technique. Consider the situation from the point of view of the children and adolescents who are learning the techniques. They would have rarely, if ever, seen anyone get cyanide poisoning, because the techniques work. And, even if the processing was ineffective, such that cases of goiter (swollen necks) or neurological problems were common, it would still be hard to recognize the linkage between these chronic health issues and eating manioc. Most people would have eaten manioc for years with no apparent effects. Low cyanogenic varieties are typically boiled, but boiling alone is insufficient to prevent the chronic conditions for bitter varieties. Boiling does, however, remove the bitter taste and prevent the acute symptoms (e.g., diarrhea, stomach troubles and vomiting). So, if one did the commonsense thing and just boiled the high cyanogenic manioc, everything would *seem* fine. Since the multi-step task of processing manioc is long, arduous and boring, sticking with it is certainly non-intuitive. Tukanoan women spend about a quarter of their day detoxifying manioc, so this is a costly technique in the short term.[125]

Now consider what might result if a self-reliant Tukanoan mom decided to drop any seemingly unnecessary steps from the processing of her bitter manioc. She might critically examine the procedure handed down to her from earlier generations and conclude that the goal of the procedure is to remove the bitter taste. She might then experiment with alternative procedures, by dropping some of the more labor intensive or time-consuming steps. She'd find that with a shorter and much less labor intensive process, she could remove the bitter taste. Adopting this easier protocol, she would have more time for other activities, like caring for her children. Of course, years or decades later her family would begin to develop the symptoms of chronic cyanide poisoning.[126]

Thus, the unwillingness of this mom to take on faith the practices handed down to her from earlier generations would result in sickness and early death for members of her family. Individual learning does not pay here, and intuitions are misleading. The problem here is that the steps in this procedure are *causally opaque*—an individual cannot readily infer their functions, interrelationships or importance. The causal opacity of many cultural adaptations had a big impact on our psychology.

Wait. Maybe I'm wrong about manioc processing. Perhaps it's actually rather easy to individually figure out the detoxification steps for manioc? Fortunately, history has provided a test case.

At the beginning of the 17th century, the Portuguese transported manioc from South America to West Africa for the first time. They did not, however, transport the age-old indigenous processing protocols, or the underlying commitment to using those techniques. Because it is easy to plant and provides high yields in infertile or drought-prone areas, manioc spread rapidly across Africa, and became a staple food for many populations. The processing techniques, however, were not readily or consistently re-generated. Even after hundreds of years, chronic cyanide poisoning remains a serious health problem in Africa. Detailed studies of local preparation techniques show that high levels of cyanide often remain, and that many individuals carry low levels of cyanide in their blood or urine, which haven't yet manifested in symptoms. In some places, there's no processing at all, or sometimes the processing actually increases the cyanogenic content. On the positive side, some African groups have in fact culturally evolved effective processing techniques, but these techniques are spreading only slowly.[127]

The point here is that cultural evolution is often much smarter than we are. Operating over generations as individuals unconsciously attend to and learn from more successful, prestigious and healthier members of their communities, this evolutionary process generates *cultural adaptations*. Though these complex repertoires appear well-designed to meet local challenges, they are not *primarily* the products of individuals applying causal models, rational thinking, or cost/benefit analyses. Often, most or all of the people skilled in deploying such adaptive practices do not understand how or why they work, or even that they 'do' anything at all. Such complex adaptations can emerge precisely because natural selection has favored individuals who often place their *faith* in cultural inheritance—in the accumulated wisdom implicit in the practices and beliefs derived from their forbearers—over their own intuitions and personal experiences. In many crucial situations, intuitions and personal experiences can lead one astray, as we saw with our lost explorers (the nardoo was satisfying). To see this more clearly, let's look at some more cultural adaptations.

TABOOS DURING BREAST FEEDING AND PREGNANCY?

We were eating a large, tasty moray eel when I noticed that Mere was not eating any of the eel, only the manioc. I asked her why she was not eating the eel. I recall Mere saying something like "A tabu; Qi sa bukete", which translates as, "it's taboo; I'm pregnant." "Interesting"… I thought; this suggested to me that there may be some taboos against consuming certain foods during pregnancy. I had noticed Mere not eating because I'd been worried about eating the moray eel myself, since I'd read that this species is known to carry high levels of ciguatera toxin. Of course, following the ethnographers' axiom, I pressed on eating the eel since no one else seemed at all worried. Many folks were even enthusiastic about the eel, as it has a richer flavor than the typical white fish. This incident, early in my fieldwork in Fiji, sparked my interest and led me to investigate more deeply over the next several years.[128]

To tap her experience with public health research, pregnancy and breastfeeding, I teamed with my wife, Natalie, on this project. Here's what we found: during both pregnancy and breastfeeding, women on Yasawa Island (Fiji) adhere to a series of food taboos that selectively excise the most toxic marine species from their diet. These large marine species, which include moray eels, barracuda, sharks, rock cod and several large species of grouper, contribute substantially to the diet in these communities; but, all are also known in the medical literature to be associated with ciguatera poisoning. Ciguatera toxin is produced by a marine microorganism that thrives on dead coral reefs. The toxin accumulates up the food chain to achieve dangerous levels in some large and long-living members of these species. Lasting about a week, the acute symptoms of poisoning involve diarrhea, vomiting, headache, itchiness and a distinctive hot-cold reversal on the skin. My village friends say they know they've been poisoned when they bathe. Bathing is always done with cool water and, when poisoned, the water provokes a burning sensation on their skin. These symptoms sometimes return periodically, weeks or even months later. Little is known about the effects of ciguatera toxin on fetuses, though we know that pregnant women have reduced resistance to toxins, and I found cases in the medical literature showing that fetuses can be highly disturbed by ciguatera poisoning. Like other toxins, it seems likely that ciguatera can accumulate in mother's milk and endanger nursing infants. For adults, ciguatera poisoning results in death in a small percentage of cases. While you have probably never heard of ciguatera toxin, it's the most common form of fish poisoning and creates a health problem for any population that routinely consumes tropical reef species.[129]

This set of taboos represents a cultural adaptation that selectively targets the most toxic species in women's usual diets, just when mothers and their offspring are most susceptible. To explore how this cultural adaptation emerged, we studied both how women acquire these taboos and what kind of causal understandings they possess. As adolescents and young women, these taboos are first learned from mothers, mothers-in-laws and grandmothers. However, this initial repertoire is then updated by a substantial portion of women who learned more taboos from village elders and prestigious local *yalewa vuku* ("wise women"), who are known for being knowledgeable about birthing and medicinal plants. Here, we see Fijian women using cues of age, success or knowledge, and prestige to figure out from whom to learn their taboos. As explained in earlier chapters, such selectivity alone is capable of generating an adaptive repertoire over generations, without anyone understanding anything.

We also looked for a shared underlying mental model of why one would not eat these marine species during pregnancy or breastfeeding—a causal model or set of reasoned principles. Unlike the highly consistent answers on *what* not to eat and *when*, women's responses to our *why* questions were all over the map. Many women simply said they did not know, and clearly thought it was an odd question. Others said it was "custom." Some did suggest that the consumption of at least some of the species might result in harmful effects to the fetus, but what precisely would happened to the fetus varied greatly, though a non-trivial segment of the women explained that babies would be born with rough skin if sharks were eaten and smelly joints if morays were eaten.

Unlike most of our interview questions on this topic, the answers here had the flavor of post-hoc rationalization: "since I'm being asked for a reason, there must be a reason, so I'll think one up now." This is extremely common in ethnographic fieldwork, and I've personally seen it in the Peruvian Amazon with the Matsigenka and with the Mapuche in southern Chile.[130] Of course, it's not particularly difficult to get similar responses from educated Westerners, but there remains a striking difference: educated Westerners are trained their entire lives to think that behaviors must be underpinned by explicable and declarable reasons, so we are more likely to have them at the ready, and feel more obligated to supply 'good' reasons upon request. Saying "it's our custom" is not considered a good reason. The pressure for an acceptable, clear and explicit reason for doing things is merely a social norm common in Western populations, which creates the illusion (among Westerners) that humans generally do things based on explicit causal models and clear reasons.[131] They often do not.

Finally, our evidence from Yasawa suggests that these taboos, while causally opaque, do actually work. We compared women's chances of getting fish poisoning during pregnancy and breastfeeding with the rest of their adult lives. Our analyses show that rates of fish poisoning are cut by a third during pregnancy and breastfeeding. The taboos are cultural prescriptions that reduce fish poisoning.

WHY PUT ASH IN THE CORN MIX?

One morning in 1998, when I was living in rural southern Chile and working with the indigenous Mapuche, I arrived at my friend Fonso's farmhouse to find him preparing what he called *mote*, a traditional Mapuche corn dish. He showed me how you have to scoop fresh ash out of the wood stove and put it into the corn mix for soaking, before heating it. I thought that was curious, so I asked him why he mixed the wood ash in with the corn. His answer was "it's our custom." And, a wise custom it is.

In the Americas before 1500 AD, corn was the stable crop for many farming societies. However, relying heavily on corn presents some tricky nutritional issues. A diet based on corn can leave one short on niacin (vitamin B_3). Failure to get enough niacin results in a disease called pellagra, a horrible condition characterized by diarrhea, lesions, hair loss, tongue inflammation, insomnia, dementia and then death. There is actually niacin in corn, but it's chemically bound and cannot be freed by normal cooking. To release this niacin, populations throughout the New World culturally evolved practices that introduced an alkali (a base) into their corn preparations. In some places, the alkali came from burning seashells (generating calcium hydroxide) or the ash of certain kinds of wood. Elsewhere, there were natural sources of lye (providing potassium hydroxide). Mixing the alkali into the recipe in the right way chemically releases the otherwise unavailable niacin in the corn, which stops pellagra in its tracks, and allowed corn-based agricultural populations to grow and spread. [132]

Perhaps mixing non-food substances, like wood ash or burned seashells, with foods during cooking is easy for a big-brained ape like us to figure out?

History, again, provides us with a natural experiment, as corn was brought from the New World to Europe after 1500. By 1735, some populations in Italy and Spain had already become reliant on cornmeal, as a staple, and pellagra had emerged. The condition was theorized to be a form of leprosy, or somehow caused by spoiled corn. Pellagra spread across Europe with this new staple crop into Romania and Russia, but remained mostly confined to the poor populations who relied on it almost exclusively through the winter—making pellagra the "springtime disease." Experiments were done, and laws were passed to address the problem, by prohibiting the sale of spoiled or moldy corn. This did little to reduce pellagra, since spoilage is not the issue—they had the wrong causal model.[133]

Later, pellagra also emerged in the southern U.S. during the late 19th and early 20th century, and spread in epidemic fashion until the 1940s. Millions died, as poor people and institutions including prisons, sanitariums and orphanages had come to rely heavily on diets of cornmeal and molasses. Despite alarms raised by the Surgeon General, special commissions, medical conferences and private donations to find a cure, the plague raged on for thirty years.

One man, Dr. Joseph Goldberger, investigated orphanages, performed controlled experiments on prisoners, and had begun to construct the right causal model by 1915. However, at the time, the medical community was convinced pellagra must be an infectious disease, so Goldberger was ineffective, and his ideas thought "absurd." Goldberger even injected his wife and friends with blood from people suffering from pellagra to demonstrate the non-infectious nature of the condition. These studies were dismissed by asserting that Goldberger's staff must have been "'constitutionally resistant'" to the disease.[134]

Thus, not only did people—Europeans and Americans in this case—not figure out the right causal model, but they actively resisted it when it was presented to them by Goldberger. Instead, they preferred to hold firmly to the wrong causal model, probably because the right model was rather less intuitive. Spoiled food and contamination were, and are, relatively 'easy to think' with regard to food compared to chemical reactions involving the introduction of non-foods, like burnt seashells, into culinary recipes. Cultural evolution had produced a rather non-intuitive fix for the pellagra challenge.

Note, if you are educated and Western, you might be thinking that my numerous examples of toxic plants and animals are merely special cases, as you might be under the impression that few plants need detoxification, and that nature's bounty is pure and safe. For many Westerners, "it's natural" seems to mean "it's good". This view is wrong, and comes from shopping in supermarkets and living in landscaped environments. Plants evolve toxins to deter animals, fungi and bacteria from eating them. The list of "natural foods" that need processing to detoxify them goes on and on. Early potatoes were toxic, and Andean peoples ate clay to neutralize the toxin. Even beans can be toxic without processing. In California, many hunter-gatherer populations relied on acorns, which similarly require a labor intensive, multi-day leaching process. Many small-scale societies have similarly exploited hardy, tropical plants called cycads for food. But, cycads contain a nerve toxin. If not properly processed, they can cause neurological symptoms, paralysis and death. Numerous societies, including hunter-gatherers, have culturally evolved an immense range of detoxification techniques for cycads.[135] By contrast with our species, other animals have far superior abilities to detoxify plants. Humans, however, lost these genetic adaptations, and have evolved a dependence on cultural know-how, just to eat.

DIVINATION AND GAME THEORY

Remember from Chapter 2 when the chimpanzees and humans each played Matching Pennies. Game theory tells us that the optimal rational strategy involves randomizing, by playing Left or Right with some fixed probability. For example, a player's optimal strategy might be to "play R" 80% of the time. The humans lost to the chimpanzees because we are bad randomizers, and probably because we tend to automatically copy each other. As I noted, much work in psychology shows that people (well, educated Westerners) are subject to the Gambler's Fallacy in which we perceive streaks in the world where none exist, or we believe that we are "due" after an extended losing streak. In fact, we struggle to recognize a sequence of hits and misses as random—instead we find phony patterns in the randomness. One famous version of this is the "hot-hand fallacy" in basketball, where people perceive a player as suddenly better than his long-term scoring average would suggest (it's an illusion). This is a problem for us, since the best strategies in life sometimes require randomizing. We are just not good at shutting down our mental pattern recognizers.[136]

When hunting caribou, Naskapi foragers in Labrador, Canada, had to decide where to go. Commonsense might lead one to go where one had success before, or to where friends or neighbors recently saw caribou. However, this situation is like Matching Pennies in Chapter 2. The caribou are mis-matchers and the hunters are matchers. That is, hunters want to match the locations of caribou while caribou want to mismatch the hunters, to avoid being shot and eaten. If a hunter shows any bias to return to previous spots, where he or others have seen caribou, then the caribou can benefit (survive better) by avoiding those locations (where they have previously spotted humans). Thus, the best hunting strategy requires randomizing. Can cultural evolution compensate for our cognitive inadequacies?

Traditionally, Naskapi hunters decided where to go to hunt using divination, and believed that the shoulder bones of caribou could point the way to success.[137] To start the ritual, the shoulder blade was heated over hot coals in a way that caused patterns of cracks and burnt spots to form. This patterning was then read as a kind of map, which is held in a pre-specified orientation. The cracking patterns are (probably) essentially random from the point of view of hunting locations, since the outcomes depend on myriad details about the bone, fire, ambient temperature and heating process. Thus, these divination rituals may provide a crude randomizing device that helps hunters avoid their own decision-making biases. The undergraduates in the matching pennies game could have used a randomizing device like divination, though the chimps seem fine without it. [138]

This is not some obscure, isolated practice, and other cases of divination provide more evidence. In Indonesia, the Kantus of Kalimantan use bird augury to select locations for their agricultural plots. Geographer Michael Dove argues that two factors will cause farmers to make plot placements that are too risky. First, Kantu ecological models contain the Gambler's Fallacy, and lead them to expect floods to be less likely to occur in a specific location after a big flood in that location (which is not true).[139] Second, as with the MBAs' investment allocations in Chapter 4, Kantus pay attention to others' success and copy the choices of successful households, meaning that if one of their neighbors has a good yield in an area one year, many other people will want to plant there in the next year.

To reduce the risks posed by these cognitive and decision-making biases, Kantu rely on a system of bird augury that effectively randomizes their choices for locating garden plots, which helps them avoid catastrophic crop failures. Divination results depend not only on seeing a particular bird species in a particular location, but also on what type of call the bird makes (one type of call may be favorable, and another unfavorable).[140]

The patterning of bird augury supports the view that this is a cultural adaptation. The system seems to have evolved and spread throughout this region since the 17th century when rice cultivation was introduced. This makes sense, since it is rice cultivation that is most positively influenced by randomizing garden locations. It's possible that, with the introduction of rice, a few farmers began to use bird sightings as an indication of favorable garden sites. On-average, over a lifetime, these farmers would do better--be more successful—than farmers who relied on the Gambler's Fallacy or on copying others' immediate behavior. Whatever the process, within 400 years, the bird augury system spread throughout the agricultural populations of this Borneo region. Yet, it remains conspicuously missing or underdeveloped among local foraging groups and recent adopters of rice agriculture, as well as among populations in northern Borneo who rely on irrigation. So, bird augury has been systematically spreading in those regions where it's most adaptive.

This example makes a key point: not only do people often not understand what their cultural practices are doing, but sometimes it may even be important that they don't understand what their practices are doing or how they work. If people came to understand that bird augury or bone divination didn't actually predict the future, the practice would probably be dropped or people would increasingly ignore ritual findings, in favor of their own intuitions.

Manufacturing complex technologies is also causally opaque. Consider just one element of the archery package found among hunter-gatherers, the arrow. Let's also pick a society known to possess one of the least complex toolkits known, the hunter-gatherers of Tierra del Fuego, who entered the historical record when they encountered Ferdinand Magellan, and later Charles Darwin. Among the Fuegians, making an arrow requires a 14-step procedure that involves using seven different tools to work six different materials. Here are some of the steps:

- The process begins by selecting the wood for the shaft, which preferably comes from *chaura*, a bushy, evergreen shrub. Though strong and light, this wood is a non-intuitive choice since the gnarled branches require extensive straightening (why not start with straighter branches?).
- The wood is heated, straightened with the craftsman's teeth, and eventually finished with a scraper. Then, using a pre-heated and grooved stone, the shaft is pressed into the grooves and rubbed back and forth, pressing it down with a piece of fox skin. The fox skin becomes impregnated with the dust, which prepares it for the polishing stage (Does it have to be fox skin?).
- Bits of pitch, gathered from the beach, are chewed and mixed with ash (What if you don't include the ash?).
- The mixture is then applied to both ends of a heated shaft, which must then be coated with white clay (what about red clay? Do you have to heat it?). This prepares the ends for the fletching and arrowhead.
- Two feathers are used for the fletching, preferably from upland geese (why not chicken feathers?).
- Right-handed bowman must use feathers from the left wing of the bird, and vice versa for lefties (Does this really matter?).
- The feathers are lashed to the shaft using sinews from the back of the guanaco, after they are smoothed and thinned with water and saliva (why not sinews from the fox that I had to kill for the aforementioned skin?).

Next is the arrowhead, which must be crafted and then attached to the shaft, and of course there is also the bow, quiver and archery skills. But, I'll leave it there, since I think you get the idea.[141] It's massively causally opaque.

'OVER-IMITATION' IN THE LABORATORY

Crucial to making cultural adaptations like manioc, corn or nardoo processing work is not only faithfully copying all the steps, but *sometimes* actually avoiding putting much emphasis on causal understandings that one might build on the fly, on one's own. As shown above, dropping seemingly unnecessary steps from one's cultural repertoire can result in neurological disorders, paralysis, pellagra, reduced hunting success, pregnancy problems and death. In a species with cumulative cultural evolution, but only in such a species, faith in one's cultural inheritance often favors greater survival and reproduction.

Dovetailing with the above field observations, experimental work with children and adults on the fidelity of cultural learning allows us to put a microscope on the cultural transmission process. Recently, psychologists have studied the when and why of people's willingness to copy the seemingly irrelevant steps used by another to get to a reward. In a typical experiment, a participant sees a model engage in a multi-step procedure, which involves using simple tools to push, pull, lift, poke and tap an "artificial fruit" (often a large box with doors and holes). The procedure usually results in obtaining some desirable outcome, such as a toy or snack. Some of the steps in the procedure are not apparently required to achieve the goal of getting the reward. Sometimes people even copy steps with no evident material-physical connection to the outcome. Notorious for inappropriately naming of behavioral patterns, psychologists have labelled this not particularly shocking phenomenon 'over-imitation'.

Let's examine a specific experiment that has been tested and replicated with children, adults and chimpanzees. In the experiment, participants first observe a model engage in a series of steps using a slender rod to access a reward in an "artificial fruit". The fruit is a large opaque box with two entry points. The first entry point is sealed by bolts, which can be (a) *pushed* or (b) *dragged* out of the away—using the rod—to provide access to the tube. This tube, however, merely dead ends—it's a decoy, and is irrelevant to obtaining the reward. The second entry point is concealed by a doorway, which can be (a) *slid* or (b) *lifted*. The rod, which has a Velcro tip, can then be maneuvered down the tube to obtain the reward, a sticker for the kids or food for the chimps.[142]

The robust results from these experiments are that children and adults are rather inclined to copy whatever the model does to obtain the reward. People even copy the irrelevant actions when they are alone, after they think the experiment is over, and when they've been told explicitly *not to copy* any irrelevant actions.[143] However, as we'd expect from Chapter 4, people are more likely to copy irrelevant actions when the model is older and higher in prestige. This is also not merely some tendency of little children: assuming the problem is sufficiently opaque, the magnitude of 'over-imitation' *increases* with age.[144] This also isn't just educated Western peoples. Research in the Kalahari Desert in southern Africa, whose populations lived as foragers until recent decades, show them to be *at least* as inclined to high fidelity cultural transmission as Western undergraduates.[145]

As you may anticipate, the chimpanzees outperformed their big-headed cousins once again. In this work, comparative psychologists Vicki Horner and Andy Whiten used the same opaque "artificial fruit" used above and a clear version of the fruit in which one could readily see that the top slot was not connected to the area with the reward. When the causality was more transparent, with the clear box, the chimpanzees immediately dropped all irrelevant actions while the 3-4 year old Scottish kids copied the irrelevant actions as much as with the opaque fruit. Chimpanzees did learn some stuff by watching the model work on the fruit: it helped them assess the affordances of the apparatus. They learned how different parts of the fruit could move. But, once they had visual evidence that these actions would not do anything, they dropped them.[146] Though chimps clearly have some culture, they aren't a cultural species.[147]

Nevertheless, there's much more to over-imitation than this. As we saw in Chapter 2, humans possess a certain degree of low-level automatic mimicry—this is one reason why the chimpanzees can zoom in on the optimal Matching Pennies solution but we can't. Second, as we'll see in the next chapter, humans have also evolved to use mimicry to build social relationships, and cue status differences. So, we also mimic others to say, "hey, I wanna relate to you; you're swell." Finally, beginning in Chapter 9, we'll see how cultural evolution generates social norms that, if violated, can result in a bad reputation or other punishment. So, sometimes people may also 'over-imitate' to avoid getting a bad reputation as a deviant. Culture-gene coevolution generates many reasons why our species is inclined to copy all the steps or closely follow the local protocols.[148]

Our reliance on cultural transmission, however, goes much deeper. In addition to acquiring practices and beliefs, which may violate our intuitive understandings, we can also acquire tastes, preferences and motivations. These too can be acquired in the face of our instinctual or innate inclinations. This does not mean we don't have instincts or innate inclinations, but merely that natural selection has endowed our cultural learning systems with the ability to, under the right conditions, overwrite these, or work around them.

OVERCOMING INSTINCT: WHY CHILI PEPPERS TASTE GOOD

Why do we use spices in our foods? In thinking about this question keep in mind that (1) other animals don't spice their foods, (2) most spices contribute little or no nutrition to our diets, and (3) the active ingredients in many spices are actually aversive chemicals, which evolved to keep insects, fungi, bacteria, mammals and other unwanted critters away from the plants that produce them.

Several lines of evidence indicate that spicing may represent a class of cultural adaptations to the problem of food-borne pathogens. Many spices are antimicrobials that can kill pathogens in foods. Globally, common spices are onions, pepper, garlic, cilantro, chili peppers (capsicum) and bay leaves. Here's the idea: the use of many spices represents a cultural adaptation to the problem of pathogens in food, especially in meat. This challenge would have been most important before refrigerators came on the scene. To examine this, two biologists, Jennifer Billing and Paul Sherman, collected 4578 recipes from traditional cookbooks from populations around the world. They found three distinct patterns.[149]

1. Spices are, in fact, antimicrobial. The most common spices in the world are also the most effective against bacteria. Some spices are also fungicides. Combinations of spices have synergistic effects, which may explain why ingredients like "chili power" (a mix of red pepper, onion, paprika, garlic, cumin and oregano) are so important. And, ingredients like lemon and lime, which are not on their own potent anti-microbials, appear to catalyze the bacteria killing effects of other spices.
2. People in hotter climates use more spices, and more of the most effective bacteria killers. In India and Indonesia, for example, most recipes used many anti-microbial spices, including onions, garlic, capsicum and coriander. Meanwhile, in Norway, recipes use some black pepper and occasionally a bit of parsley or lemon, but that's about it.
3. Recipes appear to use spices in ways that increase their effectiveness. Some spices, like onions and garlic, whose killing power is resistant to heating, are deployed in the cooking process. Other

spices like cilantro, whose antimicrobial properties might be damaged by heating, are added fresh in recipes. [150]

Thus, many recipes and preferences appear to be cultural adaptations adapted to local environments that operate in subtle and nuanced ways not understood by those of us who love spicy foods. Billing and Sherman speculate that these evolved culturally, as healthier, more fertile and more successful families were preferentially imitated by less successful ones. This is quite plausible given what we know about our species' evolved psychology for cultural learning, including specifically cultural learning about foods and plants.

Among spices, chili peppers are an ideal case. Chili peppers were the primary spice of New World cuisines, prior to the arrival of Europeans, and are now routinely consumed by about a quarter of all adults, globally. Chili peppers have evolved chemical defenses, based on capsaicin, that make them aversive to mammals and rodents but desirable to birds. In mammals, capsicum directly activates a pain channel (TrpV1), which creates a burning sensation in response to various specific stimuli, including acid, high temperatures and allyl isothiocyanate (which is found in mustard or wasabi). These chemical weapons aid chili pepper plants in their survival and reproduction, as birds provide a better dispersal system for the plants' seeds than other options (like mammals). Consequently, chilies are innately aversive to non-human primates, babies and many human adults. Capsaicin is so innately aversive that nursing mothers are advised to avoid chili peppers, lest their infants reject their breast (milk), and some societies even put capsicum on mom's breasts to initiate weaning. Yet, adults who live in hot climates regularly incorporate chilies into their recipes. And, those who grow up among people who enjoy eating chili peppers not only eat chilies but love eating them. How do we come to like the experience of burning and sweating—the activation of pain channel TrpV1? [151]

Research by psychologist Paul Rozin shows that people come to enjoy the experience of eating chili peppers mostly by re-interpreting the pain signals caused by capsicum as pleasure or excitement. Based on work in the highlands of Mexico, children acquire this gradually without being pressured or compelled. [152] They want to learn to like chili peppers, to be like those they admire. This fits with what we've already seen: children readily acquire food preferences from older peers. In Chapter 14, we further examine how cultural learning can alter our bodies' physiological response to pain, and specifically to electric shocks. The bottom line is that culture can overpower our innate mammalian aversions, when necessary and without us knowing it.

As a product of this long-running duet between cumulative cultural evolution and genes, our brains have genetically adapted to a world in which information crucial to our survival was embedded implicitly in a vast body of knowledge that we inherit culturally from previous generations. This information comes buried in daily cooking routines (manioc), taboos, divination rituals, local tastes (chili peppers), mental models and tool manufacturing scripts (arrow shafts). These practices and beliefs are often (implicitly) WAY smarter than we are, as neither individuals nor groups could figure them out in one lifetime. As you'll see in later chapters, this is also true of some institutions, religious beliefs, rituals and medical practices. For these evolutionary reasons, learners first decide if they will 'turn-on' their causal-model builders at all, and if so, they have to carefully assess how much mental effort to put into them. And, if cultural transmission supplies a pre-built mental model for how things work, learners readily acquire and adhere to those.

Of course, people can and do attempt to break down complex procedures and protocols in order to understand the causal linkages between them, and engineer better versions. They also alter practices through experimentation, errors in learning, and idiosyncratic actions. Nevertheless, as a cultural species, we have an instinct to faithfully copy complex procedures, practices, beliefs and motivations, including steps that may appear causally irrelevant, because cultural evolution has proved itself capable of constructing intricate and subtle cultural packages that are way better than we could individually construct in one lifetime. Often, people don't even know what their practices are actually doing, or that they are "doing" anything. Spicy food lovers in hot climates don't know that using recipes involving garlic and chili peppers protect their families from meat-borne pathogens. They just culturally inherited the tastes and the recipes, and implicitly had faith in the wisdom accumulated by earlier generations.

Finally, we humans do of course construct causal models of how the world works. However, what's often missed is that the construction of these models has long been sparked and fostered by the existence of complex culturally-evolved products. When people have accurately speculated on why they do something, this realization often occurs after the fact: "Why do we always do it this way? There must be a reason…maybe it's because…" However, just because some people have speculated accurately as why they themselves, or their groups, do something in a particular way does not mean that this is the reason why they do it. An enormous amount of scientific causal understanding, for example, has developed in trying to explain existing technologies, like the steam engine, hot air balloon or airplane. The device or technology pre-existed the development of any causal understanding, but *by existing* such cultural products opened a window on the world that facilitated the development of an improved causal understanding. That is, for much of human history until recently, cumulative cultural evolution drove the emergence of causal deeper understandings much more than causal understanding drove cultural evolution.[153]

This historical observation is consistent with experimental studies in young children. Research by developmental psychologists Andrew Meltzoff, Alison Gopnik and Anna Waismeyer suggests that it's exposure to models using artifacts and trying to "do things" that most effectively sparks the causal inference machinery in our minds. Toddlers, for example, will more accurately infer the causal connection between a particular means and a particular end when they observe a person using an artifact than when they observe exactly the same "naturally occurring" physical movements and environmental correlations. That is, children switch their causal model builders on in the presence of people operating cultural artifacts, but the models a focus on helping the learner better operate the artifact or engage in the practice.[154] More on this later.

MOVE OVER NATURAL SELECTION

Famous evolutionary psychologists, from Steve Pinker to David Buss, are fond of claiming that natural selection is the only process capable of creating complex adaptations that are functionally well-designed to meet environmental challenges or the demands of organisms' lives.[155] They are impressed by the fact that products of natural selection, like eyes, wings, hearts, spider webs, nests and polar bear snow caves, seem well-suited or fit to the problems they solve. Save for certain telltale imperfections, these adaptations look well-designed, even engineered. Eyes seem crafted for seeing and wings for flying; yet, there's no engineer or designer, and no agents had intentions to create them or a mental model of how they work. I largely agree with this view, and certainly share their sense of awe at the stunning power of natural selection. However, I part ways with them on the word "only". At least since the rise of cumulative cultural evolution, natural selection has lost its status as the *only* 'dumb' process capable of creating complex adaptations, well-fit to local circumstances. As this chapter aimed to show, cultural evolution, through the selective attention and learning processes discussed in Chapters 4 and 5, as well as others I've not mentioned, is fully cable of generating these complex adaptive products, which no one designed or had a causal mental model of *before* it emerged.

To see this, let's compare two types of houses, two artifacts, one built by natural selection and one built by cumulative cultural evolution. In Africa, male village weaverbirds construct strong, kidney-shaped, nests with downward facing tubular entrances that effectively protect 2-3 eggs from larger predators. Each species of weaver uses a stereotyped set of techniques to build the house in the same step-by-step pattern. Weavers first create an attachment, and then construct a ring, roof, egg chamber, antechamber and entryway (see Figure 7.2). Weaving, in different parts of the house, involves one of three knots (overhand, half hitch and slipknots) and three different weave patterns. To build the house, weavers must locate and harvest particularly stout strips from tall grasses or palm fronds. The shape of the interior combined with the downward-facing entry tunnel means that predators will have a hard time getting at the eggs. The thickness and layered construction of the woven floor means that the eggs can even survive a fall, should the nest be knocked off its' branch. None of these techniques or layouts are learned from other birds. Weavers either just know them innately, or are geared to reliably figure them out on the fly, on their own. Natural selection has constructed many such complex artifacts, and invertebrates such as termites, wasps and spiders make many such beautiful structures without any mental model of their final form.[156]

[Figure 7.2 about here, see image file. It was too large to put in]

Inuit snow houses are also a complex adaptation for living in many parts of the arctic (see Figure 7.2). Architecturally, these snow houses are unique in using snow blocks cut from drifts created during a single snowfall to form an aerodynamic dome-shape that can stand against strong arctic winds. Properly constructed, with blocks cut to fit, this dome is strong enough for a person to stand on without danger of collapse. Heated by small soapstone lamps, fueled with rendered fat from marine mammals, the insulating properties of snow mean that inside temperatures are 10°C (50°F). This internal warmth slightly melts the ice, thereby allowing the walls and ceiling to freeze together even more solidly. Properly oriented, the long tunnel entrance not only blocks the wind, but also uses pressure differences to create a heat trap. Windows, created from translucent membranes cut from seal guts or sheets of ice, provide light inside, and small holes maintain air circulation.[157]

Like village weaver nests, Inuit snow houses look designed and are clearly functionally well-fit to life in the Arctic. In fact, they appear to call for a team of engineers with knowledge of aerodynamics, thermodynamics, material science and structural mechanics. Not surprisingly, facing the real threat of freezing to death in their tents, Franklin's men didn't figure out how to make snow houses. No single individual or even a group of 100 highly motivated men in this case, could figure this out. It's a product of cumulative cultural evolution, and contains features that many or most Inuit builders just learn as "that's the way you do it" without any big causal model. Of course, there's little doubt that bits and pieces of causal models were culturally transmitted along with the procedures, rules and protocols, since partial or mini-models help builders make sure the parts are working and to adapt to changing or unusual circumstances. However, most of these causal mini-models are themselves transmitted culturally, and part of the overall package, not built on the fly by individuals.

This has serious implications for studying humans. It means that when we observe something functionally well-suited to address an adaptive challenge outside of conscious awareness, whether it be a snow house or complex cognitive ability (like subtracting 16 from 17), we can't assume the complexity comes from either natural selection acting on genes or intentional construction. It might be a product of cumulative cultural evolution.

Overall, cultural evolution is smarter than we are, and our species evolved genetically in a world full of cultural stuff, ranging from sophisticated technologies like snow houses to nuanced protocols like using ash to chemically release key nutrients from corn, that people had to just put their faith in. Relatively early in our species lineage, surviving by one's wits alone without leaning on any cultural know-how from prior generations meant getting out competed by better cultural learners, who put their efforts into focusing selectively on what and from whom to learn. However, even if you can figure out what to learn and from whom doesn't mean that those who possess the most valuable cultural know-how will be motivated to permit you to hang around them and freely tap their accumulated wisdom. It's this evolutionary challenge that gave us prestige.

Chapter 8

Prestige, Dominance and Menopause

In *Into Thin Air*, the author Jon Krakauer describes the influence of famed mountaineer Rob Hall at Everest Base Camp. Base Camp provides an interesting situation in which a diverse set of people have been plucked from the modern world and plopped down at 17,598 feet where they must figure out how to organize themselves at least well enough to complete a challenging task. At the time, Hall was recognized as perhaps the best mountain climber in the world, having summited Everest more times than any other non-Sherpa climber. Krakauer sketches the scene:

> Base camp bustled like an anthill. In a certain sense, Rob Hall's Adventure Consultants compound served as the seat of government for the entire Base Camp, because nobody on the mountain commanded more respect than Hall. Whenever there was a problem—a labor dispute with the Sherpas, a medical emergency, a critical decision about climbing strategy—people trudged over to our mess tent to seek Hall's advice. And, he generously dispensed his accumulated wisdom to the very rivals who were competing with him for clients… [158]

Rob Hall's ability to influence life at Base Camp arose from his *prestige*. Even in dealing with his rivals in both climbing and business, he was the first among equals. He held this position not because of any formal or official position, but because of a shared sense of mutual respect or admiration for him among those at Base Camp. People sought him out, and deferred to his judgments in many domains, including domains that have little to do with climbing skill per se, such as Sherpa labor disputes. Hall responded generously, which only enhanced his influence. Not long after the scene described by Krakauer, Hall froze to death on Everest as he stayed behind, still high on the mountain, in an effort to save a weakened climber.

Such patterns are not some peculiarity of late 20th century Westerners. The same phenomenon emerges all over the world. Consider the isolated inhabitants of the Andaman Islands, a population of egalitarian hunter-gatherers who were studied by the renowned British social anthropologist, A.R. Radcliffe Brown, from 1906 to 1908. Radcliffe Brown observes:

> Besides the respect for seniority, there is another important factor in the regulation of social life, namely the respect for certain personal qualities. These qualities are skill in hunting and warfare, generosity and kindness, and freedom from bad temper. A man possessing them inevitably acquires a position of influence in the community. His opinion on any subject carries more weight than that of another even older man. The younger men "attach" themselves to him, are anxious to please him by giving him any presents that they can, or by helping him in such work as cutting a canoe, and to join him in hunting parties or turtle expeditions….In each local group there was usually to be found one man who thus by his influence could control and direct others.[159]

Radcliffe Brown is describing prestige, which creates similar patterns across the globe and back in time. Great climbers and highly skilled hunters, as well as those that excel in other locally valued domains, are sought out, deferred to, and naturally emerge as influential across a wide range of domains. Such respected individuals are rarely ill-tempered or erratic, and instead are often renowned for their generosity. This occurs even in societies that are highly egalitarian, possessing no formal leadership roles or hierarchy. Across human societies, prestige is consistently associated with great skill, knowledge and success in activities or tasks people care about. This prestige-status readily forms a foundation for leadership in egalitarian societies.[160]

To understand the psychology that underlies these patterns, let's examine how *prestige psychology* evolved in our species' lineage.[161] The key is recognizing that once humans became good cultural learners, they needed to locate and learn from the best models. The best models are those who seem to possess the information most likely to be valuable to learners, now or later in their lives. To be effective, learners must hang around their chosen models for long-periods and at crucial times. Learners also benefit if their models are willing to share non-obvious aspects of their practices, or at least do not actively conceal the secrets of their success. As a consequence, humans reliably develop emotions and motivations to seek out particularly skilled, successful and knowledgeable models, and then be willing to pay deference to those models in order to gain their cooperation (pedagogy) or at least acquiescence in cultural transmission. This deference can come in many forms, including giving assistance (e.g., helping with chores), gifts and favors (e.g., watching their children) as well as speaking well of them in public (thus broadcasting their prestige). Without some form of deference, prestigious individuals have little incentive to allow unrelated learners to hang around them, and would not be inclined to provide any preferential access to their skills, strategies or know-how.

This patterning, as it emerged over human evolutionary history, created another opportunity for natural selection to sharpen our cultural learning abilities. When you are just learning a complex skill, it may often be difficult to distinguish a truly great performance from just a good one, or even a mediocre performance (e.g., playing the violin). To solve this problem, a young or naïve learner can watch other more experienced individuals to see who they pay attention to, defer to, and mimic. Our naïve learner can then use this to figure out who he or she should begin learning from.[162] As we saw in Chapter 4, this represents a kind of second-order cultural learning in which we figure out who to learn from by assessing who others think are worthy models. From this, prestige-status is born. Individuals who receive this kind of attention, imitation and deference are prestigious, even if they turn out not to be very knowledgeable or skilled. These cues of prestige, such as visual attention, cause learners to preferentially target their learning efforts. Individuals become increasingly prestigious as other members of their community come to believe they are worthy of respect, deference and admiration. This occurs even if most of those who come to respect the person cannot—or do not—directly evaluate the person's success, knowledge or skill themselves. This respect and admiration are the emotions that drive prestige-deference. It's why the young Andaman Islanders would "attach" themselves to certain individuals, and why they would help him cut a canoe.

To understand prestige as a social phenomenon, it's crucial to realize that it's often difficult to figure out what precisely makes someone successful. In modern societies, the success of a star NBA basketball player might arise from his (1) intensive practice in the offseason, (2) sneaker preference, (3) sleep schedule, (4) pre-game prayer, (5) special vitamins, or (6) taste for carrots. Any or all of these might increase his success. A naïve learner can't tell all the causal links between an individual's practices and his success (see Chapter 7). As a consequence, learners often copy their chosen models broadly across many domains. Of course, learners may place more weight on domains that for one reason or other seem more causally relevant to the model's success. This copying often includes the model's personal habits or styles as well as their goals and motivations, since these may be linked to their success. This "if in doubt, copy it" heuristic is one of the reasons why success in one domain converts to influence across a broad range of domains.[163]

The immense range of celebrity endorsements in modern societies shows the power of prestige. For example, NBA star Lebron James, who went directly from High School to the pros, gets paid millions to endorse State Farm Insurance. Though a stunning basketball talent, it's unclear why Mr. James is qualified to recommend insurance companies. Similarly, Michael Jordan famously wore Hanes underwear and apparently Tiger Woods drove Buicks. Beyonce' drinks Pepsi (at least in commercials). What's the connection between musical talent and sugary cola beverages? Finally, while new medical findings and public educational campaigns only gradually influence women's approach to preventive medicine, Angelina Jolie's single OP-ED in the New York Times, describing her decision to get a preventive double mastectomy after learning she had the 'faulty' BRCA1 gene, flooded clinics from the U.K. to New Zealand with women seeking genetic screenings for breast cancer.[164] Thus, an unwanted evolutionary side effect, prestige turns out to be worth millions, and represents a powerful and underutilized public health tool.

Having evolved alongside cultural learning in the human lineage, prestige was a latecomer to our status psychology. Inherited from our primate ancestors, and thus much older than prestige, we humans also possess a *dominance psychology*. In both primates and humans, individuals attain dominance status when others fear them, and believe they will use physical violence or other means of coercion, if they do not receive deference in the form of appeasement displays and preferred access to mates and resources (e.g., foods). In these hierarchies, subordinates signal their acceptance of a lower rank with displays involving diminutive body positions, including narrowed shoulders and a downward gaze. Dominant individuals remind subordinates of who's the boss with expansive body positions, upright torsos, widely spread limbs, and broadened chests. In some primates, high rank is achieved purely through fighting ability, based mostly on size and strength, though coalition partners and kinship play a role. In chimpanzees, alliances are also often crucial as pairs or trios establish coalitions in order to secure the top spots in the dominance hierarchy. These rankings are not the unstable products of continuous fighting, but often provide a relatively stable social order that is established after periods of fierce conflict. High dominance rank in both males and females generally leads to greater reproductive success, as measured by numbers of surviving offspring.[165]

Thus, because of culture-gene coevolution, humans came to possess (at least) two quite distinct forms of social status, *dominance* and *prestige*. Below, I'll layout how each of these forms of status connects to quite different psychological processes, motivations, emotions and bodily displays. However, before doing that, it's worth considering whether achieving dominance and prestige do both in fact favor greater reproductive fitness in small-scale societies. Reproductive fitness is the key currency that natural selection will seek to increase. If both forms of status are associated with greater fitness in these contexts, it's then at least plausible that both could have evolved genetically, and been sustained, over our species evolutionary history.[166]

Unfortunately, there's very little work on this, in part because evolutionary researchers have typically assumed humans have only one-dimension of social status. However, Chris von Rueden and his colleagues have recently studied prestige and dominance among the Tsimane' in the Bolivian Amazon, as part of a long-term field project. The Tsimane' live in relatively independent small family groups, now clustered in villages along rivers. They hunt, gather, and cultivate gardens scattered throughout the forest. Compared to most societies, their informal status hierarchies are relatively flat and local leaders are weak, making this a challenging population in which to test theories about status.

Chris asked a sample of Tsimane to rank the men in two villages along a number of dimensions, including their fighting ability, generosity, respect, community persuasiveness, ability to get their way, and their number of allies. Each Tsimane' man could then be assigned a score based on the aggregate results from his fellow villagers. Chris argues that his measures of fighting ability and community persuasiveness provide the best proxies for dominance and prestige, respectively, in this context. He then shows that both of these proxies for social status are associated with having more babies with one's wife, having more extra-marital affairs, and being more likely to remarry after a divorce, even after statistically removing the effects of age, kin group size, economic productivity and several other factors.[167] Beyond this, the children of prestigious men die less frequently and prestigious men are more likely to marry at younger ages (neither of these effects hold for dominant men). All this suggests that, at least in this small-scale society, being recognized as either dominant or prestigious has a positive influence on one's total reproductive output (children) or mating success over and above the consequences that might accrue from factors associated with status like economic productivity or hunting skills. Not surprisingly, both dominant and prestigious men tended to get their way at group meetings, but only prestigious men were respected and generous.

Key Elements of Prestige and Dominance

Table 8.1 summarizes some of the key elements of prestige and dominance, and of the strategies used by individuals to attain and maintain each type of status.[168] Beginning at the top of the table, the successful use of status-seeking strategies based on dominance or prestige leads individuals to have greater *influence* on their group's behavior—on its decisions, movements, and internal dynamics. This effect, combined with the fact that both dominant and prestigious individuals receive deference from lower status individuals, is what makes them both forms of social status. In dominance relationships, subordinates are influenced by the dominant out of fear; they submit, or go along in order not to provoke the dominant. By contrast, because people seek out prestigious individuals due to their perceived success and skill, they become truly persuasive such that learners often shift their underlying opinions, beliefs and practices to be more similar to those expressed by the prestigious individual. In addition, because lower status people seek to pay deference to their chosen models in exchange for getting to hang around them and learn about what they do, prestigious individuals gain influence as those with lower status seek to please them. Thus, prestigious individuals are influential both because people shift their own opinions and practices to match those of the prestigious, and because people are inclined to go along with prestigious individuals as a form of deference, even if they themselves don't agree.

Table 8.1. Patterns of Dominance vs. Prestige[169]		
Status Features	**Dominance**	**Prestige**
Influence	Based on coercion & threat	True persuasion & deferential agreement
Imitation By lower status	No imitative bias except to satisfy dominant	Preferential, automatic and unconscious imitation. May include affiliative imitation
Attention By lower status	Tracking of higher-ups, avoidance of eye contact and no staring.	Direct attention to and gaze at higher ups, watching and listening
Socio-linguistic Higher ups	Seize the floor and use aggressive verbal intimidation (e.g., disparaging humor and criticism)	Given the 'floor', and permitted long pauses. Use Self-deprecating humor
Mimicry By lower status	No preferential mimicry	Preferential mimicry of higher-ups
Proximity Management By lower status	Avoid higher ups; keep distance to avoid random aggression[170]	Approach higher ups; maintain proximity to higher-ups
Displays		
Lower status	Diminutive body position, shoulder slump, crouching and gaze aversion	Attention to prestigious, open body position
Higher-ups	Expansive body position, expanded chest, wide stance, arms wide	Similar to dominance display except muted. No expansive use of space
Emotions		
Lower status	Fear, shame, fear-based respect	Admiration, awe, admiring-respect
Higher-ups	hubristic pride, arrogance	authentic pride, tempered arrogance
Social Behavior Higher-ups	Aggression, self-aggrandizing, ego-centered	Prosocial, generous and cooperative
Reproductive fitness	Higher ups have greater fitness in small-scale societies	Higher ups have greater fitness in small-scale societies

The effects of prestige on attention, cultural learning and persuasion are well-established (see Chapter 4). To go beyond this to explore the idea that both prestige and dominance influence group behavior, I teamed up with my colleague Jess Tracy, an emotion and social psychologist, and our then junior colleague Joey Cheng (who did all the hard work). We formed small teams of strangers, and asked the teams to tackle a group challenge called the *Lost on the Moon Task*. Each group had to rank a set of items in order of importance, assuming they'd just crash-landed on the Moon. The items were things like a compass, gun, signal flare, and matches. Our participants were told they would be paid according to how similar their team's rankings were to the rankings of NASA engineers. Everyone first created their own personal ranking, and then their teams were assembled to come up with the team's ranking. After this, every individual privately evaluated their fellow team members on a wide range of personal and social dimensions. From these peer-ratings, we assigned each person several scores including assessments of their prestige and dominance.[171] Using complex statistical analyses, we show that being either more prestigious or more dominant led to greater influence on their group's task outcome. We measured task outcomes by considering both who participants thought were influential in determining the team's rankings (subjective assessments), and by examining whose personal rankings were most similar to their team's eventual final rankings (an objective measure).

Both prestige- and dominance-based strategies were clearly distinguishable, in the predicted patterns, and were separate and independent routes to influencing one's group—different routes to status. Dominant individuals tended to (1) act overbearing, (2) credit themselves, (3) use teasing to humiliate others and (4) be manipulative. Meanwhile, prestigious individuals (1) were self-deprecating, (2) attributed success to the team, and (3) told jokes.

Imitation, Attention and Mimicry

Lower status individuals preferentially *attend* to (watch and listen to) and *imitate* prestigious individuals, but not dominant individuals. This attention and imitation is usually automatic and unconscious. It may also include bodily mimicry that serves two separate functions. First, mimicry can be an unconscious way of showing deference, of assenting to a person's higher prestige. This works because others are watching for cues to who is being copied, so substantial mimicry can effectively boost the prestige of the person mimicked. Second, mimicry is a tool that we use to help us get into other people's minds—to understand their thoughts and preferences. For example, when two people are having a positive conversational experience, getting to know one another, they will be unconsciously mimicking each other, in their body positions, vocal frequencies, movements and facial expressions—a patterning known as the Chameleon effect.[172] Interestingly, however, since prestige-subordinates are keener on understanding what their higher ups are thinking, wanting and believing, they engage in relatively more mimicry—that is, subordinates unconsciously mimicked prestigious individuals more than vice-versa.

One study of vocal mimicry involved CNN's long time talk show host, Larry King. Researchers analyzed the low-frequency vocal patterns used by King and his guests to see whether King altered his vocal patterns to match the guest, or vice-versa. Prior research had established that one of the ways that conversationalists mimic each other is by syncing up their low-frequency vocal patterns.[173] But, who accommodates to whom?

Twenty-five guests were analyzed, ranging from Bill Clinton to Dan Quayle (U.S. Vice-President, 1989-93). As expected, when Larry was interviewing someone perceived to be highly prestigious, Larry shifted his vocal frequencies to match his guest's patterns. However, when he was interviewing those perceived to be of lower status than Larry himself, it was the guests who automatically and unconsciously shifted to match Larry's frequency. Larry most strongly accommodated to George Bush, a sitting American president, as well as to Liz Taylor, Ross Perot, Mike Wallace and a presidential candidate, Bill Clinton.

Meanwhile, Dan Quayle, Robert Strauss and Spike Lee accommodated to Larry. Sometimes neither person shifted to match the other, such as when Larry interviewed a young Al Gore. These conversations were perceived as difficult, perhaps because both individuals saw themselves as higher status than their partner so neither would defer.[174]

Part of figuring out who to learn from is attending to whom others are looking at, listening to, and emulating because, in a complex world, this can point us in the right direction, towards models we should be learning from. At least, this was the case for most of our species' evolutionary history. However, in the modern world, this aspect of our psychology may explain how someone can be famous for being famous—the *Paris Hilton effect*.[175] The nature of our media means that, without trying, many people end up attending to whomever the popular media is covering. An initial media exposure, accidentally or by design, creates attention cues that cause people to unconsciously perceive someone as a worthy model. This means that we see others consistently watching certain celebrities, and hear others talking about those celebrities because such people provide a shared point of reference for everyone who watches the same media. These attention cues can cause our prestige psychology to automatically infer that these individuals are worthy of our imitation, respect, and admiration. This also causes increased emulation and mimicry in this group, as they seek physical or at least social proximity. This shift can then create a feedback loop, as the media continues to cover those who people want to know more about, and a celebrity is born—seemingly from nothing. This all got started because the initial media coverage caused some people to mistakenly infer that others were attending to a particular person. A parallel kind of runaway phenomena is described by Duncan Watts for the emergence of renowned paintings like the Mona Lisa or chart-toping popular songs.[176]

Status displays and emotions

Being or achieving high status has characteristic bodily displays that are predictable given the nature of the underlying relationships. In primates, as in many other species, high dominance rank is associated with large size. Even in humans, by 10 months, infants expect sheer size to favor success in conflicts between two agents, even if those agents are merely rectangular shapes with faces.[177] Consequently, it's not surprising that dominants signal their status by 'looking large' standing upright, expanding their chests, and spreading their limbs apart—think professional wrestlers or male baboons. Dominants also glare at others, looking for any hint of a challenge. For prestige, the displays of higher-ups appear to be muted or toned down versions of the dominance display. These are pride displays with the aggressive elements replaced or suppressed. This makes sense, since prestigious individuals want to signal their status, but do

FIGURE 8.1. PRIDE DISPLAYS MADE BY A CONGENIALLY BLIND (RIGHT) AND SIGHED JUDO PLAYER (LEFT) AFTER VICTORIES IN COMPETITION. FROM TRACY AND MATSUMOTO (2008).

not want to inadvertently communicate aggression.[178] Figure 8.1 show bodily displays of newly achieved prestige after victories in an Olympic Judo competition. The image pairs a status display from a congenitally blind Judo player with that of a sighted player. Can you tell which person has never actually seen a pride display by another person? [179]

The differences between dominance and prestige displays can be seen clearly in the videos we took of our teams during our *Lost on the Moon Task*. By systematically coding the video, we found that individuals pursuing a dominance-strategy (1) occupied more space, (2) used a wider posture, and (3) positioned their arms further away from their bodies than did those pursuing prestige. Meanwhile, prestigious individuals were more inclined to tilt their heads up, expand their chests, and smile. We also found that dominant, but not prestigious, individuals lowered their vocal pitch over the course of the interaction.

Focusing on emotions, psychologists have independently distinguished two forms of pride, which though they have labelled them as *hubristic pride* and *authentic pride*, correspond closely to dominance-based pride and prestige-based pride (see Table 1). Hubristic pride is the affective experience of seeking or achieving high status by controlling others through force or force threat, and authentic pride arises from achieving high status through the admiration of others based on one's competence, skill, success or know-how in valued domains. Some evidence has also begun to reveal that achieving prestige vs. dominance can be link to distinct hormonal responses. [180]

Displays by lower status individuals are also distinctive. In a dominance relationship, the submissive displays of subordinates are in many ways the opposite of those made by dominant individuals. Subordinates try to 'look small', shrinking their bodies, postures and presence. They also avert their gaze from dominants, though they still keep track of them to avoid random acts of aggression. Submissive displays are associated with the emotion shame.[181] By contrast, lower status individuals in a prestige hierarchy need to approach and engage the prestigious individual, hang around him or her, and actively and openly defer. Public displays of deference are particularly effective since they generate more prestige for their recipient. Aside from approach, attention and an open body posture, this pattern is not highly distinctive except in contrast to the other displays described above. The relevant emotions are admiration, awe and respect not based on fear.

Why Prestigious People are often Generous

When asked by ABC's Christiane Amanpour about how he got involved in *The Giving Pledge*, billionaire Tom Steyer replied, "The invitation to me was a phone call from Warren Buffett. If he thinks it's a good idea, I start with the assumption it is a good idea." Warren Buffett, known as the "Oracle of Omaha," was ranked among the most admired and respected people in the world. His *Giving Pledge* asked billionaires to promise to give half of their wealth away, an amount totaling $600 billion. At the time of this 2010 interview, Buffett, working with Bill and Melinda Gates, had already signed up 40 other billionaires. The trio began by first taking the Pledge themselves, and giving away quite a bit of money. As of January 28, 2015, 128 billionaires had also pledged to give away half of their wealth.

Buffet and the Gates' have actually taken a page from an old playbook. During the early centuries of Christianity an explicit campaign by people such as Saint Ambrose, the archbishop of Milan, made giving to the poor admirable. Rich Christians began to compete to see who could give the most to the poor (often through the church), inspired by paragons like Ambrose who gave all their wealth away. Prior to this, giving to the poor was puzzling (at best) since the poor had little or nothing to give back. This move may have been crucial to the long-run success of the Church as an organization (and, no doubt, the poor appreciated it too).[182]

For the same reason, charitable organizations open their efforts to raise money by featuring donations from highly prestigious individuals, whose generosity is subsequently made known to all other potential donors. When Brooke Astor, the esteemed *grande dame* of New York philanthropy and a Medal of Freedom winner, gave generously to the New York Public Library, three donations immediately followed, from Bill Blass, Dorothy and Lewis Cullman, and Sandra and Fred Rose. Each mentioned the inspiration provided by Brooke's substantial donation. This copycat philanthropy is a well-established tool of charitable organizations.[183]

The psychology described above helps us understand why people might copy the generosity of particularly prestigious individuals, but why might highly prestigious individuals willingly take the lead and go first? We've seen this emerge everywhere, from Everest Basecamp to the Andaman Islands. While dominants seek to manipulate others for their own ends, prestigious individuals tend to be generous and cooperative. Prestigious individuals can clearly benefit by not being aggressive, to avoid scaring away those who might pay deference. However, why would they be particularly generous or cooperative? It's not obvious from the evolutionary ideas presented so far.

The reason lies in our cultural nature. When a highly successful hunter achieves local recognition for his abilities (prestige), it means that when he actively cooperates, by pitching in during a turtle hunt or by supplying a community feast, others will copy his actions, inclinations and motivations. Thus, by behaving altruistically, and because he is a role model for others, a prestigious individual can increase the overall prosociality of his or her local group, or his or her section of the social network. This, of course, means that any altruism is only altruism in the short-term sense. In the longer-run, prestigious individuals who behave generously get to live in a social network that, by virtue of their own actions, becomes more generous and cooperative. For example, by causing others to donate, Brooke Astor gets to live in a better city, with at least an excellent public library. By contrast, if a low-status individual behaves altruistically, no one is likely to copy him or his motivations, so the social world he lives in won't improve with his generosity. For this reason, I suspect that natural selection has psychologically linked the achievement of prestige with prosociality inclinations, especially generosity.

The psychological linkage is so tight that in many places, where not everyone will know who is prestigious, generosity actually turns into a cue of prestige. That is, cultural evolution has sharpened up this linkage such that attending to who is most magnanimous is sometimes the best way to figure out who, locally at least, is most prestigious. Anthropologists call some of these traditional communities "big man societies" because men can increase their prestige with vast generosity.[184] We don't live in such a society (well, at least I don't); however, as with the *Giving Pledge*, this strand of human nature does emerge in some important contexts.

In controlled laboratory settings, behavioral experiments confirm the link between prestige and generosity. In one experiment, researchers paired individuals who had just participated in a trivia contest. The trivia contest aimed to create a minor status distinction between the players, as one player had received a gold star for his or her performance ('high-prestige') while the other did not ('low-prestige'). The actual assignment of the gold star was arbitrary, though players no doubt assumed that the stars marked outstanding performance in the trivia contest. Players then engaged in a series of sequential economic interactions with different players in which each had a chance to contribute money to a joint effort. If both players contributed money, both prospered and received more money. If only one contributed, the other (non-contributor) prospered while the contributor lost money.

The results reveal the power of prestige: when the gold-starred player went first, he or she tended to contribute to the joint effort, and then the following player—the low-prestige guy—usually did as well. So, everyone wins. However, when the low-prestige player went first, he tended not to contribute to the joint project, and then, neither did the high-prestige player. Even when the low-prestige player contributed first, the high-prestige player still tended not to. Thus, not only did low-prestige players tend to copy the cooperative tendencies or actions of the high prestige player, but high-prestige players responded with cooperation only when he or she knew the low-prestige player would follow him. Creating cooperation here, and enhancing everyone's profits, depended crucially on the high-prestige player going first.

What I find most amazing about this and related experiments is how such a relatively minor cue as one's apparent performance in a trivia contest can yield such substantial effects on cooperation. Other experimental work shows how prestige can (1) influence prices in markets such that higher prestige individuals reap a disproportionate share of the benefits, and (2) help groups coordinate on mutually beneficial outcomes.[185] All these experiments indicate that prestige can be harnessed to foster cooperation if the organization or institution is structured with an understanding of prestige.

PRESTIGE AND THE WISDOM OF THE AGED

In about 1943, a band of hunter-gatherers faced a severe and enduring drought in the Western desert of Australia. With their normal water sources failing, an old man named Paralji led his band to increasingly distant waterholes, only to find them dry or insufficient. After traveling far across their vast territory and checking over two dozen waterholes, Paralji faced having to lead his band to their last tribal water refuge, a place he had only been to once in his life, during his manhood initiation rite a half century earlier. When the band finally arrived, their last refuge was jammed with people from at least five other tribal groups.

Soon local food supplies at the refuge began to fail. Confronting disaster, Paralji recalled the ceremonial song cycles that his people periodically performed at rituals. The songs told of the wanderings of ancestral beings, and included a sequence of places and names. Relying on these ancient lyrics to direct him, Paralji headed off into territories unknown to him, followed by several young men and their families. Combining the information in the songs with trail markings, Paralji led the group along a chain of 50 to 60 small waterholes and across 350 km of desert, eventually arriving at Mandora Station on Australia's west coast. The group had been saved by their ritual songs, and by the distant memories of an old man.[186]

As Chapter 4 points out, older people not only have a lifetime of their own direct experience, such as Paralji's trip to the water refuge during his initiation rite, but they also have had a lifetime of cultural learning opportunities, to memorize things like ritual songs. Once we became a sufficiently cultural species, capable of selectively focusing on and learning from certain models, older individuals often emerged as important information resources. By opening the informational floodgates between generations, cultural transmission changes the relationship between younger and older individuals. In contrast, in non-cultural species, not only is the information accumulated by older individuals limited to what they can acquire through their own experience, but it's also of little consequence to others since they usually lack the psychological abilities to obtain it. Thus, in species with cultural learning, while aging individuals may be physically declining, they still possess transmittable know-how that makes them increasingly valuable to younger generations.

This may explain why the elderly are prestigious in most, if not all, traditional societies. In an extensive cross-cultural survey of the role of the aged in 69 small-scale or traditional societies, 46 societies included explicit mentions of respect, deference, reverence, homage, or obeisance to the aged, while in five more societies this could be readily inferred. The remaining cases simply made no mention of how the elderly were treated, rather than suggesting the elderly were treated with reduced deference or respect. Across these societies, the aged receive many perks as part of this prestige-deference. Elderly Tasmanians, for example, got to eat the best food while aged Omaha were exempt from having to scarify themselves after someone died, and mature Crow got out of many unpleasant tasks. Meanwhile, leadership positions and governing councils were often restricted to people of a certain vintage.[187]

Crucially, many of these ethnographic accounts explain why the elderly were revered, because they possess an abundance of knowledge in important domains such as lore, magic, hunting, rituals, decision-making and medicine. Consistent with this view, these accounts also make clear that the aged rapidly lose status and deference when their mental faculties begin to decline, or they appear incompetent. Based on his extensive review, one researcher observes, "the most striking fact about respect for old age is its widespread occurrence … practically universal in all known societies." The evolutionary reason is that older age is often a cue that someone is likely to possess knowledge or wisdom, and for this, we humans grant prestige-status. It's also why most other animals don't respect their elderly.

In many small-scale societies, institutions or social norms also endow the senior members of a community with dominance, by giving them control of land, resources, inheritance or marriage decisions. So, the aged may sometimes simultaneously possess both dominance and prestige, just as many supervisors do in our modern institutions. Nevertheless, as discussed in the *Lost on the Moon Task*, it's important to keep prestige and dominance conceptually separate, since the underlying cognitive and emotional patterns are distinct, as are the implications for cooperation.

If the elderly are so often prestigious across human societies, why aren't they particularly admired or respected in many Western societies? To answer this, we return to the evolutionary logic. The aged are accorded prestige and deference when more decades of experience and learning can provide a proxy measure for accumulated knowledge and wisdom. However, if a society is rapidly changing, then the knowledge accumulated by someone over decades will get outdated rather quickly. Age is only a good proxy if the world faced by the new generation is pretty similar to that faced by the oldest generation. Consider, for example, that the elderly of today grew up in a world without computers, email, Facebook, Google, smartphones, apps, or online libraries. They typed on manual typewriters, mailed handwritten letters, went to bookstores and could only date people they met in person or through friends and family. In our rapidly changing modern societies, the accumulated knowledge of the elderly is less valuable than it might otherwise be. In fact, the faster things change, the younger and younger the best and most competent models get.

MENOPAUSE, CULTURE AND KILLER WHALES

What are the implications of the fact that once we are a cultural species, decades of accumulated individual and cultural learning make us increasingly valuable to younger generations? The longer we live, the more information we accumulate, and the potentially more valuable we are as transmitters of this wisdom, provided the world is relatively stable during one lifetime (which it likely was for most of our species' evolutionary history).

Under these conditions, natural selection should favor extending our lives in order to give us time to transmit our accumulated know-how to our children and grandchildren, and to make sure they have the time and opportunity to learn what they will need. As individuals, our cultural stock is going up over the decades while our physical skills are going down, as are our abilities to produce high-quality babies. At a certain point, those lines cross, and it's time to stop reproduction and focus all of our efforts on the current children and grandchildren. However, given our declining physical abilities, one of the major ways we can help our younger relatives, especially in traditional societies, is by dispensing our accumulated wisdom. This is why humans, but not other primates, live for decades beyond when we stop reproducing, and even live past when we stop being economically productive. Not only is this true in modern societies, but it has also now been shown among hunter-gatherers and other small-scale societies, and likely dates back tens or even hundreds of thousands of years into the Paleolithic. By contrast, chimpanzees and other primates do not possess a long post-reproductive life. Death usually follows in relatively short order after reproduction ends.[188]

Direct evidence for this idea is just beginning to accumulate, though it's clear that the presence of non-reproductive grandmothers often increases the survival of their grandchildren.[189] The debate now centers on whether non-reproductive grandparents do this via the informational and prestige-status benefits related to cultural transmission, like Paralji, or whether it's their contributions of labor, such as by digging up tubers. I suspect both labor (e.g., childcare) and information are important contributions. However, the key question remains as to why such non-reproductive individuals stick around in humans while they are largely absent in most other species, especially among primates. My answer is, in humans, older individuals can give something that older members of other primate species cannot, information. In a cultural species, older individuals can transmit valuable know-how in addition to any helping out.

In the Fijian villages I work in, for example, grandmothers and grandfathers are crucial information sources. Older women advise their daughters and granddaughters, among others, on the fish taboos for pregnancy and breastfeeding that I discussed in Chapter 7, as well as helping and counseling on issues related to birthing, nursing, infant care, weaning foods, weaving, cooking, social norms (etiquette) and medicinal plants. During work parties, older men attend, but don't do much actual work. Instead, they provide administration and advice on activities related to house construction, turtle butchery, feast preparation, fish netting, gardening and ritual performance.[190]

As a result of the selection pressures created by the opportunities for cultural transmission as we age, both male and female humans tend to cease reproduction at least 2-3 decades prior to death, which provides enough time to ensure that the last of their children is sufficiently well-equipped. This effect is particularly relevant to females, since they carry most the expensive reproductive equipment. By shutting down their reproductive systems, the lives of women can be extended in order to provide more time for transmitting cultural information, and for making sure their children and grandchildren are sufficiently prepared. In males, there's less natural selection can do to extend their lives, though men's testosterone levels and virility do decline, and most men in small-scale societies do in fact cease reproduction when their wives do.

Only our lineage crossed the barrier into a regime of cumulative cultural evolution and culture-gene coevolution. However, this idea, that the wisdom of a lifetime of experience may make the older members of a social group more valuable, and as a consequence, cause natural selection to extend their lives by halting or reducing reproduction, should still be observable in other species. To examine this, let's consider two of only a few species that live decades past when they stop having babies, killer whales and elephants.

Killer whales have big brains, long-lives and menopause. Estimates suggest that killer whales, like a few other species of toothed whales, live another 25 years after menopause, which is long enough to see the oldest of their grandkids reach sexual maturity. If menopause is a genetic adaptation to augment the length of females' lives in order to give them an opportunity to exploit the knowledge they've gained over a lifetime in cultural transmission, then this species ought to be both fairly cultural and possess a social structure in which this information can be put to use to help their relatives.

Though more research is needed, a preliminary look suggests that they have the predicted ingredients. First, there's much variation across killer whale groups in behavioral practices, foraging tactics and communicative calls. Some groups, but not others, have developed techniques for how to take fish from fishing trawlers, and at least one group has a team technique in which one individual uses bubbles to scare salmon or herring into a clump near the surface where his buddies slap the clump with their tails, stunning the fish. Different groups also seem to possess different ecological information, about for example, the timing and location for catching particular salmon species. Second, experimental work suggests that killer whales are impressively good imitators, so cultural information can potentially flow through social networks and across generations, which probably explains many of the enduring behavioral differences observed among killer whale groups. Third, killer whales may engage in some of the most impressive teaching outside of our own species. In some places, young killer whales appear to learn from their mothers how to beach themselves to capture elephant seal and sea lion pups, and some observations suggest that killer whale moms facilitate this learning process in various ways. For example, moms push their calves up the beach to get the prey and rescue them when they get stuck on the beach. Finally, detailed demographic studies of killer whales confirm that adult males, even those over age 30, are more likely to survive if their mom is still around. This study can't tell us what mom is doing for her adult sons, but she definitely matters.[191]

The opportunity to dispense the information accumulated over decades is possible in killer whales because females remain in stable family groups. These matrilineal groups associate with related families, who are probably sister lineages, to form pods. So, knowledgeable grandmothers often have the chance to use their knowledge to benefit most or all of their close relatives, which may be the key selection pressure giving rise to menopause.

The story is similar for elephants.

In 1993, a severe drought hit Tanzania, resulting in the death of 20% of the African elephant calves in a population of about 200. This population contained 21 different families, each of which was led by a single matriarch. The 21 elephant families were divided into 3 clans, and each clan shared the same territory during the wet season (so, they knew each other). Researchers studying these elephants have analyzed the survival of the calves and found that families led by older matriarchs suffered fewer deaths of their calves during this drought.

Moreover, two of the three elephant clans unexpectedly left the park during the drought, presumably in search of water, and both had much higher survival rates than the one clan that stayed behind. It happens that these severe droughts only hit about once every four to five decades, and the last one hit about 1960. After that, sadly, elephant poaching in the 1970's killed off many of the elephants who would have been old enough in 1993 to recall the 1960 drought. However, it turns out that exactly one member of each of the two clans who left the park, and survived more effectively, were old enough to recall life in 1960.[192] This suggests, that like Paralji in the Australian desert, they may have remembered what to do during a severe drought, and led their groups to the last water refuges. In the clan who stayed behind, the oldest member was born in 1960, and so was too young to have recalled the last major drought.

More generally, aging elephant matriarchs have a big impact on their families, as those led by older matriarchs do better at identifying and avoiding predators (lions and humans), avoiding internal conflicts and identifying the calls of their fellow elephants. For example, in one set of field experiments, researchers played lion roars from both male and female lions, and from either a single lion or a trio of lions. For elephants, male lions are much more dangerous than females, and of course, three lions are always worse than only one lion. All the elephants generally responded with more defensive preparations when they heard three lions vs. one. However, only the older matriarchs keenly recognized the increased dangers of male lions over female lions, and responded to the increased threat with elephant defensive maneuvers.

This greater knowledge does in fact cash out, as older matriarchs, while not reproducing themselves, do appear to increase the reproductive success of their family group, and their knowledge is passed onto their offspring and grand-offspring.[193]

My point is that under the right conditions, natural selection will favor extending the lives of individuals in order to provide them with opportunities to exploit and transmit the information they've gleaned over a lifetime. Selection also favors attending to, learning from, and respecting the senior members of one's community when they are likely to possess valuable cultural information. This goes for humans as well as less cultural species like elephants and killer whales.

LEADERSHIP AND THE EVOLUTION OF HUMAN SOCIETIES

Exploring how culture-gene coevolution has shaped our species status psychology is crucial for understanding the emergence of political institutions. In egalitarian societies, which lack hierarchical institutions, prestige lays a crucial foundation for politics and economics. As we saw above, even the smallest-scale foraging societies are disproportionately influenced by prestigious individuals, whose status is rooted in success or skill in locally valued domains like hunting or warfare. In traditional societies living in richer environments, prestigious men use their persuasive abilities, influence and generosity to expand their sphere of influence in competition with other prestigious big men. In some places these competitions result in epic feasts at which these individuals seek to enhance their prestige by giving away more than their competitors, crushing them with their productivity, organizational skills and generosity. These "big men", which is often the literal local translation, can accumulate substantial influence in their lifetimes, though when they die little of this influence passes to their descendants. Similarly, understanding dominance helps illuminate the psychological underpinnings of hierarchical institutions, such as those based on hereditary chiefs or divine kings. Many modern institutions harness both forms of status as they aspire to promote individuals based on merit, skill, success and knowledge, into positions of dominance, where they control the costs and benefits deliver to others (e.g., salaries, promotions and vacations).

Effective institutions often harness or suppress aspects of our status psychology in non-intuitive ways. Take the Great Sanhedrin, the ancient Jewish court and legislature that persisted for centuries at the beginning of the Common Era. When deliberating on a capital case, its 70 judges would each share their views beginning with the youngest and lowest ranking member and then proceed in turn to the "wisest" and most respected member. This is an interesting norm because (1) it's nearly the opposite of how things would go if we let nature take its course, and (2) it helps guarantee that all the judges got to hear the least varnished views of the lower ranking members, since otherwise the views of the lowest status individuals would be tainted by both the persuasive and deferential effects of prestige and dominance. Concerns with dominance may have been further mitigated by (1) a sharing of the directorship of the Sanhedrin by two individuals, who could be removed by a vote of the judges, (2) the similar social class and background of judges, and (3) social norms that suppressed status displays.

These customs are not something that smart people often just think up, and even when they do, such practices are hard to implement. This is because the high status members of such deliberative bodies tend believe their views deserve special attention, and want the opportunity to speak first to increase their influence on outcomes. Converging with their colleagues, low status members are often disinclined to speak first, out of a fear of looking ill-informed or of contradicting high status individuals who haven't yet spoken. Thus, neither high nor low status individuals would necessarily be particularly supportive of a 'low-to-high status speaking rule' unless they understood something of status psychology and were more concerned about the institution's long-term success than their personal influence and careers. Professors in university departments, for example, regularly meet to discuss 'important' issues and then vote. In my experience in Departments of Anthropology, Psychology and Economics, the spontaneous speaking order is almost always from high to low prestige, except that often the youngest and most junior professors don't say anything at all. Similarly, though the Supreme Court of Canada uses the same speaking protocol as the Great Sanhedrin, the U.S. Supreme Court goes the opposite way, beginning with the Chief Justice and going down from there.[194]

Across human societies, we see that seeking prestige, often more than wealth itself, drives much human behavior. However, prestige derives from success, skill or knowledge in locally valued domains. While not infinitely malleable, what constitutes a *valued domain* is amazingly flexible. The differential success of societies and institutions will hinge, in part, on what domains are valued. How respectable was it to excel in reading, inventing machines, memorizing ancient texts, having children, obtaining additional wives or growing yams?

I'll close this chapter with a lesson in leadership that reflects an intuitive grasp of prestige from the English explorer James Cook. In 1768, as Lieutenant Cook was preparing to depart for the South Pacific, scurvy continued to plague the British navy, as it had for centuries, killing many sailors. Scurvy symptoms start with spongy gums and a general malaise, which is followed by bleeding from the nose and mouth and the loss of teeth. If vitamin C is not consumed, this decline ends in death. On the suggestion of an English physician, Cook obtained a large supply of sauerkraut, which we now know will prevent scurvy. Since sauerkraut represented a rather pungent and unusual deviation from the traditional maritime fare, Cook worried that his sailors would refuse to eat it, and knew that neither force nor education were likely to succeed in creating an enduring dietary shift. Instead, he ordered that plates of sauerkraut be dressed and served at the officers' mess, but not at the sailors mess. Within a week of setting sail, inferring that the officers had a taste for sauerkraut, the rank-and-file crew began actively requesting servings of sauerkraut. Very quickly, sauerkraut became so desired that it had to be rationed. Cook finished his expedition with not a single case of scurvy, a feat theretofore unheard of among Europeans during such long ocean voyages.

Chapter 9

In-laws, incest taboos and rituals

One evening, in the village of Teci (pronounced Tethi) on Yasawa Island (Fiji), I was drinking kava by lantern light at a crowded social gathering. Made from powdered roots mixed with water, kava is a ritually served beverage that numbs the tongue and imbues one with a peaceful feeling. In Fijian style, we were all sitting on comfortable woven mats, with the higher status (older) men sitting toward the private end of the one-room house and lower status people arrayed toward the other end. On this particular evening, I had achieved a small anthropological victory, as I'd managed to sit in the middle of the room with my age-mates, and had not been ushered immediately to the high status end, as a guest. Just as I was wondering when the next round of kava would be served, I looked up to see a neighbor, Kula, appear at the open doorway. He spotted me immediately (I stand out among Fijians), and noticed the open space next to me, in the otherwise crowded room. Flashing a big smile, the young man crouched according to custom as he made his way toward me. As Kula slid into position, while greeting me, his back pressed accidentally against a young woman. Almost immediately, with laughter breaking out, Kula was poked by his cousin and told that the girl behind him wanted to chat with him. Kula turned around to see who was behind him. He immediately looked terrified as he realized that, in the dimly-lit room, he'd sat down beside, and inadvertently brushed against, his "sister". This behavior, though unintentional, was completely inappropriate and embarrassing. Of course, as usual, I was initially confused, and not laughing, because I still hadn't quite pieced together what had just happened. With shame oozing down his body, Kula stood up and quickly exited, disappearing into the darkness. He did not return that evening.

Kula had sat down next to one of his many "classificatory sisters", who by most readers' kinship taxonomy would have been Kula's distant cousin. In these communities, as in many small-scale societies, certain types of cousins are labeled as "brothers" and "sisters", and they are supposed to be treated like one's "real" (genetic) siblings. In anthropological parlance, these classificatory siblings are your *parallel cousins*, which include your father's brother's children and your mother's sister's children, but not your mother's brother's or father's sister's children. These cousins, your parents' opposite sex siblings' children, are your *cross-cousins*, who are kind of like your official friends and potential lovers. Following the same logic, people also have classificatory siblings through their great-grandparents and beyond. Kula had violated, in a small way, the local incest taboo, which prohibits any direct interactions with one's opposite sex siblings, real or classificatory. This taboo requires that opposite sex siblings avoid interacting at all, which precludes talking or even sitting near each other. Of course, sex or marriage is out of the question, as is touching or being alone together. The logic here is that any touching or talking could blossom into sex and marriage, so it's best to nip this in the bud.

Kula had infringed on this incest taboo by sitting next to, and incidentally touching, his sister-cousin. Almost gleefully, Kula's cross-cousin highlighted his mistake, by suggesting that he talk to his sister-cousin—an action that would have made things much worse (it was a joke). Cross-cousins have reciprocal and egalitarian relationships, which are re-enforced and affirmed by constant joking. This joking relationship is totally unlike the relations of respect and authority between, for example, real and classificatory brothers of different ages.[195]

Kula's mishap opens a window on how traditional societies operate and organize themselves, which illuminates something of the social worlds experienced by both our ancestors, and much of the world today. Even the smallest scale human societies—unlike primate societies—are built on and organized around a set of kinship norms. While no doubt grounded in innate psychological processes that influence how we locate and treat our close genetic relatives and reciprocal partners, these social norms variously re-enforce, extend and suppress aspects of our genetically evolved psychology. Building on this idea over the next three chapters, I will show how the emergence of social norms drove a genetic evolutionary process of *self-domestication* that dramatically shaped our species' sociality. To begin, in this chapter I'll introduce you to some of the ways in which cultural evolution grabbed a hold of our innate psychology and harnessed it to expand human groups and our social networks. This created new forms of social organization that intensified the cooperation and sociality in our evolutionary lineage. Along the way, we'll take a closer look at social norms related to marriage, fatherhood, incest and rituals. In Chapter 10, we'll see how intergroup competition has long shaped cultural evolution to favor the proliferation of prosocial or group-beneficial norms, and the formation of more complex institutions (packages of social norms). These norms and institutions have long been important selection pressures on our species' genetic evolution. Then, in Chapter 11, we'll bring all this together, and focus on the impacts of this culture-driven process of self-domestication on our psychology.

This view contrasts sharply with the canonical view of the evolution of human cooperation. For decades, evolutionary researchers, from Richard Dawkins to Steven Pinker, have argued that humans are able to organize and cooperate so effectively because our psychology has been shaped by the evolutionary forces of kin selection and reciprocal altruism (reciprocity).[196] Our kin psychology evolved genetically because it permits us to bestow help or benefits on individuals who are genealogically related to us and thus likely to share particular altruistic genes. Our reciprocity psychology emerged as natural selection readied us to take advantage of the potential for ongoing tit-for-tat exchanges of benefits (or costs) with others.[197] In what's to come, I will be substantially augmenting and amending this canonical view. We'll see that not only are kin selection and reciprocal altruism insufficient to explain cooperation in the modern world, or in other complex societies, they are insufficient to explain cooperation in small-scale societies, including nomadic hunter-gatherers. So, though humans certainly do possess innate proclivities for helping our kin and engaging in reciprocity,[198] these are, in and of themselves, too weak or narrowly delimited to explain cooperation in real human societies. For example, though motivations to help close relatives can be strong, even in small foraging bands the average other person is a quite distant relative and bands contain many non-relatives.[199] By studying a diversity of real small-scale societies, we'll see how understanding human cooperation and sociality requires exploring how our social instincts are harnessed, magnified and recombined within an interlocking web of culturally-evolved social norms.

We'll see that cooperation, even in small, nomadic hunting and gathering societies, hinges on the existence of culturally-constructed norms that substantially augment our innate proclivities.

SOCIAL NORMS AND THE BIRTH OF COMMUNITIES

At some level, it should be uncontroversial that culture shapes the kinds of kinship relations that I described at the outset of this chapter. Kula's behavior, when he sat down with me, was being monitored by other members of his community, who started giggling among themselves almost immediately when he sat down. The question is why did the community care that Kula sat down next to his classificatory sister? If the pair's shared ancestor had been opposite sex siblings instead of same-sex siblings, then Kula could have brushed her back intentionally and made sexual jokes toward her without a negative reaction from his fellow villagers. Instead, shame crashed over Kula, and an otherwise enjoyable party was ruined, as he felt compelled to vanish into the night.

The origins of this form of sociality lie in our cultural learning abilities, which became increasingly sophisticated over our species' evolutionary history. As we saw in Chapter 4, simply by observing others we can acquire ideas, beliefs, values, mental models, tastes and motivations. Growing up in Teci, as in many other places throughout the world, means gradually acquiring and internalizing the notion that sexually mature males and females who stand as classificatory siblings ought not to interact in direct ways. Cultural learning means that it's possible for people to acquire notions of how people *should* behave, both towards others and even in purely non-social situations. Deviations from 'proper behavior' evoke negative emotions toward the deviant, even in uninvolved third party observers. In Chapter 11, we'll see that even very young children respond negatively to violations of completely arbitrary rules.

As part of this, we've begun to see how effective cultural learning is for acquiring tastes for performing all manner of costly actions, including even food preferences that require overcoming our innate aversions, as we saw with chili peppers. Building on such empirical observations, evolutionary researchers have been using mathematical modeling tools to ask this question: what happens when people culturally learn from others, and then those acquired behaviors, strategies, beliefs or motivations influence future social interactions? The answer from *cultural evolutionary game theory* is that *social norms* spontaneously emerge. Groups of individuals who engage in social interactions and learn from each other using cues like success and prestige often end up sharing similar behaviors, strategies, expectations or preferences, and deviations from these shared standards are penalized or sanctioned in some way. Or, in some cases, individuals come to share standards for valuing uncommon excellence, for rewarding individuals for going above and beyond the standard. Either way, the resulting behavioral patterns are stable in the sense that they tend to stick around, and resist efforts by one or a few individuals to change them.[200]

In both the real world and in many of these mathematical models, norm violators are sanctioned by the effects of reputation. When individuals break social norms, it often doesn't impact them immediately, though it may. Rather observers of the violation spread the word about what happened, and this gossip has negative consequences downstream, for some later interaction. What is often underappreciated is that reputation itself is merely a type of cultural information, which spreads because of many of the same psychological abilities that underpin other types of culture. Once our ancestors could learn from each other, say about which foods to eat or how to make a tool, we could also learn from each other about who not to build a long-term relationship with, for activities like hunting, sharing, mating and raiding. Sophisticated language is not necessary, since I can convey my feelings about an incestuous norm violator to a friend in the same way I communicate my feelings about vegetarian hot dogs to my wife (using my disgust expression).

Two other interesting results arise from studies using cultural evolutionary game theory. First, it turns out that any behaviors, underpinned by certain beliefs, strategies or motivations, that call for individuals to pay personal costs, such as not eating a tasty type of food (e.g. bacon) or not having sex with an attractive distant cousin, can be sustained by cultural evolution, through reputational damage for example. Norms even make non-social behavior (e.g. masturbation) into social behaviors, because uninvolved third parties come to care about such behavior. Second, social norms will tend to stick around—to remain stable—even when they help neither the group nor the individual. In fact, cultural evolution can produce sticky social norms that are bad for everyone. Ethnographic examples are numerous, and range from cutting off the clitorises of young girls (female genital cutting) to consuming the brains of dead relatives at funerals (which can transmit a deadly prion disease).[201]

Social norms make it possible for humans to solve—often without anyone understanding how—what would otherwise be inescapable social dilemmas. Social life is riddled with chances to exploit others, which most people don't even notice. And, the more individuals interact and trust each other, the greater the opportunities are to exploit others—to cheat or free-ride on the efforts of others. Culture has several tools and some secret tricks, but two are most important. First and foremost, it brings in third-parties to monitor, reward and sanction others based on local culturally-transmitted and widely shared rules. When necessary, it incentivizes third party actions in some way, often to sanction norm-violators. Second, by providing mental models of situations and relationships, it directs our attention away from opportunities to exploit others and reframes situations in ways that tap or harness our instincts in distinct, and often prosocial, ways. Behaviors like smoking, eating horse meat or littering can go from perfectly acceptable to disgusting, once new culturally-transmitted mental connections are made. This is how, over tens of thousands of years, cultural evolution forged primate troops into human communities. Now, let's take a deeper look at how social norms have shaped small-scale societies.

From Kin to Kinship

To understand how cultural evolution has shaped our kinship systems, and our forms of social organization, over our species' evolutionary history, I'll use non-human primates as reference points (hereafter, I'll just say "primates" instead of always "non-human primates"). This make sense, since if you go back far enough, our ancestors were just another primate. By drawing lessons from across the primate order about kin relationships and forms of social organization, we can begin to infer what cultural evolution and culture-gene coevolution has done, and what it continues to do.

Let's start with marriage. Marriage institutions are sets of social norms, including beliefs, values and practices that regulate and re-enforce our pair-bonding instincts. By firming up this somewhat flimsy bond, marriage norms can re-enforce spousal relationships, and create affinal (in-law) relationships. They can also strengthen the paternal side of a child's kinship network. The innate psychological foundation of marriage is a long-term pair-bonding instinct, which humans appear to share with some other apes, including gorillas and gibbons, as well as with some monkeys. This instinct can be thought of as a potential strategy, which may be deployed depending on the context. We don't have to pair-bond (it's not like peeing), but it's one of the things we'll be inclined to do under some circumstances. The term pair-bonding is often confused with notions of monogamy. It's important to realize that pair-bonding does not imply monogamous mating. Pair-bonds form between dyads, but a single individual can have multiple pair-bonds. Gorillas, for example, often form long-term pair-bonds with multiple females at the same time. In humans, both historically and cross-culturally, individuals often pair-bonded and married more than one other person at a time—85% of human societies permitted polygamous marriage in some form. Here, pair-bonding refers to enduring, or at least not ephemeral, relationships between mates.[202]

Marriage, often with its accompanying rituals and gift exchanges, brings the community in on a couple's pair-bond. That is, community members are third parties who monitor (gossip about) and potentially sanction those who violate marriage norms. Widely shared standards of behavior prescribe economic, social and sexual roles, as well as the obligations and contributions required by each spouse and their relatives. Cross-culturally, marriage norms govern such arenas as (1) who one can marry (e.g., incest taboos), (2) how many partners one can marry (polygamy?), (3) what the inheritance rights are and who is a "legitimate" heir, (4) where the new couple will live, with the wife's parents (matrilocal) or with the husband's parents (patrilocal), and (5) what the rules are regarding sex outside the pair-bond.

By helping to guarantee that a male is in fact the genetic father of the offspring produced by his mate, pair-bonding brings males into the raising of offspring, or at least makes them more tolerant of their mates' offspring. *Paternity certainty* captures the notion that, in some species, males have to worry about whether they are the genetic father.[203] All other things being equal, the more paternity certainty a male has, the more willing he will be to invest in his mate's offspring. In many primates, including chimpanzees, females mate promiscuously, so males usually have little or no idea who their offspring are, and don't care much.[204] Even in pair-bonding primates, male investment is pretty minimal, such as in gorillas, where males act only to protect their mates and their offspring from other males.[205]

By re-enforcing pair-bonds, marriage norms can make better fathers, and failing that, they can make more fathers, as you'll see below. Most, but not all, societies have social norms that regulate the wife's sexual fidelity (i.e., no cheating), and about one quarter also constrain the husband in some way. Both kinds of norms can increase the man's investment in his wives' children. Social norms about sexual fidelity mean not only that the husband is monitoring his wife's sexual and romantic life, but so is the rest of the community, making it much tougher for the wife to behave in ways that might lower the husband's confidence that his wife's children are indeed his children. This has a psychological impact on the husband, motivating him to invest more in his wife's offspring (because they are more likely to be his). Wives also know that if they are caught violating fidelity norms (e.g., having sex with someone else), it will influence their reputation with people well beyond their current husband and his kin.

On the husband's side, norms that constrain his sexual behavior also inhibit—not prevent—him from diverting resources away from his family in efforts to obtain extra-marital sexual opportunities—that is, have affairs, pay prostitutes, etc. Again, for the same reason, a community is now monitoring him, and violations of these norms can affect his relationships well beyond that with his wife and her kin. By curbing his ability to freely divert resources in seeking sex, social norms about fidelity can help channel the husband's resources to his wife's children. Of course, in societies that permit or encourage men to have multiple wives (polygyny), men are likely to use any extra resources or wealth to obtain more wives.

By binding husbands and wives together, for longer than would otherwise be the case, and increasing paternity certainty, some marriage norms can create, or at least strengthen, links to the husband's relatives, including his parents, siblings and even kids he might have with other wives in a polygynous society. For children, this dramatically expands their kinship networks firming up their linkages to paternal grandparents, aunts and uncles. While close genealogical relatedness often does not underpin affinal relationships (though it may), there remains a common evolutionary interest. For both the wife and husband, marriage norms create *affines* (in-laws, those who you are related to through marriage), which come with both benefits and responsibilities as we will see below. My sister-in-law, Illyse, and I do not share any genetic variants through our recent common descent (we aren't related), but we both share a genetic interest in my children, who are genetically related to both of us.

To my knowledge, no evidence indicates that this shared interest has been exploited by natural selection in primates, probably because a species needs to both live in larger social groups and have enduring pair-bonds, which primates are not good at. In Chapter 16, I'll return to the question of how and why pair-bonding might have emerged in our particular evolutionary lineage.

Making Dads

In building a broader kinship network, social norms and practices connect a child more tightly to his or her father's side of the family, in subtle ways. In contrast to many complex societies, mobile hunter-gatherer populations often emphasize kinship through both mom and dad, and permit new couples much flexibility in where they can live after marriage. However, there's always that problem of paternity certainty for dad's entire side. Among Ju/'hoansi, mobile hunter-gatherers in the Kalahari Desert in southern Africa, social norms dictate that a newborn's father—or, more accurately, the mother's husband—has the privilege of naming the child. These norms also encourage him to name the child after either his mother or father, depending on the infant's sex. Ju/'hoansi believe name sharing helps the essence of the paternal grandparents live on, and it consequently bonds both the grandparents and the father's whole side of the family to the newborn. Relatives of the grandparents often refer to the newborn using the same kinship term they use for his or her older namesake—that is, the grandfather's daughter will call the newborn baby "father."[206]

This bias to the father's side is particularly interesting since Ju/'hoansi kinship relationships are otherwise quite gender egalitarian, emphasizing equally the links to both mom's and dad's sides of the family. This biased naming practice may help create that symmetry by evening out the imbalance that paternity uncertainty leaves behind. In many modern societies, where social norms favoring the father's side have disappeared, the effect of paternity certainty emerges as *maternal* grandparents, uncles and aunts invest more than the same *paternal* relatives do.[207] Thus, Ju/'hoansi practices link newborns directly to their father's parents and simultaneously, via the use of close kin terms like "father" and "sister", pull all of dad's relatives closer.

More broadly, in Ju/'hoansi society, sharing the same name is an important feature of social life, which has many economically important implications. Psychologically, creating namesakes may work in two interlocking ways. First, even among undergraduates and professors, experiments suggest that sharing the same, or even a similar, name increases people's liking for the other person, their perceptions of similarity and their willingness to help that person. In one study, for example, professors were more likely to fill out a survey and mail it back if the cover letter was signed by someone with a name similar to their own name. The perception of similarity suggests that namesakes may somehow spark our kin psychology, since we already know we use other cues of similarity (appearance) to assess relatedness.[208] Second, even if this same-name trick doesn't actually spark any change in immediate feelings, it still sets the appropriate social norms—the reputational standards monitored by others—which among the Ju/'hoansi specify all kinds of important things about relationships, ranging from meat sharing priorities to water-hole ownership. Norms related to naming or namesake relationships are common across diverse societies, and many people in small-scale societies intuitively know the power of namesakes, as my Yasawan friends with names like Josefa, Joseteki and Joseses often remind me. My own kids are named Joshua, Jessica and Zoey, thus matching my own first name by first initial or by rhyming.

While many evolutionary and economically-oriented researchers have often assumed that social norms such as these are merely a superficial window dressing on our evolved psychology, the evidence suggests that such social norms run deep and profoundly shape social life. To throw these effects into stark relief let's have a look at societies in which social norms and beliefs about marriage (1) only lightly regulate pair-bonding, (2) structurally eliminate marriage and suppress pair-bonding, thereby dispensing entirely with husbands, dads and in-laws, and (3) encourage, or at least permit, women to obtain "secondary fathers" for their children—creating additional social fathers.

Societies with few or weak marriage norms provide us with a sense of how much "work" marriage norms are actually doing vs. the effect of our innate pair-bonding instincts. Consider the Ache', who before contact were mobile hunter-gatherers in the forests of Paraguay, South America. Pre-contact Ache' did form somewhat enduring bonds between mates, and these bonds were important for linking children to their paternal relatives. However, while social norms did prohibit relationships between siblings, first cousins and individuals in certain ritual relationships, community-wide expectations otherwise appeared to have little to say about the behavior of those involved in pair-bonds, and the formation of pair-bonds were not marked by communal rituals or public promises. Divorce was initiated unilaterally by either party, and involved simply moving out, which was easy since Ache' didn't have much stuff. A sequence of pair-bonded relationships began around age 14 for women and 19 for men. Early marriages were typically interspersed with other more fleeting romances, but usually became more stable once a woman had 2 or 3 kids with the same man. By age thirty, women had experienced an average of 10 marriages, and first marriages ended in divorce at a rate of 100%. Postmenopausal women reported an average of 13 marriages, and most women had children with different fathers. While enduring polygamous relationships were uncommon (4%), every woman had been in a polygamous marriage at some point. Most of these involved multiple wives with one husband, but a few went the other way. Some men had serially married and had children with three sisters. Some women reported marrying both the father and his son, at different times. And, men reported having married both the mother, and then her daughter.[209]

This suggests that the more demanding marriage norms found in most societies—for better or worse—operate to re-enforce our otherwise flimsy pair-bonding instincts.

No fathers

In the provinces of Yunnan and Sichuan in China, the Na and three other ethnic groups have maintained societies without husbands or fathers for thousands of years, despite aggressive efforts by the Chinese government to introduce their own preferred marriage norms. This stable society is organized around female-headed matrilineal households. Children are conceived principally during "furtive visits," in which men slip into women's houses for sex and are gone by morning. The paternity of children is not a concern (and often uncertain), and genetic fathers are not expected to contribute to the child's household; instead, men invest in their sister's children. There are no terms in the local language for "fathers", "husbands" or "in-laws". Social norms have organized this remarkably stable society by suppressing pair-bonding and entirely erasing patrilineal kinship.[210]

Multiple fathers

Even in societies with marriage, social norms and beliefs need not re-enforce concerns about sexual fidelity that arise from male pair-bonding psychology, but can instead promote investment in children in other ways. Many South American indigenous populations believe that a child forms in his or her mother's womb through repeated ejaculations of sperm, a belief system that anthropologists have labeled *partible paternity*.[211] In fact, people in many of these societies maintain that a single ejaculation cannot sustain a viable pregnancy, and men must "work hard" with repeated ejaculations over many months to sustain a viable fetus. Women, especially after the first fetus appears, are permitted, and sometimes even encouraged, to seek another man, or men, to have sex with in order to provide 'additional fathers' for their future child. Anyone who contributes sperm to the fetus is a secondary father. In some of these societies, periodic rituals prescribe extramarital sex after successful hunts, which helps establish and formalize the creation of multiple fathers. Secondary fathers—often named at birth by the mother—are expected to contribute to the welfare of their children (e.g., by delivering meat and fish), although not as much as the primary father, the mother's husband. Frequently, the secondary father is the husband's brother.

Obtaining a second father is adaptive, at least sometimes. Detailed studies among both the Bari' in Venezuela and the Ache' show that kids with exactly two fathers are more likely to survive past age fifteen than kids with either one father or three or more fathers.[212]

Importantly, social norms cannot just make male sexual jealousy vanish. Men don't like it when their wives seek sex with other men. However, rather than being supported by their communities in monitoring and punishing their wives for sexual deviations, they are the one's acting defiantly—violating social norms—if they show or act on their jealousy. Reputational concerns and norms are flipped around here, so now the husband has to control himself. In the eyes of the community, it's considered a good thing for an expectant mother to provide a secondary father for her child.

Marriage norms help expand human kinship systems by harnessing our pair-bonding instincts. In doing this, norms variously exploit the shared fitness interests of in-laws, the willingness of men to invest in the offspring of women they've had sex with, and the power of namesakes. They also variously sometimes suppress male sexual jealousy (in partible paternity), male parental investment (among the Na), female extra-marital sexual desires (most societies), and polygynous pair-bonding (in societies with monogamous marriages). As societies expanded, and became more complex, marriage norms were increasingly used to build intergroup alliances, to promote peace and to sustain larger-scale forms of social organization. But, even in the simplest human societies, these norms have long been at work shaping social life.

FROM INCEST AVERSION TO INCEST TABOOS

Unlike most other primates, human brothers and sisters form long and enduring social bonds. Among hunter-gather populations, brothers and sisters often live in the same bands. In many other traditional societies, either brothers or sisters continue to live in their home community while the other sex marries outside the community, but sibling bonds usually remain strong. Like other primates, the most important factors in establishing a brother-sister bond is familiarity while growing up. For opposite sex siblings, this early familiarity breeds both deep affection and sexual aversion.[213]

An immense variety of kinship systems—sets of social norms—found across diverse small-scale societies have harnessed and extended these innate psychological tendencies to distant and even remote relatives. As mentioned, social norms identify classificatory siblings and stipulate that these individuals *should* be treated like real siblings. These norms could be 'stand-alone' social rules (like putting the fork on the left), but the fact that they tap our evolved incest psychology probably makes them easier to learn, internalize and enforce on others.[214]

However, in these societies, no one completely confuses their real (genetic) siblings and their classificatory siblings, as some famous anthropologists seem to suggest. In my own work in Fiji, for example, I've occasionally heard villagers refer to their "true" sister or brother. One time I was standing outside of a Fijian kitchen house, wondering about dinner, when I heard the wife of the house defending herself to her husband after she'd given the entire stock of the little store she'd recently setup away to her older brother. "But, he's my real brother", she said defensively in Fijian, as she went on to describe how her brother came and sat so humbly at the low-status end of the house and performed the simple "*kerekere*" ritual of request. She felt moved, and that she had to help him, even if it meant the store would close permanently. It was salient to her and her husband that it was her *real* brother, and not merely one of her many classificatory brothers, who made the request.

Tapping this real vs. classificatory sibling difference in the context of the incest taboo, my Fijian team and I wrote up two stories, and had a random sample of adults from a couple of villages respond to our stories. As background, recall Kula: in these villages, social norms demand that brothers and sisters—real or classificatory—must never be alone in a house, and never talk to each other. Also, note that village houses have their three doors open all day (if someone is home), so a passerby can usually get a glance inside. In our first story, a *real* brother and sister were sitting inside a house alone, chatting. Our second version was the same except the siblings were now classificatory.

Can you guess how people responded? My undergraduates usually guess wrong. Though Yasawans felt that the pair were doing something wrong in both versions of the story, it was the actions of the classificatory siblings that would really get the community riled up, and turn into serious and rapidly spreading gossip. They felt that while the real sibling shouldn't be breaking the rules, it was minor and nothing would happen. It seemed that the villagers understood that innate incest aversion was prophylactic, so chatting was very unlikely to lead to sex. However, for classificatory siblings, the only effective prophylactic was the continuous monitoring and potential wrath of the community. Chatting alone, in most societies, is often an important step on the road to sex.

This is the difference between incest aversion and incest taboos. Incest taboos are social norms that evolved culturally to regulate sex and pair-bonding between non-close relatives by harnessing innate intuitions and emotional reactions that originally arose via genetic evolution to suppress sexual interest among close relatives, especially siblings. By harnessing innate incest aversion and labeling distant relatives as "brothers" and "sisters", cultural evolution seized a powerful lever to control human behavior, since incest taboos can strongly influence mating and marriage, and kin-based altruism can be extended through social norms. If you control mating and marriage, you get a grip on much of the larger social structure and even aspects of people's cognition and motivation.[215]

Of course, to construct kinship systems, cultural evolution also harnesses our reciprocity psychology in various ways. One common way is through a set of social norms that define certain kinds of relatives, such as the cross-cousins who teased Kula, as governed by reciprocity-based relationships. Such relationships are egalitarian, relaxed, and often affirmed through joking. This reciprocity can be both positive and negative, as those who get teased can, and will tease right back. Crucially, however, these are more than long-running dyadic exchange relationships because third parties are monitoring the pair to make sure they are behaving in the manner prescribed by the local norms for such relationships.[216]

The point that I'm slowly rolling out here is that human communities—who we ally with, help, marry and love—are forged by social norms, which variously harness, extend and suppress our social instincts. Our species cooperation and sociality is deeply influenced by and highly dependent on culturally-evolved social norms, which makes us rather unlike other animals. We acquire social rules by observing and learning from others, and we—at least to some degree—internalize them as goals in themselves. Because cultural learning influences how we judge others, it can create self-re-enforcing stable patterns of social behavior—social norms.

This view suggests that, stripped of our social norms and beliefs, we aren't nearly as cooperative or as communal as we might seem. And, to the degree that we are more cooperative than other mammalian species (and we are), it's because culturally-evolved norms constructed social environments that, over eons, penalized and gradually weeded out aggressive, anti-social types (norm violators) while rewarding the more sociable and docile among us.[217] In chapter 11, I examine the evidence suggesting that this culture-gene coevolutionary process domesticated our species by shaping our psychology, making us uncomfortably similar to animals like dogs and horses.

As noted above, my view contrasts with that of some prominent evolutionary writers, who have suggested that while the sociality and cooperation we observe in the modern world is due to modern institutions, the social behavior of small-scale societies, and especially hunter-gatherers, *directly* reflects our genetically evolved social psychology. This implies that the patterns of social interaction and cooperation among these populations should be explicable *without* reference to culturally-transmitted norms, practices or beliefs. Sociality in these populations should be easy—an automatic operation of an evolved psychology designed by natural selection to snugly fit this way of life. By contrast, if I'm right, sociality and cooperation among hunter-gathers and everyone else should depend on norms, practices and beliefs that amplify or suppress our innate motivations and dispositions. We've already seen how social norms (sometimes) re-enforce our pair-bonding instincts and fatherly motivations as well as extend our incest aversions. Now let's zoom in a bit closer on one kind of foraging society, that of mobile hunter-gatherers, who have been routinely used to gain insights into the lives of Paleolithic societies, before the spread of agriculture.[218]

Sociality and Cooperation among hunter-gatherers

Mobile hunter-gatherer bands are renowned for their cooperation in activities like hunting, and in their broad sharing of valuable foods, like meat. A common explanation for this cooperation has been that hunter-gatherers live in small groups of closely related individuals. If true, the argument goes, kin selection can explain much of the observed cooperation.

The problem with this is that the best available evidence indicates that hunter-gatherers do not live in groups mostly composed of close kin. Based on work by Kim Hill and colleagues, Figure 9.1 shows the average composition of both Ju/'hoansi and Ache' bands. "Primary kin" includes siblings, half-siblings and parents, while "Distant kin" includes anyone with a blood link going back up to five generations (extending to second cousins). Together, these two categories plus one's self make up only about a quarter of the band. That means that about three quarters of band relationships are based on something besides genetic relatedness. Among the Ache', where the data are most detailed, band members are on-average only very distant relatives, a bit more related than second cousins and about 1/10th that of a full brother or sister (r = 0.054). This tiny bit of relatedness predicts very little cooperation, and guarantees that humans should be keenly tuned into distinguishing close relatives from the distant- and non-relatives who compose most of the group. Overall, the similarity between these two foraging populations, one from Africa and the other from South America, is striking, and comparisons with less detailed data from 30 other hunter-gatherer societies supports this basic picture.[219]

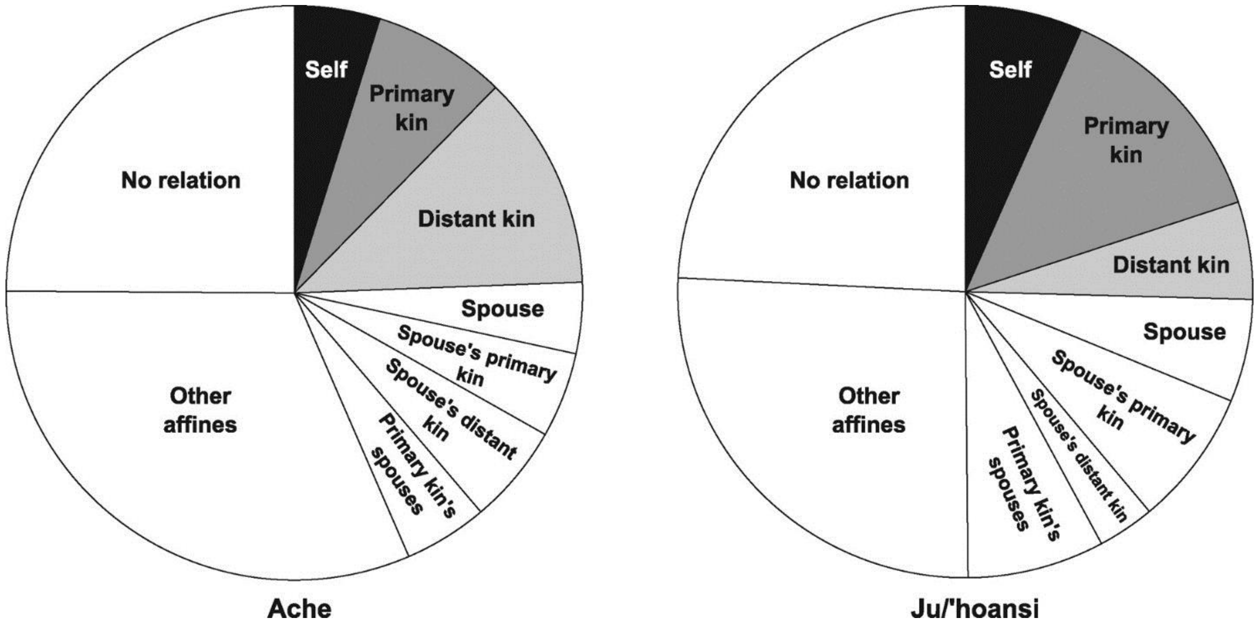


FIGURE 9. 1. THESE PIE CHARTS SHOW THE FRACTION OF DIFFERENT KINDS OF RELATIONSHIPS IN THE AVERAGE BAND AMONG THE ACHE AND JU/'HOANSI, HUNTER-GATHERERS IN PARAGUAY AND AFRICA, RESPECTIVELY. THESE PLOTS ARE MODIFIED FROM HILL ET. AL. (2011).

Okay, so who are these other unrelated band members? Well, two thirds are spouses and affines. That is, marriage norms create over half the ties in adult relationships within a band. Arguably, primates who pair-bond may create bonds that are spouse-like, but as noted, no evidence suggests that primate affines hold any special relationships. Perhaps surprising to some, the evolution of in-laws may be one of the key features that make humans special. However you look at it, bands are culturally constructed, as it's only through marriage and affines that hunter-gather bands can be said to be "mostly relatives."

A remaining quarter of the band have neither blood nor affinal ties. Yet, as in most small-scale societies, they are likely all referred to using kinship terms.[220] They aren't genetic relatives, but they are labeled as classificatory kin of some kind. Among the Ju/'hoansi, as alluded to above, many are linked using same-name relationships. For example, if we are unrelated, you might tell me to call you "mother" because your son has the same name as I do. This tells me how I must treat you, and also cues everyone else into how I should behave toward you (e.g., no flirting or sexual jokes with "mom"). Through social norms, culture re-enforces our kin-based and pair-bonded relationships, and dramatically expands our narrow circle from genetic kin to cultural kinship.

Meat Sharing

Paleoanthropologists believe that cooperative hunting and meat sharing were crucial elements in human evolution, reaching back millions of years into our past. Among those foraging peoples studied by anthropologists, meat provides an important and highly valued contribution to the diet, and as we saw in Chapter 8, hunters generally receive much prestige from their hunting success.[221] However, since even the best hunters can't reliably obtain game on a consistent basis, as streaks of bad luck, illness and injury are inevitable, meat sharing has probably long been a problem that needed solving. By sharing meat, cooperative hunters can avoid the otherwise long stretches of time without fat or protein in their diets.

Because of this, some believe that the broad sharing of meat across foraging bands arises from innate psychological dispositions, without any cultural input. Could meat sharing among foragers be instinctual?[222]

A close look at food sharing among foragers reveals that it too is governed by social norms and fostered by what might be called 'cultural-institutional' technologies.'[223] For example, in addition to social norms specifying that shares of meat be delivered to certain categories of culturally-constructed kin, such as the hunter's in-laws, cultural-institutional technologies like *ownership transfer* and *meat taboos* operate to make sharing psychologically easier. Let's consider these in more detail.

In many foraging groups the ownership of meat is diffused, or transferred from the hunter to a third party, who is designated to distribute the meat. Because it wasn't their sweat and skill that produced the meat, a third party may find it easier to follow the local distributional norms.[224] For example, Ju/'hoansi hunters frequently use arrowheads owned by someone else while hunting. Social norms dictate that the owner of the arrowhead becomes the owner of any kill made with that arrowhead, and this owner has the responsibility for distributing the meat. Hunters often like to use other people's arrowheads, since it relieves them of the responsibility for making fair distributions—where "fair" is defined by local standards and others will rapidly criticize any appearance of bias in the distribution. For example, elderly men and women commonly own and lend arrowheads, and anyone can receive them as gifts from one of their special *hxaro* exchange partners (see below), especially if they themselves can't make arrowheads.[225] By relieving the hunter of ownership, this institution mitigates self-interested biases and disperses the responsibility for dividing the meat to others in the band, who might not otherwise experience it.

Food taboos also influence meat distribution in many hunter-gatherer groups, and in some groups, the entire distribution is governed by a complex system of such taboos. An interesting system of taboos was observed in the early 20th century among certain Khoisan hunter-gatherers. These taboos virtually guaranteed that large prey had to be widely distributed across the band. Here, the hunter himself could only eat the ribs and one shoulder blade; the rest of the animal was taboo for him. The hunter's wife received the meat and fat around the animal's hindquarters, which she had to cook openly and share with other women (only). Taboos prohibited young males from eating anything except for the abdominal walls, kidneys, and genitals. Violations of any of these taboos were believed to result in the failure of future hunts. Such beliefs create collective interests in making sure that other members of the band don't violate the taboos: since your violations will result in hunting failures that will reduce my meat intake, I'm going to make sure you don't violate any taboos. Thus, everyone in the band (believes) they have direct and personal incentives to monitor and sanction taboo violators.[226] Such complex systems of taboos were common, having been recorded in detail among hunter-gatherers in South America, Africa and Indonesia.[227]

Taboos on particular game species or certain parts of animals for particular categories of people are interesting because, to the learner, they appear to be facts about the world that can drive purely self-interested actions: I want to avoid illness, and certain animal parts will cause me to get sick, so I'd best not eat those. Crucially, such beliefs induce sharing in a community without anyone realizing it. However, if such beliefs are inaccurate and costly to the individual, it's sensible to ask why either individual experience or rules like 'copy the successful' would not result in the eventual disappearance of such taboos. Three interrelated psychological factors work against this:

1) There is reason to suspect that we humans have an innate susceptibility to picking up meat aversions, due to the tendency of dead animals to carry dangerous pathogens. [228] Thus, we humans are primed to acquire meat taboos over other food avoidances.
2) These taboos are social norms, so violations will be monitored and judged by others. This is especially potent here because the punishment or misfortunes believed to result from taboo violations will (often) be felt by the whole band (e.g., hunting failures).
3) A good learner will acquire this rule while growing up and never actually violate it (meat is consumed in public), so he'll never directly experience eating the tabooed part and not having bad luck. Rare cases of taboo violations that, by coincidence, were followed ill-luck or illness will be readily remembered and passed on (psychologists call this "negativity bias"). Meanwhile, cases of violations followed by a long period when nothing bad happens will tend to be missed or forgotten, unless people keep and check accurate records.

Based on my field experience, any skeptic who questions the taboos will be met with vivid descriptions of particular cases in which the taboos were violated and then poor hunting, illnesses or bad luck ensued.[229]

Amazingly, despite immense variation in the details of local social norms and beliefs, the consequences across mobile hunter-gatherers are similar: most or all band members obtain some meat from any large kill. Of course, this doesn't mean everyone gets an equal share. In many such societies, priority extends first to the hunter's close kin, affines and ritual partners, and only secondarily to the full band and visitors.[230] It appears that cultural evolution has devised numerous solutions—combinations of norms—that achieve roughly the same end: a diffusion of the risks associated with repeated hunting failures across the band.[231]

COMMUNAL RITUALS

As darkness fell in the Kalahari desert, Ju/'hoansi women from many bands squeezed together around a blazing dance fire, and began to sing in a high chorus. Then, with soft rattles made from moth cocoons wrapped around their legs, the men assembled around the women and danced in a circle, stomping out a rhythm. Soon, the women began a special high-pitch clap to complement the men's rap and rattle. Accompanied by string instruments played from the periphery, the main event began as the women started to sing loudly of the *n/um*, a powerful supernatural essence that can be either protective or dangerous. An hour or two later, the men's dance line began snaking through the women's circle to form a figure eight. As some men began to enter into trances, the dance intensified. Entranced men increasingly struck out into the darkness, shouting, as they battled spirits and hurdled invectives at their god. This ritual storm intensified and abated in cycles through the night, until dawn, when it slowly faded away. [232]

Having seen 39 of these communal rituals, the ethnographer Lorna Marshall writes, "People bind together subjectively against external forces of evil, and they bind together on an intimate social level… Whatever their relationship, whatever the state of their feelings, whether they like or dislike each other, whether they are on good terms or bad terms with each other, they become a unit, singing, clapping, moving together in an extraordinary unison of stamping feet and clapping hands, swept along by the music". Similarly, Megan Biesele, an ethnographer who studied another Ju/'hoansi group 15 years later, explains that "The dance is perhaps the central unifying force in Bushman life, binding people together in very deep ways which we do not fully understand."[233]

Psychological powerful communal rituals like this one are common in small-scale societies, and among mobile hunter-gatherers, from the central desert in Australia to the Great Basin in North America. Like Megan and Lorna, keen observers of human communities going back to at least the 14th century Muslim scholar Ibn Kaldun have argued that communal rituals have a potent psychological impact on their participants that create strong personal ties, deep trust and a profound sense of group solidarity. Recently, however, researchers have begun to systematically measure the effect of communal rituals on social bonding and cooperation, and to further break rituals down into their active ingredients. These ingredients include (1) synchronous singing and dancing or other movements (e.g., marching), (2) collaborative music making, (3) extreme physical exhaustion, (4) feelings of a common fate, (5) shared experiences of danger or terror, (6) supernatural or mystical beliefs, and (7) causal opacity or a lack of instrumentality (that is, people are not sure why the ritual must be done in a particular way, but they know it *must* be done in that way).[234]

Several recent experimental studies, for example, show that singing and/or moving in synchrony with others deepens feelings of affiliation, fosters trust and promotes cooperation within groups. In one experiment, American university students were placed into one of four groups. Though the groups all listened to the Canadian national anthem through headphones and could read the lyrics, each group was told to do different things, some of which involved cups. The control group just listened while holding one cup above the table. In the 'synchronous-singing' group, participants were told to sing along with the music, which caused them to sing in sync with each other. In the 'singing & moving in sync' group, participants both sang together, and moved their cups in sync with the music, which caused them to move in sync with each other. Finally, in the 'asynchronous singing & moving group', participants did the same thing as in the 'synchronous moving and singing' group, except that the music in their headphones started at different times, so they all moved asynchronously.[235]

After this exercise, participants then engaged in a cooperative project in which they could contribute money to a joint investment. The more money contributed in total by the group members to their joint project, the more money everyone would take home. However, since everyone got an equal share of the money at the end, individuals could profit by not contributing money to the project, effectively free-riding on the contributions of others. The results show that synchrony, both singing & moving together and just singing together, promoted greater cooperative contributions, which resulted in higher monetary payoffs for the whole group. Parallel results have been found even among four-year-old children, where jointly making music promotes greater prosociality.[236]

Perhaps even more enduring and powerful than synchrony is the potent social bonds forged among those who share terrifying experiences. Such experiences have been routinely created in different ways by male initiation rites in societies across the globe and throughout history, and can be found in many hunter-gatherer societies. Among the Arunta of central Australia, for example, the initiation into manhood involved four main rituals that spanned roughly 15 years from age 10 to 25 years. Based only in the local community, the first three of these rituals involved being thrown in the air, kidnapped at night, blindfolded, bitten, piled on by a group of men, and forced to endure periods of silence and deprivation, as well as learning much tribal lore through a series of frightening dances and song narratives performed by inhuman-looking men, painted and costumed. The second rite in particular, performed just after their puberty started, culminated in a ritual circumcision in which a stone knife was used to cut off the adolescent's foreskin. Then, soon after these wounds had healed, a third rite would commence, and eventually climax in a ritual subincision: the boys' penises were sliced lengthwise, along the underside, slit and split like a hot dog.

The final initiation rite was performed on young men in their twenties assembled from across the tribal network. Formal invitations went out to all bands, and even to neighboring groups, to gather at a particular location for a rite that would last for months, with dances and songs performed by many of the assembled bands. People believed that these invitations could not be refused, lest they get an illness as punishment. Secluded together, often deprived, and silenced for months, initiates experienced a long sequence of nighttime ceremonies, dance performances, and sacred narratives. In the final phase of this rite, initiates had to repeatedly lie on a bed of glowing embers, with only a layer of leaves to protect them. Initiates had to stay on the embers, while choking on the smoke, until they were told they could get up (after roughly 4-5 minutes). Only after this ordeal by fire would these young men considered fully-fledged men of the tribe.[237]

Lest you think that these young guys somehow took this ritual in stride, and were not scared, it's worth noting that it was not uncommon for adolescents and young men to flee from the advancing front of these spreading rites by moving to distant groups who had not yet adopted the practice.[238] Nevertheless, the elderly Arunta explain that the ritual "imparts courage and wisdom" and "makes the men more kindly natured and less apt to quarrel".[239] We'll return to the spread of such rituals in Australia in the next chapter.

While systematic experimental research is just beginning on such "rites of terror", it appears that the psychological effects created by these rites establish enduring emotional bonds among the initiates, and even potentially among observers. Psychologically, these rites create a potent emotional memory that somehow binds together those who shared the experience. These bonds may be closely related to those observed among soldiers who have experienced intensive combat together, creating the "band of brothers" phenomenon.[240] Crucially, however, by incorporating these experiences into regular initiation rites, cultural evolution has engineered a way to solidify social ties within age cohorts of males drawn from across the tribal group. Older Arunta had themselves noticed the power of their rituals for social bonding, though they couldn't explain how or why the ritual worked, and certainly knew of no one who designed the protocol.

More broadly, communal rituals are sets of culturally evolved social norms that, though quite diverse, often exploit various aspects of our psychology in ways that foster greater solidarity, trust, affiliation and cooperation among participants. They represent one of the institutional-cultural technologies deployed by cultural evolution to shape our sociality and cooperation across diverse societies. Even among the smallest scale human societies, communal rituals nourish the social fibers that bind a collection of bands into a tribe.

Threads in the fabric of social life among bands

Perhaps the most important feature of social life in human hunter-gatherers, by contrast with other primates, is that individuals are socially connected into an immense network of other people, scattered across numerous other groups. In many foraging societies, band membership itself is quite fluid. If an individual or family wants to leave their band, due to some acute social tensions, drought, or just to visit friends, they can tap a network of contacts who can open the doors to extended visits in other bands. By contrast, chimpanzees live in troops that patrol and defend a territory. As I'll explain in the net chapter, intruders are attacked and killed on sight, unless they are young females who are permitted to move among troops. Let's consider how culture made us the only tribal primate.[241]

What determines the linkages or social ties that foragers extend *outside* their band? Kim Hill, Brian Wood and their collaborators have recently explored this among two mobile hunter-gather groups, the Hadza and the Ache'. The Hadza live in nomadic foraging bands in Tanzania's vast savannah woodlands, and continue to hunt with bow and arrow, and gather roots, tubers and honey. Kim and Brian questioned people from dozens of bands in each population about their interactions with a randomly chosen set of other adults drawn from the entire society. They asked about interactions related to helping, hunting together, and many other associations. Then, to analyze their data, they asked what relationship factors predict the existence of various kinds of interactions, such as hunting together, giving and receiving meat, sleeping in the same camp, helping or joking around. As expected, being close kin (aunts and closer) is important, and about 5% to 10% of the other people were close kin of some kind. For example, people were overall more than twice as likely to have received food from a person when they were sick or injured if they were close relatives. Beyond genetic relatedness, affines were important too, being 50% more likely to have received food. Since affines made up 15% to 20% of the randomly selected sample, this is a rather big contribution.[242]

Even more important than blood and affinal relationships, ritual relationships establish important social ties across bands. At Ache' rituals, adult sponsors step forward to assist children through birth and puberty rites (like "godparents"). As part of the ritual, they then enter into a special named relationship with the children's parents. Each ritual relationship is associated with a particular role (e.g., cutting the umbilical cord, washing the newborn, etc.), and results in lifelong rights and obligations of mutual support governed by social norms. Being in a ritual relationship, holding genetic relatedness constant, is strongly associated with sharing meat and information, as well as receiving help when one is sick or injured. These culturally-constructed ritual relationships are much more important than close genetic relatedness, and this is further magnified by the fact that Ache' have twice as many ritual partners as they do close kin outside their own band.

Among Hadza hunter-gatherers, the *Epeme* taboos and ritual dances bond a select group of men in a secret covenant. Ritually, the men communally consume particular joints from large game, and perform in undisturbed silence and darkness for other members of the community. Here, the data again show that ritual relationships are associated with sharing meat and information as well as receiving help when one is sick. Not only are individual ritual relationships more important than genetic relatedness, but individuals have three times as many ritual partners as they do close blood relations.[243]

Taken together, ritual and affinal relationships, both of which are culturally constructed and non-existent in primates or other animals, explain much more about the patterns of association, cooperation, helping and sharing than blood ties.

Elsewhere, in southern Africa, the Ju/'hoansi achieve the same end as the Hadza and Ache', a vast interconnected social web that threads through many bands. They too also rely on affinal connections and communal rituals, but they also have the *hxaro* exchange relationships. *Hxaro* partnerships are special, culturally-defined, relationships that come with obligations, and are sustained by ongoing exchanges of goods. Since people form and inherit many such relationships, goods given as gifts between partners pulse constantly through this broad network. *Hxaro* appears to tap our innate reciprocity psychology, but this is then fueled, extended and re-enforced by social norms, all monitored by third parties.[244]

Thus, the vast tribal social networks that mobile hunter-gatherers rely on, in times of drought and war for example, are largely constituted and nourished by social norms of various types, including those related to rituals, marriage and exchange.

ONWARD

Let me close by underlining my major points. Our ability to learn from each other gives rise to sets of social norms, including practices like communal rituals, food taboos and kinship rules, which strongly influence human social life. In shaping individual decisions, social norms are powerful for a number of reasons, but they generally:

- Deploy third-parties to monitor and sanction norm-violators often through reputational damage.
- Shape individuals' perceptions of the costs and benefits of various actions (e.g., food taboo violations cause hunting failures).
- Harness aspects of our evolved psychology, such as the way marriage re-enforces our pair-bonding psychology or rituals exploit the cooperation-inducing effects of synchrony.

Such social norms are crucial for understanding community and cooperation in all human societies, including those of mobile hunter-gatherers. Detailed studies of contemporary hunter-gatherers show how practices related to marriage, naming, exchange and ritual influence the formation of bands and sow the broader social threads that weave bands together into tribes. Even meat sharing in hunter-gatherer bands, which is often argued to be an ancient and important feature of our species' evolutionary history, depends crucially on the culturally-constructed kinship ties, social norms of ownership, food taboos and ritual practices.

Until now, I have casually described a variety of social norms that appear to promote sociality, harmony and cooperation among the groups possessing them. But, clearly, in many cases people don't understand how or why their norms work, or that their norms are even ‘doing’ anything. And, in the cases of the food taboos and communal rituals, it’s probably the case that if people knew precisely what was going on—if they had the correct causal model—the practices would lose at least some of their effectiveness.

So, how can we explain the emergence of such group beneficial norms?

Chapter 10

Intergroup Competition Shapes Cultural Evolution

In the forests of Uganda, primatologists have been studying a particularly large troop of chimpanzees at Ngogo for about two decades. As of 1999, this group of 150 or so individuals controlled a territory of 29 km^2 (11.2 mi^2). As in other chimpanzee groups, adult males go out on "boundary patrols." During these nighttime expeditions, but unlike their other movements, males neither socialize nor feed, but silently travel in single file through regions separating their territory from that occupied by adjacent chimpanzee troops. There, moving along the border, they sometimes make targeted incursions into the territories of other troops. Over 9 years, 114 of these patrols attacked and killed 21 members of other chimpanzee troops. Thirteen of these 21 murders occurred during incursions into the northeastern corner of their territory, and thus targeted one particular troop. While the exact size of this other group is uncertain, this many kills implies that about three quarters of the chimpanzees in the other group can expect to be murdered by a patrol, before dying of old age at 50. In 2009, Ngogo chimpanzees including females and infants began regularly entering this new territory and acting as they do at the core of their own territory. It appears that their systematic raids over at least a decade drove the other troop back, allowing this large group to effectively expand its territory by 22.3%.[245]

The presence of substantial and deadly intergroup competition, and territorial expansion, in one of our closest primate relatives suggests that it may be old, even older than our species' heavy reliance on cultural learning. Cultural evolution may have emerged in a world in which inter-group competition was already prevalent.

When our genetically evolving capacities for cultural learning began to give rise to cultural evolution and social norms, it's likely that our species was already living in stable social groups. Many of these norms would have been arbitrary, such as using a particular type of stone for smashing nuts open. But, occasionally, prosocial norms might have emerged that fostered food sharing, internal harmony ('no fighting' or 'no stealing others' mates'), or cooperative efforts in community defense. But, how could such systems of social norms have culturally evolved to perform this function? As we saw in the last chapter, many social norms appear almost engineered to harness and extend our social instincts. Yet, few if any adherents to these norms understand the 'design' or implicit 'function' of their institutions.

Intergroup competition provides one important process that can help explain the spread of norms that foster prosociality. Different groups culturally evolve different social norms. Having norms that increase cooperation can favor success in competition with other groups that lack these norms. Over time, inter-group competition can aggregate and assemble packages of social norms that more effectively promote success in competition with other groups, and this will involve social norms related to cooperation, helping, sharing and maintaining internal harmony.[246] Below, I discuss the most important categories of intergroup competition and highlight key lines of evidence. In the next chapter, I'll consider how a long evolutionary history of living in a social world regulated by norms, which themselves were shaped by intergroup competition, influenced our species' genetic evolution.

Once a new norm emerges in one group, inter-group competition can grab a hold of it and spread it widely through a number of related processes. Consider five forms of inter-group competition[247]:

1) **War and raiding**: The first and most straightforward way that inter-group competition influences cultural evolution is through violent conflicts in which some social groups, due to institutions that foster greater cooperation or generate other technological, military or economic advantages—drive out, eliminate, or assimilate other groups with different social norms.[248]
2) **Differential group survival without conflict**: In sufficiently harsh environments, only groups with institutions that promote cooperation, sharing and internal harmony can survive at all, and spread. Groups without these norms go extinct or flee back into more amicable environments. The right institutions allow groups to enter new ecological niches, by surviving in the arctic by cooperating in whale hunting, or by surviving shocks, like droughts in deserts, that would exterminate or disperse less cooperative groups. Groups with superior institutions simply out last and eventually replace those with less cooperation-galvanizing norms. Since humans expanded out of Africa and into harsh environments, for which they had few genetic adaptations or innate proclivities, this may have been particularly important during human evolution. For this kind of process to work, groups don't ever have to meet each other, and violence between groups need not occur.[249]
3) **Differential migration**: Since social norms can create groups with greater internal harmony, cooperation and economic production, many individuals will be inclined to migrate into more successful groups from less successful ones. Meanwhile, few will want to move to less successful groups, unless forced to. Over time, more successful groups will expand through immigration while other groups will contract thorough emigration. This has been observed in both the differential rates of switching groups at boundaries of small-scale tribal populations, and in migration patterns among nations in the modern world.[250]
4) **Differential reproduction**: Under some conditions, social norms can influence the rate at which individuals within a group produce children. Since children tend to share the norms of their group, over time, the social norms of groups who produce children at faster rates will tend spread at the expense of other social norms. Some modern religions, for example, take advantage of this, with their pronatalist gods and fertility-favoring institutions.[251]
5) **Prestige-biased group transmission**: Because of our cultural learning abilities, individuals will be inclined to preferentially attend to and learn from individuals from more successful groups, including those with social norms that lead to greater economic success or better health. This causes social norms, including ideas, beliefs, practices (e.g., rituals) and motivations, to flow via cultural transmission from more successful groups to less successful groups.[252] Since individuals cannot easily distinguish what makes a group more successful, this results in a substantial amount of cultural flow that has nothing to do with success (e.g., hairstyles and music preferences).

Over time, combinations of these intergroup processes will aggregate and recombine different social norms to create increasingly prosocial institutions. To be clear, by "prosocial institutions" I mean institutions that lead to success in competition with other groups. While this often includes institutions that increase group cooperation and foster internal harmony, I do NOT mean "good" or "better" in a moral sense. To underline this point, realize that intergroup competition often favors norms and beliefs that can readily result in the tribe or nation in the next valley getting labeled as "animals", "non-humans" or "witches", and motivate efforts to exterminate them.

How old is intergroup competition?

How important was intergroup competition in shaping the culturally-evolved institutions of our Paleolithic ancestors? Has it been shaping cultural evolution for long enough to have had an impact on our genetic evolution?

Several converging lines of evidence, though all admittedly indirect, suggest that intergroup competition was likely important for much of our species evolutionary history. To triangulate in on this, we'll first look at non-human primates, since at some point in the past we were just another primate species, so they provide a point of departure. Next, since our ancestors lived in societies very different from today's modern nation states, we will examine small-scale societies, and focus especially on hunter-gatherers. While none of these societies is in any sense representative of Paleolithic populations, they collectively provide much insight into the broad patterns and potential diversity of ancestral human societies, who faced the same problems, used similar technologies, and relied on many of the same resources. Finally, we consider these lines of evidence in light of paleoanthropological efforts to reconstruct the lifeways of human ancestors. This work draws insights from both the unearthed tools and bones of past populations, and from reconstructions of ancient environments, which draw on data from ice and lake cores that help resolve long-term patterns of environmental change.

As I discuss intergroup competition, keep in mind that there are many other cultural evolutionary forces that do not favor prosocial institutions. When the forces of intergroup competition are spent or weakened, success-biased cultural learning (or purely rational self-interest) will cause individuals to seek out any 'cracks' in their groups' institutions to manipulate or exploit for their own benefits or that of their kith and kin. Over time, history suggests that all prosocial institutions age, and eventually collapse at the hands of self-interest, unless they are renewed by the dynamics of intergroup competition. That is, though it may take a long time, individuals and coalitions eventually figure out how to beat or manipulate the system to their own ends, and these techniques spread and slowly corrode any prosocial effects.

Let's start with intergroup conflict via warfare and raiding. As we saw at the outset of this chapter, chimpanzees have violent intergroup conflicts that can result in significant gains and losses of territory. Aggressive intergroup interactions are common in many primate species, but chimpanzees are particularly interesting because they provide a ready model for what the common ancestor of humans and chimpanzees might have been like. If modern chimpanzees do it, it's plausible that the common primate ancestor we share with chimpanzees also did it. The mortality rate we saw above at Ngogo is unusually high, but data from other sites suggest that mortality rates from chimpanzee intergroup conflicts range from 4% to 13%, which as we will see is comparable to many small-scale human societies. Aside from Ngogo, intergroup aggression has been well documented at four chimpanzee sites, and territorial expansions have been observed in two other populations besides Ngogo.[253]

While chimpanzees do reveal some behavioral patterns that probably represent cultural traditions, no reliable evidence so far suggests they have social norms, and certainly no norms that promote success in intergroup competition.[254] This suggests that intergroup competition may have preceded the emergence of cultural evolution, and could have started shaping norms as soon as they began to emerge. However, even if intergroup competition did not exist initially, cultural evolution would have created the know-how to exploit clumped resources (which could be defended and controlled) and social norms that would have given rise to differences among groups—imbalances of power—that would have generated intergroup competition. Of course, it's possible that during the course of human evolution something happened to suppress intergroup competition. So, we need to ask whether small-scale societies, and particularly hunter-gather groups, really do experience intergroup competition.

Conveniently, one form of intergroup competition in small-scale societies, warfare, is actually a hot topic.[255] The answer is that there's lots of conflict, and lots of variability in conflict rates. And, while it's certainly true that farming and herding societies fight much more than most hunter-gatherers, substantial evidence indicates that many hunter-gatherer populations experienced enduring violent conflicts between groups that inflicted high mortality rates and much loss of territory. Reviews of the evidence for warfare among hunter-gatherers show that 70% to 90% of these societies experience war or raiding as either "continuous" (with conflicts every year) or "frequent" (with conflicts at least once every 5 years). Estimates of the percentage of deaths directly due to violent intergroup conflicts average 15%, based on ethnographic observations, and 13% based on archeological studies of cemeteries (remember, chimps ranged from 4% to 13%). These percentages are very high compared to the same rates in the U.S. or Europe in the 20th century, where the numbers are all less than 1%, but low compared with many pre-industrial agricultural societies.[256]

Beyond the loss of life, conflict among hunter-gatherer populations resulted in the systematic gain and loss of territory (and thus resources) over time. In five groups for which there is ethno-historical data, gains and losses in territory ranged from 3% to 50% per generation (25 years), with an average of 16%. We might worry about these numbers since four of the five groups derive from Western North America, and thus may have been influenced in their territorial expansion by agriculturalists, at least indirectly. However, even if we take the 3%, which comes from the Warlpiri who lived in the middle of a vast continent of hunter-gatherers in Australia, a territory of 100 square miles would more than double every six hundred years. In 5,000 years, which is brief given the over two million years since the origins of the genus *Homo,* a territory the size of the original Washington DC (100 square miles) will expand to the size of Indiana (36,417 square miles).[257] In another 5,000 years or so, a group expanding at this rate could displace enough other groups to cover all of Asia. In short, 3% per generation is plenty fast.

To be clear, conflicts among nomadic foragers were very different from war in more complex societies. Most conflicts involved raids or ambushes, which relied on stealth, surprise and superior numbers to mitigate the risks. Attackers typically came out much better than the victims, at least in the short run, until the victims sought revenge with stealth raids of their own. Pitched battles did occur, and sometimes involved hundreds of individuals on a side, but these were relatively rare. Groups often experienced enduring periods of hostility with neighboring groups, in which strangers were killed on sight and the groups maintained a no-man's land (a kind of DMZ) between them. These patterns are reminiscent of chimpanzees, except crucially, this hostility usually occurred between tribal populations, which consisted of many interlinked bands who share customs and language, rather than between residential groups, as in chimpanzees. That is, intergroup conflict occurred on a much bigger scale in humans.

There's reason to suspect that the Paleolithic world may have been even more prone to such intergroup conflicts than these historical and ethnographic data suggest. This is because of the much more intense climatic fluctuations experienced over most of our evolutionary history, compared to the last 10,000 years of relatively stable climates. Not only were ancient populations dealing with constantly shifting seasons, and rising and falling seas, but they would have been hit more frequently by immense storms, floods, fires and droughts. Two kinds of evidence indicate that these shifts would have sparked more war. First, the archeological record of California's maritime hunter-gatherer populations over a 7,000 year period shows that violence is most common during periods of climatic shifts, which stress resources. Second, quantitative analyses on warfare using ethnographic data from both a global sample of diverse small-scale societies and a regional sample from East Africa indicate that unpredictable environments likely cause more warfare between groups.[258] Thus, unpredictable environments, which characterized the Paleolithic, probably intensified inter-group competition.

Intergroup competition also often shapes the cultural evolution of institutions without violence or war. To see one mechanism, let's look at a case in which a village in New Guinea decided explicitly to copy the institutions of a regionally more successful group, including their practices, rituals and beliefs.

Throughout the Highlands of New Guinea, a group's ability to raise large numbers of pigs is directly related to its economic and social success in competition with other regional groups. The ceremonial exchange of pigs allows groups to forge alliances, re-pay debts, obtain wives, and generate prestige through excessive displays of generosity. All this means that groups who are better able to raise pigs can expand more rapidly in numbers—by reproduction and in-migration—and thus have the potential to expand their territory. Group size is very important in intergroup warfare in small-scale societies so larger groups are more likely to successfully expand their territory. However, the prestige more successful groups obtain may cause the rapid diffusion of the very institutions, beliefs, or practices responsible for their competitive edge as other groups adopt their strategies and beliefs.

In 1971, the anthropologist David Boyd was living in the New Guinea village of Irakia, and observed intergroup competition via prestige-biased group transmission. Concerned about their low prestige and weak pig production, the senior men of Irakia convened a series of meetings to determine how to improve their situation. Numerous suggestions were proposed for raising their pig production but after a long process of consensus building the senior men of the village decided to follow a suggestion made by a prestigious clan-leader who proposed that they "must follow the Fore'" and adopt their pig-related husbandry practices, rituals, and other institutions. The Fore' were a large and successful ethnic group in the region, who were renowned for their pig production.[259]

The following practices, beliefs, rules, and goals were copied from the Fore', and announced at the next general meeting of the community:

1) All villagers must sing, dance and play flutes for their pigs. This ritual causes the pigs to grow faster and bigger. At feasts, the pigs should be fed first from the oven. People are fed second.

2) Pigs should not be killed for breaking into another's garden. The pig's owner must assist the owner of the garden in repairing the fence. Disputes will be resolved following the dispute resolution procedure used among the Fore'.

3) Sending pigs to other villages is tabooed, except for the official festival feast.

4) Women should take better care of the pigs, and feed them more food. To find extra time for this, women should spend less time gossiping.

5) Men must plant more sweet potatoes for the women to feed to the pigs, and should not depart for wage labor in distant towns until the pigs have grown to a certain size.

The first two items were implemented immediately at a ritual feast. David stayed in the village long enough to verify that the villagers did adopt the other practices, and that their pig production did increase in the short term, though unfortunately we don't know what happened in the long-run.

Let me highlight three features of this case. First, the real causal linkages between many of these elements and pig production are unclear. Maybe singing does cause pigs to grow faster, but it's not obvious and no one tried to ascertain this fact, via experimentation for example. Second, the village leadership chose to rely on copying institutions from other groups, and not on designing their own institutions from scratch. This is smart, since we humans are horrible at designing institutions from scratch. And third, this transmission between groups occurred rapidly because Irakia already had a political institution in the village, involving a council of the senior members of each clan, who were empowered by tradition (social norms) to make community-level decisions. Lacking this decision-making institution, Fore' practices would have had to spread among households, and thus been much slower in spreading. Of course, such political decision-making institutions themselves are favored by intergroup competition.

More broadly, this case is not unique in any way, as much ethnography and ethno-history from New Guinea, and elsewhere, indicates that the copying of institutions and rituals from more successful groups is commonplace. For example, an in-depth study of the Enga, a small-scale agricultural population in the New Guinea Highlands, reveals the effects of intergroup competition on the spread of a ritually galvanized sets of norms and political beliefs (termed "cults") that promoted "identity, welfare, and unity" among local communities. These institutional packages often included the psychologically potent and terrifying initiation rites described in the last chapter. These cults were:

> readily transmitted across linguistic boundaries when (1) donors and recipients faced comparable problems, so that underlying beliefs and overt procedures were meaningful, and (2) the owners of the cults were perceived as being successful…Cults were imported in order to acquire new and

more effective ways to communicate with the spirit world, as well as to emulate those who appeared more successful.[260]

In some cases, less successful communities would go to more successful communities and pay them, in pigs, to learn about their rituals and institutions in order to better ascertain the crucial details.

Elsewhere, in the Sepik region of New Guinea, villages typically breakdown after they exceed about 300 people, as squabbling clans fracture and move apart. However, one Arapesh community named Ilahita dramatically exceeded the size of all other villages in this region, maintaining an ethnically diverse population of 1500 people. The ability to sustain solidarity with this locally immense population led to both success and security in a region with substantial military and economic threats.

The anthropologist Donald Tuzin studied Ilahita in detail in order to figure out how it managed to sustain such a large size where other communities could not. He found that in the last century Ilahita had adopted a ritually-galvanized form of social organization ensconced in an encompassing mystical belief system. This package reorganized the community to create cross-cutting mutual interdependencies among subgroups, which were sacralized in rituals. The basic elements of this institutional-ritual complex, which Ilahita elaborated upon, were first copied from a highly successful and aggressively expanding group called the Abelam around 1870. Their acquisition, retrofitting and apparent improvement of the Abelam package permitted Ilahita to stand against this group, and has since led to both military and economic success. Ilahita has also grown through the in-migration and assimilation of groups fleeing from hostile neighbors, which represents a case of intergroup competition via differential migration.[261]

These ethnographically rich cases suggest that increasingly effective social-bonding rituals spread over time along with rising community size and political complexity, and that this may have been driven by the rising intensity of military and economic competition. This suggestion fits with recent cross-cultural statistical analyses of small-scale societies showing that more warfare is associated with the presence of more terrifying and costly rites for males. In many cases, the threat of war seems to drive the spread of rituals via prestige-biased group transmission, so these two forms of intergroup competition combine synergistically to favor more cooperative cultural forms.[262]

The presence of violent conflicts, territorial losses and gains, and the wholesale copying of institutions from more successful groups show us that some of the crucial elements of intergroup competition are not only present, but common, even in the smallest scale human societies.[263] However, they don't tell us if these relatively short-term interactions matter over the long-run for cultural evolution, over centuries or millennia, in ways that systematically shape institutions, forms of social organization, and ultimately our social psychology. Did inter-group competition shape the social worlds that our genes and psychology faced over the long run during human evolution?

HUNTER-GATHERER EXPANSIONS

Currently, there is relatively little evidence of some groups of hunter-gatherers expanding at the expense of other groups of hunter-gatherers over centuries or millennia. Part of the reason for this is that most of the available evidence for one group systematically spreading involves farmers or herders expanding at the expense of foragers, or other groups of farmers and herders. Many of these population expansions can be traced to institutions or forms of social organization, or to technological differences, or both. As I show in Chapter 12, the size and complexity of a group's suite of tools, weapons and other technologies are heavily influenced by the group's social institutions, so sustained technological differences cannot be neatly partitioned from institutional differences. The massive success of farmers, in taking over the globe thousands of years ago, has made it hard to spot the older expansions of hunter-gatherer groups. This has led some to think that sustained expansions via intergroup competition remains a peculiar condition of farming and herding societies, an affliction to which mobile hunter-gatherers are immune. However, if hunter-gather expansions are important, then we should be able to spot them when we look at parts of the globe that farmers and herders either couldn't get to, or didn't get to until late in the game. This will take us to Australia, a continent of hunter-gatherers until Europeans arrived, the Arctic, and the Great Basin of Western North America. Unlike potential cases of hunter-gatherer expansions found deep in the archeological record, these more recent expansions allow us to combine linguistic, archaeological, genetic, and ethnographic evidence, and thus generate a richer picture of what happened.

THE PAMA-NYUNGAN SPREAD

In Australia, we saw that the Warlpiri were increasing their territory by 3% per year. However, this doesn't tell us if that rate could be sustained for, say, 5,000 years. Maybe groups variously gain and lose over centuries with no *net* effect. Crucially, it turns out that the Warlpiri are part of the distinctive Pama-Nyungan language family. As shown in Figure 10.1, this single language family covers seven eighths of Australia (the white part). All of the other roughly two dozen language families of indigenous Australian languages were crowded into the remaining 1/8th of the continent, all in the North, just west of the Gulf of Carpentaria (where Burke and Wills went). This linguistic patterning, along with more detailed analyses of the Pama-Nyungan family itself, reveals a well-known linguistic signature, one that usually marks an expansion. These analyses indicate that the Pama-Nyungan expansion began in Northwestern Queensland, between 3,000 to 5,000 years ago, and gradually spread over most of the continent.[264]

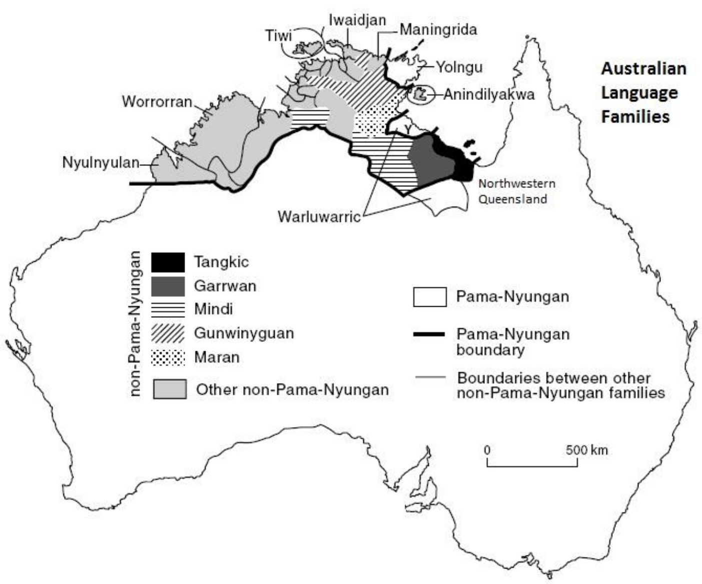


FIGURE 10. 1. MAJOR AUSTRALIAN LANGUAGE FAMILIES. THE PAMA NYUNGAN FAMILY OF LANGUAGES COVERS MOST OF AUSTRALIA. ADAPTED FROM EVANS (2005).

This linguistic picture is enriched by archeological, epidemiological, genetic and ethnographic data. Archaeologically, at about the same time as this linguistic expansion was occurring, new and different stone tools began appearing across Australia, including distinctive "backed blades." The distribution of these new tools roughly matches the distribution of Pama-Nyungan languages. New plant foods also began appearing that, like Nardoo, require complex preparations, such as the grinding of various seeds. Though they are rather labor intensive, these new food sources could be stored, gradually accumulated, and eventually used to feed large gatherings. Not coincidently, evidence also suggests that large ceremonial gatherings became common, population density increased, and people moved into new, challenging and inhospitable environments. Studies of stone tools and their geographic sources indicate the development of substantial trade networks and the intensification of exchange.

This evidence suggests that language, tools, rituals and food preparation techniques spread across Australia, replacing or supplanting their alternatives. By combining all the available evidence, two linguists, Nick Evans and Patrick Mcconvell, have proposed that the Pama-Nyungan speakers spread because of new (1) patrilineal kinship institutions, (2) marriage rules that prescribed unions outside the local group and possibly outside the dialect group, (3) multi-group ritual gatherings or ceremonies supported by seed processing and storage capabilities, (4) intensive initiation rites for adolescents (as we saw among the Arunta), and (5) more encompassing cosmologies, conveyed through song cycles, that establish sacred group identities (which saved Paralji's band in Chapter 8). These kinship, marriage and ritual institutions involved social norms that tightly bound males from different residential groups in interdependent social webs. The marriage norms of "dialect exogamy" meant that men had to seek wives from groups speaking different languages or dialects. This created an incentive to build relationships with other groups, and forced local groups to remain integrated into larger populations. As discussed in the last chapter, the emotional impact of these new rites might have fostered solidarity among local bands, and especially bound male adolescents together for life.

Both the wide-ranging affinal ties and large ceremonial gatherings created by these social norms would also have fostered better technologies and more adaptive cultural repertoires through the exchange of information about tools, weapons, skills, food sources and medicines. Similarly, large ceremonies would have institutionalized 'technology transfer' as young men learned complex skills from the most skilled members of all participating groups. Without social norms demanding such ceremonies, which required diverse groups, the population's ability to develop and sustain a large repertoire of complex technologies would have been inhibited. Recall that the Arunta believed failure to heed the ritual summons would result in illness.[265]

One key question is whether this expansion involved violent conflict, biased migration into successful groups, prestige-biased group copying, or one of the other mechanisms through which intergroup competition operates. Sparse as it is, the available evidence indicates that several of these mechanisms were at work. First, the genetic comparisons of Australian aboriginal populations suggest that speakers of Pama-Nyungan languages are often, but not always, genetically distinct from speakers of other languages. Paralleling this, Pama-Nyungan speakers tend to have high rates of the retro-virus HTLV1, while non-Pama-Nyungan have low rates. HTLV1 is principally transmitted through breast milk, which means that mothers pass it to their children with very little transmission occurring between tribal groups. This suggests that, in part, the competition occurred through the replacement of people—suggesting either *differential reproduction* or *violent conflict*, or both.

Accompanying these forms of competition, however, ethnographic and ethno-historical data indicate that both *differential migration* and *prestige-biased group transmission* were probably also important parts of this spread, especially in light of the weak and sometimes non-existent relationship between language and genes (or retroviruses). While we can't be sure that some of these ancient norms, beliefs and practices spread by being copied from group to group, we do have more recent cases that catch this process in action, as new kin-based institutions and rituals have been observed to emerge and get systematically and repeatedly copied by neighboring groups. For example, over about 60 years, a particular rite of male circumcision diffused out of the Kimberleys, to Arnhem Land, the Great Australian Bight and eventually to Queensland.[266] Similarly, new and even more complicated sets of marriage rules spread widely in parts of Australia, when two groups integrated their kinship and marriage systems. The more complex, recombinant institution that emerged probably fostered even greater integration across diverse groups than did its parent forms.

Intergroup competition by *differential survival* in a challenging environment may have also played a role, as Pama Nyungan speakers eventually entered, or perhaps re-entered, the uninhabited and hostile environments of the Western Desert. Here, where earlier arrivals hadn't endured, groups bearing this new package of social norms and rituals, which permitted widely scattered bands to remain socially interconnected, could have survived more frequently when droughts or floods struck.[267] As we saw in Chapter 8, Paralji saves his band from the 1943 drought in the Western desert by variously relying on the knowledge of distant waterholes he gained during his adolescent initiation rite and on the rich song cycles he'd gradually memorized over decades of ritual performances. Of course, Burke and Wills couldn't even find water in the Australian desert when there was not a drought.

The Inuit and Numic Spreads

The same kinds of processes of intergroup competition have also shaped hunter-gatherer institutions in the Arctic. On the North Slope of Alaska, around the time of the battle of Hastings in England (around 1000 A.D.), speakers of an Inuit-Inupiaq language—the Inuit—began expanding eastward across the vast Canadian Arctic. In a few hundred years, these hunter-gatherers would colonize Greenland, and move south into Labrador on the east coast of Canada. The territory they entered, however, was not empty. The Dorset Eskimo, an archaeologically and probably genetically distinct population who had long inhabited these regions, rapidly receded and vanished (mostly) in the wake of the Inuit tide. The Inuit may also have driven out, or at least encouraged the speedy departure of, the Norse settlers they encountered and fought in Greenland.[268]

Compared to the Dorset, the archeology shows that the Inuit (the "Thule") had a more sophisticated technological repertoire. The Inuit arrived equipped with advantages that included powerful compound bows, high quality adzes (for woodworking), kayaks, dogs, sleds and snow goggles. Along the coast, Inuit groups also had a full whaling package, which included skin boats and harpoons. Interestingly, the Dorset had had archery and dogs in the past, but had mostly lost them centuries before encountering the advancing Inuit (note, if you are skeptical that useful tools can be 'lost' stand by for Chapter 12). Socially, the Inuit probably also had the capability to rapidly organize men under a prestigious leader, for economic endeavors like whale hunting and probably for raiding, warfare and community defense. Their repertoire of cultural-institutional technologies included flexible kinship norms, special namesake relationships (like the Ju'hoasi), rituals and other bonding tools. For example, by providing his wife to another man for sex, an Inuit (man) could cement an enduring and mutually beneficial bond, even creating a special relationship between the men's children. Together, such institutional-cultural technologies helped individuals and communities weave and sustain vast webs of social relationships across widely scattered populations. These networks were crucial for maintaining trade relationships and linguistic similarity as well as for finding marriage partners and recruiting allies for defense and raiding (offense). As we'll see for the Polar Inuit, a group's ability to sustain complex technologies depends on their sociality, on their ability to sustain broad ranging social contacts.[269]

As with Pama-Nyungan peoples, ethnographic and ethno-historical evidence suggests that multiple forms of intergroup competition were likely afoot during the Inuit expansion. In terms of warfare, I suspect that the Inuit gradually occupied Dorset territories, and out-competed them for local resources. When conflict did eventually break out, Dorset tended to lose and retreat. Neither the archaeological nor the language evidence tells us if success in warfare influenced the Inuit expansion. However, ethno-historical evidence from Northern Alaska shows that raiding was an ever-present feature of Arctic life, and even pitched battles were common. Devastating surprise attacks at dawn aimed to annihilate whole communities, and sometimes did. Ambushes sometimes wiped out large trading or hunting parties. Consequently, in this hunter-gatherer social environment, strangers were viewed with great suspicion and usually killed, a fact that placed a premium on having lots of personal contacts in other communities.[270]

Differential extinction could also have played a role. With their superior technology and more diverse set of foraging strategies, the Inuit likely endured and adapted to changing environments and ecological shocks more effectively than the Dorset, and reproduced faster. Prior to the arrival of the Inuit, the Dorset seemed to have periodically gone extinct in particular regions. If the Inuit's institutional advantages meant they went locally extinct less frequently than the Dorset, Inuit norms and practices would have spread and eventually come to dominate—even if the Inuit and Dorset never confronted each other violently. [271]

Some cultural transmission did occur between the Inuit and the Dorset. Over time, archaeological evidence suggests that late Dorset populations were acquiring Inuit house designs, for example. Researchers have also located a few isolated arctic populations who are not genetically related to the Inuit, yet have clearly adopted many Inuit practices. These may be descendants of the Dorset.[272]

As in Australia, inter-group competition among foraging populations would have favored the spread of social institutions that permitted widely scattered small-groups to sustain broad and enduring social relationships, and to pull together local teams to engage in cooperative activities, like whaling, community defense and raiding. Groups less effective at this, because of their social norms, would have lost to more capable groups. In this environment, inter-group competition would not have fostered trust and fairness toward strangers, but rather would have highlighted the need to sustain a tight social network of trusted allies, friends and kin.

The story was very much the same in North America's Great Basin. The Great Basin is a vast watershed between the Rockies and the Sierra Nevada Mountain Range. Between about 200 AD and 600 AD, Numic-speaking hunter-gatherers expanded out of eastern California in a fan-shape across the Great Basin. Three Numic groups, the Paiutes, Shoshoni and Utes, gradually replaced the pre-Numic foragers living there, as well as driving off some encroaching agricultural peoples at the fringes. Like their Australian counterparts, they were fueled by a combination of new forms of social organization and advanced technologies. Their flexible fission-fusion social organization and rituals permitted them to aggregate periodically for hunting, sharing information, making marriages and raiding, but also to seasonally scatter as independent families for hunting, gathering and defense (it's very hard to effectively attack mobile nuclear families). Unlike the foragers they replaced, these groups relied heavily on intensive plant processing techniques and stored foods (and fancy twined water containers) that permitted them to both sustain higher population densities and to better withstand environmental shocks—like droughts.

After 1650 AD, when Numic groups first entered the historical record, they rapidly became renowned for their bravery and feared for their raiding parties and surprise attacks. During this period, Numic groups drove the non-Numic inhabitants of both Warner and Surprise Valleys out, and seized the territory for themselves.[273] One Numic-speaking group, the Comanche, would eventually enter the Great Plains, adopt horses, and expand dramatically. The Comanche rapidly drove out other indigenous groups, most of which were farmers, and permanently pushed back the Spanish. These mobile hunting bands would come to dominate a vast territory, and would only be driven back by another rapidly expanding group, the United States.[274]

Ancient Expansions

These cases of intergroup competition in which one group of hunter-gatherers expands at the expense of another group or groups of hunter-gatherers are rich in part because we know what these societies looked like at the earliest European contact, and have some sense of their institutions, languages and lifeways. However, archaeological evidence suggests that these kinds of expansions, on large and small scales, go deep into our species' evolutionary history. Our genus expanded out of Africa over a million years ago, into a vast range of Eurasian environments that were experiencing rapid climatic and ecological shifts. To the degree that survival in these evolutionarily new and harsh environments depended on cooperation or social networks to sustain technologies (like fire, bows and arrows, fishing and clothing), differential extinction would have favored any culturally-transmitted behaviors that fostered either.[275]

Around 60,000 years ago, groups of *Homo sapiens* expanded out of Africa (our lineage), this time at the expense of other members of our genus and species. As they did for the Pama-Nyungan speakers in more recent millennia in Australia, "backed blades" marked the expansion of these populations into Neanderthal-occupied Europe after 50,000 years ago. Like the Inuit, they may have advanced with the help of superior technology, specifically bows and arrows. These African varieties did interbreed to some degree with the other human lineage they encountered, but the Africans eventually replaced them culturally and dominated them genetically. This should now sound familiar. The archaeology can't tell us much about the processes behind these expansions, but the evidence of violence is consistent with some degree of warfare and raiding (as with chimpanzees). The recurrent presence of cannibalism among Paleolithic humans, which involved the consumption of fully-grown adults, suggests violent intergroup conflicts.[276] As is typical in these expansions, the European variants—that is, the Neanderthals—also appear to have been copying the newcomers from Africa, suggesting prestige-biased group cultural transmission.

In more recent millennia, especially since the origins of plant and animal domestication some 12,000 years ago, the intensity of intergroup competition has dramatically escalated, driving the rise of increasingly large and complex societies. At the global level, Jared Diamond has argued that intergroup competition is crucial for explaining the expansion of particular agricultural groups around the globe, and that the elevated intensity of this competition in Europe, and Eurasia more broadly, helps explain why it was Europeans who conquered the world after 1500AD, and not Aztecs or Warlpiri.[277]

Overall, this combination of evidence suggests that intergroup competition, in a variety of forms including non-violent competition, has been shaping cultural evolution and the social worlds we live in for eons, well back into our species' evolutionary history. If this evidence provides even a roughly correct view, then intergroup competition, through its influence on the social norms, reputational systems, punishment and institutions experienced by individuals, will have shaped our genetic evolution. Let's now turn to this process, which is a form of self-domestication.[278]

Chapter 11

Self-Domestication

Upon entering the *Developmental and Comparative Psychology Laboratory* at the Max Planck Institute in Germany, three year-old participants engage in a series of tasks. First, they meet a hand puppet named Max for a warm-up, which allows them to get comfortable. As part of the warm-up, the experimenter uses some familiar objects in a typical way, like using a colored pencil to draw. Then, the child has a chance to use the same objects. After the child's turn, Max has a chance with the objects. Sometimes Max uses the object incorrectly; for example, by using the wrong end of the pencil to draw. Most kids immediately point out Max's mistake, and the few that don't will highlight these mistakes once asked about Max's actions. For the children, this establishes that Max sometimes makes mistakes and that it's okay to point these out.

In the next phase of the experiment, the child and Max are sitting at a table, and Max decides to take a nap. At a nearby table, off to the side, an adult is performing a multi-step procedure using several unfamiliar objects. For example, one of these "target tasks" involves a Styrofoam board with a gutter, a wooden block, and a black suction head. The adult at the other table—the model—puts the wooden block on the board, and uses the suction head to push the block across the board, into the gutter. Without looking at or addressing the child, the model either (a) acts like he knows what he's doing and is familiar with the task, or (b) acts like it's all new to him, and he's making it up as he goes along. Then, after the model finishes, the original experimenter returns and brings the unfamiliar objects over to the child, saying, "Now you can have it." The child can do whatever he or she wants with the objects, while the researchers covertly record any imitation of the model by the child.

FIGURE 11. 1. AN EXPERIMENTAL SUBJECT WAGGING HIS FINGER AT MAX WHO IS VIOLATING THE RULES FOR THIS CONTEXT. FROM SCHMIDT AND TOMASELLO (2012).

Finally, Max wakes up, and it's his turn to have a go at the objects. He uses the unfamiliar objects in perfectly sensible ways, but in ways that are *different from how the model used them*. This is the key moment in the experiment. The researchers carefully record the child's reaction to Max, as he uses the objects in divergent ways.

Most children immediately protested against Max's 'aberrant' actions (see Figure 11.1), both when they had seen the confident model and when they'd seen the model who wasn't quite sure what he was doing.

However, the kids protested much more when they'd seen the confident model. Many of these protests were in normative form, like "No! It does not go like this!" or "you must use this!" Other times kids just gave commands like, "No, don't put it there!" The kids who most accurately imitated the model themselves were more likely to react in protest. Yet, even those kids who only weakly imitated the model reacted negatively to Max's deviations from what the model had done. It was as if they had inferred a social norm without having themselves mastered the techniques necessary to live up to the local standards.

Psychologist Mike Tomasello and his collaborators have performed many experiments like these, all of which tell the same story.[279] By observing others, young children spontaneously infer context-specific rules for social life, and assume these rules are norms—rules which others should obey. Deviations and deviants make children angry, and motivate them to instill proper behavior in others. What's striking about these findings is that children can and will do all this without any direct teaching or pedagogical cues (like pointing or eye contact) from adults—though no doubt these must help convey the rules in many circumstances. The children's peculiar motivations to reprimand Max's actions is not imitated from adults in the experiment as no adult ever reprimands Max, but are spontaneously applied by the child to violations of inferred rules. This experiment illustrates one of the essential features that distinguish human social life in all societies from other species:

- We live in a world governed by social rules, even if not everyone knows the rules
- Many of these rules are arbitrary, or seem arbitrary (e.g., fish taboos in Fiji)
- Others care whether we follow these rules, and react negatively to violations
- We infer that others care about whether we follow these rules.

As in the small-scale societies seen in earlier chapters, the social world faced by our Paleolithic ancestors would have been increasingly shaped by the emergence of an immense variety of norms, and by the selective spread of specific norms packaged in institutions, that fostered success in intergroup competition. From the genes' eye view, survival and reproduction would have increasingly depended on the abilities of one's bearer (the individual) to acquire and navigate a social landscape governed by culturally-transmitted local rules—those appropriate to whatever group a particular gene happened to find itself in. Typically, in small-scale societies as in many communities, the sanctioning of norm violators begins with gossip and public criticism, often through joking by specific relatives (as with Kula), and then intensifies to damage marital prospects and reduce access to trading and exchange partners. If violators are still not brought into line, matters may escalate to ostracism or physical violence (e.g., beatings), and occasionally culminate in coordinated group executions.[280] In parallel to how wolves were domesticated into dogs by killing those that wouldn't obey and refused to be trained, human communities domesticated their members.[281]

In research in the villages of Yasawa Island, my team and I have studied how norms are maintained. When someone, for example, repeatedly fails to contribute to village feasts or community labor, or violates food or incest taboos, the person's reputation suffers. A Yasawan's reputation is like a shield that protects them from exploitation or harm by others, often from those who harbor old jealousies or past grievances. Violating norms, especially repeatedly, causes this reputational shield to drop, and creates an opening for others to exploit the norm-violator with relative impunity. Norm violators have their property (e.g., plates, matches, tools) stolen and destroyed while they are away fishing or visiting relatives in other villages; or, they have their crops stolen and gardens burned at night. Despite the small size of these communities, the perpetrators of these actions often remain anonymous and get direct benefits in the form of stolen food and tools as well as the advantages of bringing down a competitor or dispensing revenge for past grievances. Despite their selfish motivations, these actions act to sustain social norms, including cooperative ones, because—crucially—perpetrators can only get away with such actions when they target a norm-violator, a person with his reputational shield down. Were they to do this to someone with a good reputation, the perpetrator would himself become a norm-violator and damage his or her reputation, thereby opening themselves up to gossip, thefts and property damage. This system, which Yasawans themselves can't explicitly lay out, thereby *harnesses* past grievances, jealousies and plain old self-interest to sustain social norms, including cooperative norms like contributing to village feasts.[282] Thus, individuals who fail to learn the correct local norms, can't control themselves or repeatedly make mistaken violations are eventually driven from the village, after having been relentlessly targeted for exploitation.

Over our evolutionary history, the sanctions for norm violations and the rewards for norm compliance have driven a process of self-domestication that has endowed our species with a *norm psychology* that has several components. First, to more effectively acquire the local norms, humans intuitively assume the social world is rule governed, even if they don't yet know the rules. The violation of these rules could and should have negative consequences. This means that the behavior of others can be interpreted as being influenced by social rules. This also means that, at a young age, we readily develop cognitive abilities and motivations for spotting norm violations and avoiding or exploiting norm violators, as well as for monitoring and maintaining our own reputations.[283] Second, when we learn norms we, at least partially, *internalize* them as goals in themselves. This internalization helps us navigate the social world more effectively, and avoid temptations to break the rules to obtain immediate benefits. In some situations, internalizations may provide a quick and efficient heuristic that saves the cost of running the mental calculations that consider all the potential short and long-term benefits and probabilistic penalties of an action; instead we simply follow the rule and abide by the norm. This means that our automatic and unreflective responses come to match the normatively required ones. Other times, internalized preferences may merely provide an additional motivation that goes into our calculations.[284]

The experiments involving Max are cool because we get a look at kids' reactions to novel arbitrary rules for specific contexts. These rules aren't about cooperation or helping others; they are just context-specific rules. Nevertheless, kids automatically infer that they are social norms, and get mad when they are violated. Importantly, this same pattern emerged when psychologists focused on studying altruism in children during the 1960's and 1970's. In the classic experimental setup, a schoolchild is brought alone to a testing area to get acquainted with an experimenter. The child is then introduced to a bowling game and shown a variety of attractive prizes that he or she can obtain with tokens won in the bowling game. The child is also shown a charity jar for "poor children" where they can put some of their winnings from the game, if they want. This jar often has a "March of Dimes" poster, or some facsimile, posted behind it. A model, who could be a young adult or another child, demonstrates the game by playing for 10 to 20 rounds. On pre-set rounds, the model wins some tokens and donates some of these token to the charity jar. Children experience one of three situations: (1) a generous guy who puts lots of tokens in the charity jar, (2) a stingy guy who puts only a few tokens in the jar, or (3) no demonstration. After the demonstration is complete, the child is left alone to play the bowling game, and to donate to charity, if he or she wants.

The results of many versions of this experiment demonstrate four key findings. First, children spontaneously imitated the model, becoming either more generous or more selfish, depending on which model they saw. Those who saw the generous model gave more than children in the 'no model' condition, while children who saw the stingy guy gave less than children in the 'no model' condition. Second, beyond merely the effects on their donations, children also imitated other aspects of the model's behavior, including the model's verbal statements. Children even repeated verbal statements from the model when they seemed to contradict their own and the model's actual behavior. That is, they say how important it is to give to poor children, but then not give much. Third, the effect of exposure to a model—generous or stingy—endures for weeks or months in retests. But, the effect does not extend to quite different contexts, those which don't resemble a bowling game.[285] Finally, children readily imitate standards for self-reward or self-punishment and readily impose those standards on others. When children are assigned to help a younger novice with the bowling game, they will demonstrate either generosity or stinginess to the novice, and then impose the standard they've acquired on the novice by scolding them, if he or she doesn't spontaneously adopt it.[286]

Overall, children are not culturally learning to be altruistic in some general or dispositional sense; they are acquiring norms about proper behavior in the bowling game context, and those behaviors include proper donation sizes. Because they have inferred social norms exist, they impose these behaviors on other children in the same way that the puppet Max was reprimanded for his 'mistakes'.[287]

HOW ALTRUISM IS LIKE A CHILI PEPPER

It's clear that when people encounter a new situation they try both to figure out what norms, among those they've already acquired, might apply to the situation, and are also prepared to acquire new norms specific to this unfamiliar context. With this in mind, we can now look at findings from economic games. In classic experimental social dilemmas, two or more strangers interact anonymously, and make decisions that influence both their own payoffs and those of the other players. All decisions in these experiments are real in the sense that these decisions are implemented and determine how much money people take home. Many valuable insights about social norms and psychology come from the use of economic games. Properly interpreted, economic games are valuable tools for measuring social behavior, and teasing apart the complex packages of motivations, understandings and beliefs that jointly influence decisions. Well-known economic games include the Prisoner's Dilemma, Ultimatum Game and Dictator Game. To understand these experiments, imagine this situation:

> You enter an experimental economics laboratory at Big City University. It's filled with college-age strangers seated at computer terminals. You are told to sit down at an open terminal, which has partitions that prevent others from seeing your screen. After some preliminaries, the computer screen informs you that your ID has been randomly assigned to interact with another person in the room, but neither you nor this person will ever know the other's identity. You each make one

> decision and the game is over. If you get any money from this decision, it will be added to your "show-up fee" (which is $20). You will receive all money in cash at the end as you exit.
>
> In this interaction, you have been randomly assigned to the role of the "proposer" and the other person is the "responder." As the proposer, it's your job to divide $100 between you and the other person by making an offer between $0 and $100 to the responder (in increments of $1). The responder then has two choices: they can either 'accept' your offer or 'reject' it. If the responder accepts, he or she will receive your offer, and you get the remainder. If the responder rejects, you both get nothing (no money). This means you'll go home with only your show-up fee.

This is the Ultimatum Game. Using game theory, we can figure out what a person would do if they were only interested in maximizing their take-home pay. To figure this out, put yourself into the shoes of the responder. If the proposer offers you any money more than zero, you face a choice between zero (if you reject) and some positive amount of money (if you accept). If, for example, the proposer offers you $1, you can leave with $1 more by accepting it. Thus, if you are a money-maximizing responder, you should accept any positive offer. Proposers, realizing this, should offer only $1, which would be accepted. If humans were money-maximizers, Ultimatum Game experiments should reveal many low offers and few rejections of non-zero offers. Not surprisingly, it turns out that this never happens in any human society. By contrast, experiments with primates show little or no evidence of motivations besides narrow self-interest *in dealing with strangers*. Chimpanzees, for example, never reject in the Ultimatum Game.[288]

In Western societies, most people offer half ($50 out of the $100), and enough people reject offers below 50% that it doesn't pay to give less than half because the risk of having your offer rejected is too great. Interestingly, among people over about age 25, this willingness to offer 50% is mostly not driven by concerns about getting rejected. To explore this, we can turn the Ultimatum Game into a Dictator Game by removing the possibility of rejection. In the Dictator Game, the proposer gives some portion of the $100 to the other player and the proposer keeps whatever is left. If people were strictly self-interested, the proposer would give nothing to the other player and take home the entire $100. But, rather than giving $0, most Western adults continue to give half. This suggests that people have an internalized equality norm, applicable in this context, towards strangers that is calibrated to allow them to effortlessly and without constant strategic recalculation navigate through a world with punishers, like the responders in Ultimatum Games who would sanction them for keeping too much for themselves. But, they continue to adhere to the norm even when no punishment is possible, and no consequences outside the game are plausible.[289]

My collaborators and I have systematically performed economic games across diverse societies and among chimpanzees. In humans, the evidence is clear that such games often tap social norms that people bring into the laboratory from their social lives outside, and consequently game play varies dramatically across societies. In modern industrialized societies, these experiments often measure social norms that regulate impersonal exchange and other social interactions, and evolved culturally to facilitate mutually beneficial interactions in large-scale societies with lots of strangers and anonymous interactions. The strength of these impersonal norms, though unusual, is a key feature of many modern societies. By contrast, the smallest scale human societies tend not to offer very much nor reject low offers because they lack social norms for monetary exchanges with strangers or anonymous others.[290]

However, when games are played repeatedly in the laboratory, participants begin to develop 'lab-specific' social norms as they adapt to a new context. These social norms include motivations, beliefs and expectations, including concerns about what other people will think of those who violate whatever norms govern the game.

IT'S AUTOMATIC

Internalized social norms help guide us through complex social environments, allowing people to automatically—without conscious reflection or complex mental calculations of the reputational consequences—do the "right thing" (comply with local norms). This can be seen in how people respond in a Public Goods Game. The structure of this game captures the logic of real life situations, like recycling, giving blood, paying taxes and defending the community, in which the group does best if everyone cooperates but the individual does best if he or she acts selfishly while everyone else cooperates. In this classic cooperative dilemma, individuals are placed into groups with three strangers for a single interaction. Each person gets $4 to start. Without knowing what others will do, they have to contribute between 0 and 4 dollars to a common project. Whatever enters the project is doubled and then distributed equally among all four group members, regardless of whether they contributed.

To highlight the cooperative dilemma, consider that the group gets the highest payoff if everyone contributes all four of their dollars to the common project (4X$4 = $16). This money doubles to $32, and is distributed equally so that everyone goes home with $8 (twice what each started with). However, every individual does best if they keep their $4 and free-ride on those who contribute to the common project. For example, if three people contribute $4 and one free-rider contributes nothing to the common project, then the three contributors go home with $6 each, and the free-rider goes home with $10—his initial $4 plus the $6 he got from the common project. If three people free-ride and only one person contributes his entire $4, then the free-riders go home with $6 each while the contributor gets only $2. Thus, those aiming to maximize their payoff should contribute zero. However, most educated westerners agree that—if asked—players *should* contribute all the money to the common project. Among the typical experimental subjects (undergraduates), the average contributions are commonly between 40% and 60%, with many people contributing either 100% (cooperators) or 0% (free-riders).[291]

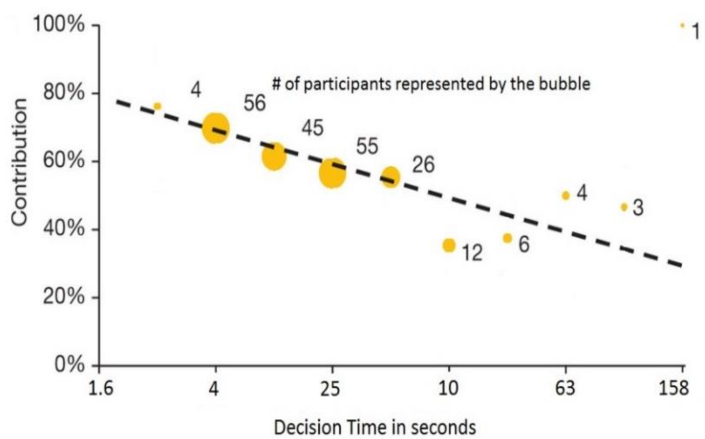


FIGURE 11. 2. THIS SHOWS THAT THE LONGER PEOPLE TOOK TO DECIDE WHAT TO DO, THE LESS THEY COOPERATIVE THEY WERE. ADAPTED FROM (RAND, GREENE, AND NOWAK 2012)

To examine whether high contributions in the Public Goods Game, and prosocial choices in other such games, result from automatic norm-following, David Rand and his colleagues examined the relationship between the time people spent making their contribution decisions and the size of their contributions. Figure 11.2 shows one of Dave's findings: the more rapidly participants made their decision, the higher their contribution was to the common pool—that is, quick, gut responses were more cooperative.[292]

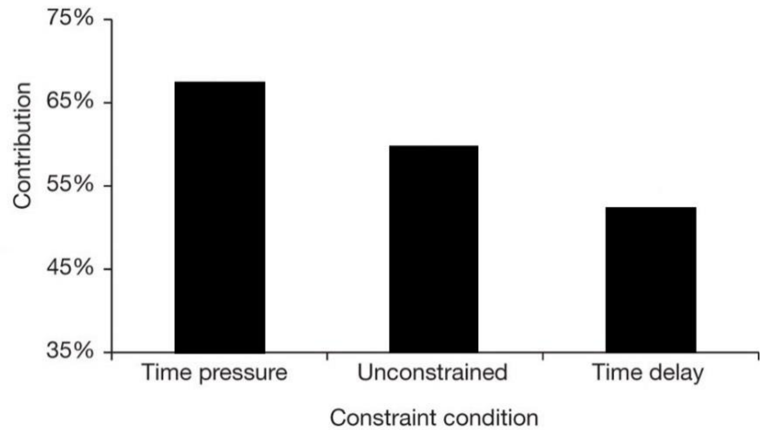


FIGURE 11. 3. AVERAGE PERCENTAGE CONTRIBUTED IN THREE TREATMENTS. UNDER TIME PRESSURE PEOPLE COOPERATED MORE.

Such findings are provocative, but it could be that cooperative people happened to also be people who respond quickly to questions. To address this, Dave ran participants through the same experiment again but this time rather than letting them take however long they wanted, people were randomly put into one of three different treatments. They were alternatively (1) forced to answer in less than 10 seconds, (2) unconstrained as before, or (3) forced to delay their decision for 10 seconds and asked to reflect on it. Figure 11.3 shows the results: under time pressure participants were more cooperative. When forced to delay and reflect, participants became less cooperative than when they were unconstrained.

Rand and his team showed the same effects across many different experiments, including experiments in which they unconsciously cued participants to either 'reflect' or 'go with their gut'. Going with one's gut leads to more cooperation, if you have the appropriate norms.

Above, we saw young children immediately express anger when Max violated a social norm that the children had inferred. This fits well with much work on rejections in the Ultimatum Game. Not only do people from some societies get angry when they receive a low offer, but participants are quicker when deciding to reject low offers. By contrast, deciding to accept a low offer—the rational and self-interested thing to do—seems to take much careful consideration. When placed under time pressure for their responses, individuals from these societies reject more of the unfair offers. In one experiment, researchers used drugs to deplete people's impulse control (serotonin depletion). Loss of their impulse control resulted in more rejections of low offers, but not of 50/50 offers. Negative emotional reactions are our automatic and unreflective response to norm-violations and norm-violators.[293]

The power of norms in economic games first struck me in 1995 when I was administering the Ultimatum Game among the Matsigenka in the Peruvian Amazon. Lacking strong social norms specifying equality towards strangers in monetary exchanges, these people were happy to be offered any money in the game, didn't expect proposers to offer half, and weren't inclined to punish proposers for low offers. Nearly 20 years of subsequent research across two dozen diverse societies showed these sentiments are common in the smallest scale human societies.

Converging evidence for the importance of norm psychology in economic decisions comes from the economist Erik Kimbrough. Late one night, while returning from a pub in Amsterdam, Erik noticed that people waited at the "walk/don't walk" lights on the street, even at broad intersections when no cars were in sight. Inspired, Erik used this observation to create an experiment in which participants first played a very simple game. They were given a pool of money that would begin slowly draining as their little avatar walked down a virtual street on their screen. Whatever money remained in their pool when the avatar reach the other side of their screen was theirs to take home. Following an explicit rule, the avatar would automatically stop at red lights along the virtual street and wait, while the money would continue to drain from the participant's account. To make the avatar go, players only had to press a key, any key. While they could make their avatar go at any time, regardless of the light's color, many people waited at all the lights for green. After this 'rule-following' game, participants played economic games, like the Ultimatum, Dictator and Public Goods Games. The results confirmed Erik's suspicions: the amount of time people waited at the lights was associated with making more equal offers in the Dictator Game, contributing more in the Public Goods Game, and punishing low offers more frequently in the Ultimatum Game. Following a costly non-social rule, like waiting at traffic lights, appears to be underpinned by the same psychological machinery as complying with, and punishing, social norms in behavioral games.[294]

As both Adam Smith and Friedrich Hayek have argued long before Erik and me, it's our automatic norm-following—not our self-interest or our cool rational calculation of future consequences—that makes us do the 'right thing', and allows our societies to work. This means that how well a society functions depends on its package of social norms.

AND IN THE BRAIN

The effects of internalizing norms can be seen in our brains when economic games are combined with tools from neuroscience. When people cooperate, give to charity, or punish norm-violators in locally prescribed ways, the 'rewards circuits' in their brains fire up. Some of these are the same circuits that fire up when people are rewarded with money or food, yet in these costly social contexts they are firing up despite the fact that individuals are actually losing money.[295] Neurologically speaking, people 'like' to comply with norms and punish norm violators.

Using these brain-imaging tools, it's instructive to consider what people's brains do when we decide to break a social norm. Consider lying. Neurologically, lying requires most people, though presumably not lawyers or car salesmen (just kidding), to override their automatic or unreflective reactions by engaging those brain regions responsible for cognitive control and abstract reasoning. That is, violating a social norm requires mental effort, and 'higher' cognition.[296] Most Westerners, for example, have to override an internalized norm to lie to strangers in many contexts. Note of course, that intentionally not telling the truth isn't always a norm violation, such as with "white lies". And, in many places it's considered totally fine—if not encouraged—to lie to strangers or foreigners to benefit oneself or one's family (no 'over-ride' needed).

Why would natural selection have built us to be norm-internalizers? Broadly speaking, internalizing motivations helps us more effectively and efficiently navigate our social world, a world in which some of the most frequent and dangerous pitfalls involve violating norms. Such motivations may help us avoid short-term temptations, reduce cognitive or attentional loads, or more persuasively communicate our true social commitments to others. The logic here parallels that which we encountered in Chapter 7, where I explained how cultural learning could overcome an innate aversion to chili peppers and other spices in order to reduce the dangers of meat-borne pathogens. Reinterpreting the pain as pleasure helps individuals navigate the ecological landscape by solving an adaptive problem (meat-borne pathogens) without us even being aware of it. Analogously, internalizing norms as tastes helps us more easily and intuitively navigate the social landscape.

WHY SPOTTING POTENTIAL NORM VIOLATIONS IS EASY

In addition to the internalization of social norms, culture-gene coevolution has honed our cognitive abilities, motivations and emotions in various ways, including ways that permit us to effectively manage our reputations. On the cognitive side, both children and adults are more skilled at solving logic problems when they are contextualized as norm violations. This helps us avoid committing norm violations ourselves and to pick out other norm violators, who we might be required or rewarded for punishing, avoiding or ostracizing. As we saw in Fiji, spotting norm-violators results in opportunities to justifiably steal their crops or take revenge for past grievances.

To see these abilities, consider this experiment with three and four year olds: the children hear one of two stories, and then have to solve a logic problem. In both stories, they are told about some mice that go out to play in the evening. Some of these mice tend to squeak while playing, which attracts the neighborhood cat who comes and tries to catch them. In one version, the children hear a *descriptive claim*, which states that all squeaky mice stay in the house in the evening. In the other version, they are told about a *social norm* prescribing that all squeaky mice *must* stay in the house. Now for the test. The children are placed in front of the mouse-house, with 10 yellow rubber mice inside the house. They are also shown that "squeaky" vs. "quiet" mice can only be distinguished by squeezing the mice, and listening for a squeak. Then, evening arrives at the mouse-house and four mice leave the house to play in the backyard. Depending on which version of the story they heard, children were tasked either with (1) checking to see if the descriptive claim was true or (2) locating norm violators. The answer is the same in both cases, you have to check all the mice in the backyard, not in the house. Checking the mice in the house tells you little, since quiet mice might be in the house in either case, and you don't know how many of each kind of mice there are. When checking for norm violations, most three and four year olds decided to check the mice in the backyard. However, when verifying the descriptive statement, most of the children did not think to check the backyard mice.[297] This suggests that setting up the task to cue norm psychology made the children better at solving the logic problem.

This self-domestication process has also tinkered with our feelings and emotional displays to better navigate a world governed by social norms. Primate emotions related to shame and pride have been retrofitted to apply to social norms. Shame in humans evolved (genetically) from a primate "proto-shame", the package of feelings and bodily displays that we see in primates when individuals demonstrate or signal their subordinate status to a dominant group member. The shame and proto-shame display in both humans and primates involve slumped shoulders, downcast gaze, crouching, and a diminutive body posture—the idea seems to be to look small and unimposing. However, as anthropologist Dan Fessler has persuasively argued, shame in humans emerges in status hierarchies (see Chapter 8) as well as when someone violates a social norm or delivers a substandard performance. Norm violators display shame to their communities for communicative reasons that parallel those which drive subordinates to display shame in the presence of more dominant animals. In both cases, the shame display re-affirms their acceptance of the local social order. In the context of norm violations, the ashamed is effectively saying to the community "yes, I know I violated a norm, and should be admonished for it; but, please don't be too harsh on me".[298]

The same kind of coevolutionary process may have provided some of the basic mental tools for assigning reputations to individuals as well as certain default settings and motivations for judging things like harm, fairness and status. These have evolved genetically in response to the broad spreading—by intergroup competition—of social norms that (1) suppressed the harming of community or in-group members, (2) prescribed equitable treatment to peers, and (3) established enduring status relationships. My UBC colleague, developmental psychologist Kiley Hamlin, has shown that before the end of their first year of life babies make rather nuanced social distinctions consistent with these predictions. By using puppet shows as simple morality plays, Kiley's efforts reveal that infants prefer puppets who help others, but don't generally like those who hinder or otherwise hurt others. Crucially, however, babies rapidly develop a key nuance: by 8 months of age, babies prefer puppets who *hurt* previously antisocial guys (those spotted harming other puppets) over those who help antisocial types. Hurting others is fine according to babies, as long as those others are known to harm others or are members of other groups. Similarly, toddlers actively punish, by taking treats away from guys who help antisocial others; instead, they prefer puppets who hurt antisocial guys. This work shows that, early in development, babies already possess some of the key reputational and motivational elements that sustain social norms in small-scale societies, and seem prepared to apply that reputational logic to simple circumstances of helping and hurting.[299]

In short, to survive in a world governed by social rules enforced by third parties and reputations, we became norm-learners with prosocial biases, norm-adherers internalizing key motivations, norm-violation spotters and reputation managers. This makes us rather unlike any other species.

NORMS CREATED ETHNIC STEREOTYPING

When a group of chimpanzees bumps into a lone individual from a neighboring group, hostility erupts immediately with a volley of aggressive hoots and barks. If the group is large enough, they will likely attack and kill the unlucky traveler. Human societies, even the smallest-scale ones, are quite different in this respect from chimpanzee populations because local groups, whether those are bands, villages or single households, are enmeshed in larger tribes or at least diffuse tribal networks. Tribal members, or co-ethnics, share a dialect or language, and often many other obvious markers of membership such as dress, greetings, gestures, rituals and hair-styles. Less obvious is that co-ethnics tend to share a set of social norms, beliefs and worldviews that govern their lives, and allow them to anticipate each other's behavior, coordinate and cooperate.[300]

It's not that humans are so nice, or generally friendly to strangers. In many human societies past and present, a lone traveler could easily find himself fleeing for his life because he's encountered a large party of strangers—as I discussed among the Inuit. Among small-scale societies, this often happens at language boundaries, or when local communities are at war. However, it's also the case that within a tribal network, which often involves many more individuals than anyone can know personally, people could often hunt, gather, farm, travel and look for mates in relative security. Strangers, especially if they are wearing the relevant symbols and make the appropriate greetings, can be approached and shared networks of relationships can be determined.[301]

Tribes or ethno-linguistic groups, and the psychology that permits us to navigate the social world they create, likely arose through a culture-gene coevolutionary process. Here's the idea: cultural evolution gave rise to a variety of different social norms, so different groups became increasingly characterized by different practices and expectations about such things as marriage, exchange, sharing and rituals. Then, natural selection acting on genes responded to this world governed by social norms by endowing individuals with the cognitive abilities and motivations to help them better navigate and adaptively learn. The success of someone growing up in this emerging landscape of social norms depended—at least in part—on their ability to acquire the appropriate social norms for their own group, and to preferentially target their interactions toward those most likely to share their norms. If a learner acquires social norms that don't fit with others in his or her group, the learner will end up violating the local norms, getting a bad reputation, getting punished, etc. Even if they acquire the appropriate local norms but then interact with people from other groups, who have different norms, they can end up getting sanctioned, wasting time or mis-coordinating. For example, a boy and girl from different ethnic groups might fall in love and carry on a romance for years only to find out that a marriage is impossible, since his family demands a dowry but her family is looking for a bride price (a payment in exchange for their daughter). Both sides expect to be paid by the other, and this is serious business.

However, social norms are tricky because they are often hidden from view until it's too late. Many of our norms are so profoundly part of how we view the world that it's hard to imagine anyone could believe otherwise. For example, you might marry a lovely man from the Horn of Africa, only to find out years later that he had your eight-year-old daughter ritually circumcised while visiting his family. His decision might not fit your preferred customs, though it seemed a matter of course for your husband and his mother, who is disgusted by the idea of clitoris-bearing women. In this part of Africa, as well as in the Middle East, female genital cutting is a long-standing tradition, and associated with purity and fertility. They can't understand why you are so upset.

To deal with the non-obvious nature of social norms, natural selection took advantage of the fact that the cultural transmission pathways of social norms are often the same as those for other more observable markers, like language, dialect or tattooing practices. Such markers can then be used as cues to both (1) figure out who to learn from and (2) whether a potential partner is likely to share one's norms.[302] The best markers are those that are difficult to fake. The reason why difficult-to-fake markers, or complex combinations of simple markers (e.g., dress, gestures *and* manners), are best is because an easy-to-fake marker, like a distinctive hat, can be simply put on in order to trick or manipulate another person. For example, a gentile physician living in Manhattan might place a mezuzah outside her office in hopes of attracting or retaining more (Jewish) patients. A mezuzah is a tiny piece of parchment with specific Hebrew verses inscribed on it, often stored in a decorative case. It's typically attached to the doorframe at the entryway of houses. I suspect many Jews readily notice these tiny boxes (my wife does), while they remain invisible to most non-Jews. In contrast to something like a mezuzah, language and dialect are better markers because they are not easy to get right unless one grows up in a certain place, or within a certain social group. This suggests that language or dialect might be a priority cue for figuring out who to learn from and interact with, and for making guesses about the likely actions of the speaker.

We've already seen the evidence that infants and young children preferentially learn tool use and food preferences from those who share their language or dialect in Chapter 4. Developmental psychologist Katie Kinzler and her colleagues have also shown that young children preferentially seek interaction with those who share their language, especially when it's spoken in their dialect. This holds for diverse populations, with similar experimental results emerging from kids in Boston, Paris and South Africa.[303] At 5 to 6 months of age, infants preferentially watch those who share mom's accent. By ten months, infants preferentially accept toys from those who speak with their mom's accent.[304] Later, preschoolers tend to pick those who share their language or dialect as "friends."

The importance of language as an ethnic marker came across most strikingly while my wife, Natalie, was conducting her PhD dissertation research among Chaldeans in Michigan. Chaldean immigrants from Northern Iraq have been gradually clustering in metro-Detroit over the last century. By the late 1990s, this ethnic group had come to dominate the small grocery store business sector of the city. By forming tight social networks, hiring mostly relatives or fellow Chaldeans, and preferentially using Chaldean doctors, lawyers, and other professionals, this group has consistently prospered in an often challenging economic environment (it's Detroit). Being considered "Chaldean" by the community was and is crucial, since it gives one access to jobs, handshake contracts with other Chaldean businesspersons, broad social networks and substantial marriage possibilities. Speaking Chaldean, the language spoken by Jesus, as any Chaldean will remind you, is very important for establishing one's Chaldean identity. It was so important that many in the second and third generations would take Chaldean language classes. Even some first generation immigrants from urban areas in Iraq, like Mosul, would also take the language classes, since Iraqi city dwellers of Chaldean descent sometimes would only learn Arabic. Of course, speaking Arabic was absolutely not a Chaldean marker, since Detroit is full of Muslim Arab immigrants that Chaldeans want to distinguish themselves from. Of course, practicing Chaldean Christianity was also an important cue of Chaldean identity.[305]

Ethnic markers go way beyond language and dialect, however. For thousands of years and across the globe, many populations have shaped their skulls, including Europeans until recently. By using a variety of techniques on infants, such as strapping boards to the head, people have created distinctive and beautiful (to them) cranial forms, including flat, round and conically-shaped heads.[306] The shapes often marked distinct ethnic groups or classes. Because cranial reformation must begin in infancy and requires serious investments by one's family, it's nearly impossible to fake this cue (see Figure 11.4[307]).

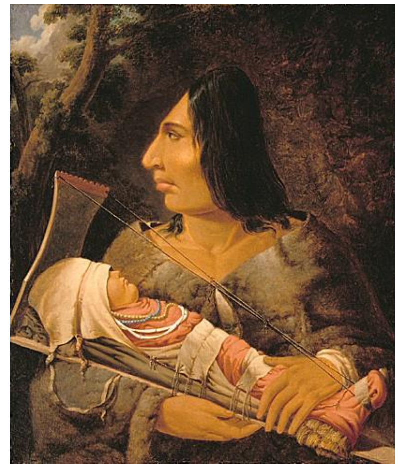


FIGURE 11. 4. DEVICE TRADITIONALLY USED ON INFANTS FOR HEAD FLATTENING AMONG CHINOOKAN SPEAKING POPULATIONS IN THE PACIFIC NORTHWEST, USA.

Thus, the world that cultural evolution often creates is one in which different groups possess different social norms, and where norm boundaries are often marked by language, dialect, dress or other markers (e.g. head shape). This social environment would have favored reliably developing cognitive tools for navigating such a world. In this world, knowing a person's dialect would have allowed one to predict with some confidence many other aspects of his or her preferences, motivations and beliefs because dialects get transmitted along the same learning pathways as social norms, beliefs and worldviews. The situation may also have favored an evolved psychology for recognizing the groups in the world, figuring out their markers, and making generalizations about their members, using category-based induction (as discussed in Chapter 5). That is, if you learn something about one member of a group—e.g., he doesn't eat pigs—you tend to assume that this applies to all members. Of course, the downside of such tendencies and abilities is that they sometimes yield incorrect inferences, and they tend to throw the whole social landscape of groups and their behaviors into a starker relief than reality (sometimes) supports. Cognitive scientists call these abilities our folksociological capacities.[308]

We can see how deeply norms are intertwined with our folksociology by returning to the experiments with Max the puppet. The child subjects now encounter Max along with Henri. Max speaks native-accented German but Henri speaks French-accented German. Young German children protested much more when Max—their co-ethnic as cued by accent—played the game differently from the model than when Henri did. Co-ethnics are favored because they presumably share similar norms, but that also means they are subject to more monitoring and punishment if they violate those norms. This appears to hold cross-culturally, as people from places as diverse as Mongolia and New Guinea willingly pay a cost to preferentially punish their co-ethnics in experiments like the Ultimatum Game, over their non-co-ethnics, for norm violations.[309]

This approach to how and why we think about tribes and ethnicity has broader implications. First, intergroup competition will tend to favor the spread of any tricks for expanding what members of a group perceive as their tribe. Both religions and nations have culturally evolved to increasingly harness and exploit this piece of our psychology, as they create quasi-tribes. Second, this approach means that the in-group vs. out-group view taken by psychologists misses a key point: not all groups are equally salient or thought about in the same way. Civil wars, for example, strongly trace to ethnically or religiously marked differences, and not to class, income or political ideology.[310] This is because our minds are prepared to carve the social world into ethnic groups, but not into classes or ideologies.

Finally, the psychological machinery that underpins how we think about 'race' actually evolved to parse ethnicity, not race. You might be confused by this distinction since race and ethnicity are so often mixed up. Ethnic group membership is assigned based on *culturally-transmitted* markers, like language or dialect. By contrast, racial groups are marked and assigned according to *perceived* morphological traits, like skin color or hair form, which are *genetically transmitted*. Our folksociologcial abilities evolved to pick out ethnic groups, or tribes. However, cues like skin color or hair form can pose as ethnic markers in the modern world because members of different ethnic groups sometimes also share markers like skin color or hair form, and racial cues can automatically and unconsciously 'trick' our psychology into thinking that different ethnic groups exist. And, this byproduct can be harnessed and reified by cultural evolution to create linguistically labeled racial categories and racism.

Underlining this point is the fact that racial cues do not have cognitive priority over ethnic cues: when children or adults encounter a situation in which accent or language indicate 'same ethnicity' but skin color indicates 'different race', the ethno-linguistic markers trump the racial markers. That is, children pick as a friend someone of a different race who speaks their dialect over someone of the same race who speaks a different dialect.[311] Even weaker cues like dress can sometimes trump racial cues. The tendency of children and adults to preferentially learn and interact with those who share their racial markers (mistaken for ethnic cues) likely contributes to the maintenance of cultural differences between racially marked populations, even in the same neighborhood.

My point: because of culture-gene coevolution, humans reliably develop the psychological equipment to map and navigate a world of immense cultural diversity. However, in mapping the social world around us using both our own observation and culturally-acquired categories (like race, see Chapter 7), our folksociological system, like our visual system, errs on the side of providing us with only the essential landmarks and main avenues around us, while ignoring lots of detail. Thus, the dynamically shifting gradations and clines of cultural variation are often rendered as a snap shot, in stark relief.

WHY KIN-BASED ALTRUISM AND RECIPROCITY ARE SO STRONG IN HUMANS

Efforts to apply evolutionary theory to humans have long emphasized the importance of kinship and reciprocal altruism (reciprocity), as noted in Chapter 9. There's no doubt these are important. However, what's interesting is how potent kinship and reciprocity are in humans compared to other species. Genetic relatedness certainly matters in primate social life, but it doesn't matter nearly as much as it does in humans. Humans help more relatives more often than other mammals, who miss both helping opportunities and whole classes of relatives (like paternal half-siblings). For kin-based altruism to emerge, individuals have to be able to identify *when* and *who* to help; yet, natural selection misses many situations where relatives could help each other but don't because relatives are often hard to spot and it's not always easy to know when they need help.

The cultural evolution of social norms can strengthen the power of kin-based altruism by creating social norms that point to specific situations and relatives that need help. Social norms bring the community in as monitors, to make sure people don't overlook their responsibilities to their relatives. Brothers will be naturally inclined to help each other, but brothers monitored by a community possessing norms about brotherly responsibilities will be even more inclined to help each other. Thus, sanctions for norm violations can then strengthen natural selection's potency in shaping our nepotistic instincts, especially those that bind fathers' to their offspring.

For reciprocity, the effects of social norms may have been even more striking, as reciprocity is relatively rare outside of humans and especially outside of primates. Social norms can galvanize reciprocity in ways that make it more enduring and applicable to more domains. Governed by local norms, third parties can help monitor and decide whether someone has defected (failed to reciprocate), and can assistant sanctioning non-reciprocators. For example, in many small-scale societies men exchange sisters as wives. You permit me to marry your sister now, and I promise that when my sister is old enough, she will marry you. After my marriage, in the meantime, circumstances may change. Perhaps you get permanently injured or my sister disappears with another man. As a consequence, I might be inclined not to pay you back, even if it ends the relationship between our families. However, in many places, I'd not only be violating our personal agreement but also social norms about sister exchange. Failure to meet my obligations will impact my reputation broadly. In one well-studied case among the Gebusi in New Guinea, my failure to meet my sister exchange obligations would increase the chances that I would, at some future date, be found guilty of witchcraft, and executed by the community. In this culturally-constructed world, if I defect on our reciprocity relationship I risk not only the end of our relationship but possibly my own end.[312] In such a world, natural selection will favor potent motivations for reciprocity.

Cultural evolution has created a social world that magnified natural selection's ability to shape our instincts for kin-based altruism and dyadic reciprocity.

War, External Threats, and Norm-adherence

In Nepal, from 1996 to 2006, Maoist rebels battled the Nepalese Armed Police Force and then the Royal Nepalese Army. The conflict killed over 13,000 people, destroyed property and displaced hundreds of thousands from their homes. Violence in small rural communities was random and unpredictable. Sometimes violence was used to intimidate locals, coerce support or gather information. Other times it was used for revenge or as an excuse to settle old political scores. To study the impact of this war on people's social motivations, political scientist Michael Gilligan and his colleagues deployed a battery of behavioral games, including both the Public Goods and the Dictator Games, in six pairs of communities. Each pair of communities was selected to match on a range of geographical and demographic dimensions. The key difference between each community in the pair was that one had experienced high levels of fatalities during the war while the other had not experienced any war-related fatalities.[313]

People from communities that had experienced more war-related violence, even if their own households had not experienced any violence, property loss or displacement, were more likely to cooperate with their fellow villagers in the public goods game. They also gave more in the dictator game, but this appears to be mostly due to the violence experienced specifically by their household. The sums of money involved were non-trivial, with most people taking home somewhere between one-half and a full day's wage from these games.

The effects of the strengthened social norms and a more tightly-bonded community appears to have resulted in the formation of more, and more active, community organizations. *None* of the communities *unaffected* by the war established new local organizations, like farming cooperatives or women's groups. By contrast, 40% of those communities affected by the war had subsequently established new organizations. Even if the communities affected by violence didn't establish any new organizations, the ones they already had, or were started by outsiders, were more active than those in non-affected villages. By strengthening prosocial group norms, the experience of war resulted in more, and more energized, community organizations.

Why would war have these prosocial effects?

Over hundreds of thousands of years, intergroup competition spread an immense diversity of social norms that galvanized groups to defend their communities, created risk-sharing networks to deal with environmental shocks like drought, floods and famines, and fostered the sharing of food, water and other resources. This meant that, over time, the survival of individuals and their groups increasingly depended on sticking to those group-beneficial social norms especially when war loomed, famine struck or droughts persisted. In this world, culture-gene coevolution may have favored a psychological response to intergroup competition, including threats that demand group solidarity for survival. Under such threats, or in environments where such threats are common, intergroup competition favors cultural practices that monitor individuals more closely and sanction norm violators particularly harshly, thereby suppressing the increased temptation to break the norms (e.g., not sharing food during a famine). Under threat, increased sanctions in the form of ostracism, injury and execution may have favored an automatic and unconscious innate response to cling more tightly to our social norms and groups, including their beliefs, values and world views. This means that cues of intergroup competition should promote greater solidarity and identification with one's group, as well as stronger norm adherence. Stronger norm adherence means both more compliance with norms and stronger negative reactions to norm violations.[314]

Though historians have long speculated that war influences our prosocial motivations, several recent studies, including my opening account of the Nepal work, have now rigorously documented these effects by studying the devastating quasi-natural experiments that can still be found around the globe. We are far from nailing this down, but it's clear that war creates enduring psychological effects in a manner consistent with what we'd expect in a cultural species that evolved in a world torn by intergroup conflict.

Now, let's head to the Republic of Georgia in the Caucuses and Sierra Leone in West Africa.

The economists Michael Bauer, Julie Chytilová and Alessandra Cassar (and later me) wondered whether the experience of war might affect children more than adults. This is a good question since many social norms are acquired and internalized during middle childhood and early adulthood. The team also wondered whether war created some generalized prosociality, or if it might be galvanizing in-group solidarity. In other words, do the effects of war bias people toward those in their own community and against those outside one's social sphere. To explore this, the team conducted experiments with children between the ages of 3 and 12 in the Republic of Georgia 6 months after Russia had attacked in 2008, and with adults in Sierra Leone in West Africa 10 years after the horrendous civil war there. Note that many of the adults in Sierra Leone were adolescents or even children during the war. In each place, the effect of war on these populations was essentially random, providing a kind of natural experiment. Using interview data, our team divided participants up into three categories according to how much the war had impacted them. The three categories were: (1) those most affected by the war (e.g., they had relatives killed and were displaced from their homes), (2) those somewhat effected by the war (e.g., injured relatives) and (3) those least effected.[315]

To facilitate studying children, the team used simple experiments where the children just had to choose between two options. For example, one experimental game called the Costly Sharing Game gives participants the choice between (a) keeping two for themselves and giving zero to another person, or (b) keeping one for themselves and giving one to the other person (a 50/50 split). They also varied the identity of the other person, making them either an in-group member or an out-group member. For the children in Georgia, the in-group person was someone from their school class while the out-group player was from a distant Georgian school. In Sierra Leone, the in-grouper was another person from their village while the out-grouper was from a distant village in Sierra Leone.

The results reveal that the experience of war has its maximum impact on sociality during a developmental window that opens during middle childhood, at roughly age 7, and remains open into early adulthood. If war is experienced during this age range, it sharpens people's motivations to adhere to their egalitarian norms, but only for their in-groups. That is, those more exposed to war increased their egalitarian choices, choosing for example the even split in the Costly Sharing Game, but only for members of their in-group. Crucially, the effect endures at least a decade after the conflict. By contrast, the experience of war seemed to have no effect on the treatment of distant strangers, though of course it bears emphasis that these distant strangers were not members of the attacking group.

Outside of the developmental window (age 7 to 21), the results were different. Those beyond their early twenties did also show an increase in their in-group egalitarianism, but the increase was quite small. So, the window doesn't shut, it substantially narrows. Meanwhile, those younger than age 7 showed no effect from the war in these experiments.

These wars in Asia, Europe and Africa are not isolated cases or unusual conflicts. Research on the effects of war in Burundi, Uganda and Israel, studied using both behavioral games and survey data on things like voting and community engagement, tell the same story.[316] All this suggests that the experience of World War II in their developmental window may have forged America's Greatest Generation, permanently elevating their national commitment and public spirit.[317]

Overall, when disaster threatens and uncertainty reins, people cling more tightly to their community's social norms, including their rituals and supernatural beliefs, because it's these social norms that have long allowed human communities to adhere, cooperate and survive.

Over centuries and millennia, cultural evolution, often propelled by intergroup competition, created social environments replete with social norms, which influenced diverse domains ranging from marriage, ritual and kinship to exchange, community defense, and valued domains of prestige. Over tens and hundreds of thousands of years, the diverse social environments produced by this process became important selection pressures driving human genetic evolution, and shaping our sociality. The greater sociality generated by this process interacts with our cultural nature, on our ability to learn from others, to generate greater technological sophistication and larger bodies of adaptive know-how. This process gives rise to our Collective Brains.

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ENDNOTES

[1] This introduction draws on Chudek, Muthukrishna and Henrich (forthcoming).
[2] See (Vitousek et al. 1997, Smil 2002, 2011). Also, see http://www.newstatesman.com/node/147330. Thanks to Kim Hill for pointing me toward this information.
[3] By "success", I mean the ecological success of our species in diverse global environments, in terms of energy capture. Chapter 2 provides some numbers on this.
[4] There remains much debate on all the forces contributing to these extinctions, including the hypothesis that humans transmitted diseases to megafauna. In total, however, it seems likely that humans made substantial contributions to many of these extinctions, through both direct hunting and indirect effects such as fire (expansive

burning in Australia) and other ecological disturbances (competition with other top carnivores). See (Surovell 2008, Lorenzen et al. 2011).

[5] Of course, the magnitude and speed of the impacts created by industrialized societies on the earth is unparalleled in the history of our species, or any other (Smil 2011).

[6] The ants material is drawn from Hölldobler and Wilson (1990).

[7] See discussion in Boyd and Silk (2012). Because our global expansion occurred relatively recently in evolutionary terms, there hasn't been much time for genetic differentiation.

[8] See (Dugatkin 1999, Dunbar 1998).

[9] The notion that the key to our species' success is our 'intelligence' is ubiquitous (Bingham 1999). Most recently, however, this idea has emerged in the work of evolutionary psychologists, such as Barrett, Tooby and Cosmides (2007) and Pinker (2010). The "on the fly" quotation comes from Pinker. See Boyd et. al. (2011a) for further discussion.

[10] Pinker (1997, 184).

[11] This view is widespread but most recently can be in the works of E.O. Wilson (2012) and D.S. Wilson (2005).

[12] I'll generally use the word "intelligence" in its commonsense way, unless otherwise stated. "Intelligence" is a feature of individuals that allows them to figure out new and better solutions to difficult problems. The more intelligent a person is, the better she is able to devise solutions to problems or challenges on her own, including to previously unrecognized problems. We typically do not include the ability to copy from (or imitate) others as part of our "intelligence." For example, children taking intelligence tests, or almost any kind of test in school, are prohibited from using their preferred cultural learning strategies (see Chapter 4)—copy answers from the smartest kid in the room. Similarly, groups can have "group-intelligence", which aims to measure the group's ability to solve problems. This need not in any direct way reflect the intelligence of its individual members (Woolley et al. 2010). Group-intelligence also does not include copying solutions from other groups. Thus, trying to include cultural learning strategies as a type of "intelligence" violates common usage.

[13] These findings are drawn from Herrmann et. al. (2010, 2007). In drawing out this data, I've focused narrowly on the key results relevant to my point, and not for example presented the findings related to communication or mentalizing abilities. These would only further underline the overall argument in this book.

[14] Actually, in the Space subset there is a tiny increase in performance with age. Older animals perform slightly better (Ester Herrmann, personal communication).

[15] We should consider three concerns with this study (De Waal et al. 2008). First, the apes may have been at a disadvantage in learning socially because the demonstrators in these tasks were always humans, regardless of the participant's species. However, work by Dean et. al. (2012) shows that using same-species demonstrators does not close the human-chimpanzee gap in social learning. Second, the ape participants were not fully wild, but were wild-born orphans who were moved to ape sanctuaries where they were incorporated into mixed-age social groups. This means that (1) they have had extensive exposure to humans and (2) don't face food shortages or serious predation threats. Though this is a real concern, prior work suggests that, if anything, exposure to humans and greater security improves cognitive abilities, especially social learning (van Schaik and Burkart 2011, Henrich and Tennie forthcoming). Moreover, these sanctuaries provide social groups with access to primary tropical forest, where they spend much of their time. Third, perhaps the apes (who didn't bring their moms with them) were shyer or more uncertain, leading to less impressive results. Herrmann et. al. measured "inhibition" or "temperament", which aimed to capture this shyness. These results indicate that not only were humans more (not less) inhibited than the apes (who were eager), but measures of temperament and inhibition are not associated with performance on social learning. It's also not clear why such differences would only operate in the social learning tasks but not on all the other tests.

[16] See (Fry and Hale 1996, Kail 2007).

[17] See (Inoue and Matsuzawa 2007).

[18] See (Silberberg and Kearns 2009, Cook and Wilson 2010).

[19] The humans would no doubt counter by complaining that while the chimpanzees were rewarded with snacks for each correct sequence, the students received no snacks (and may thus have been lacking a key glucose boost). The humans would also argue that Ayumu is clearly a ringer, who figured out some secret way of winning that none of his fellow chimps have replicated. Humphrey provides an interesting discussion of potential issues with this research (Humphrey 2012).

[20] See (Byrne and Whiten 1992, Dunbar 1998, Humphrey 1976).

[21] See Martin, Bhui, Bossaerts, Matsuzawa and Camerer (2014). The average deviation from the Nash Equilibrium target was 0.02 for the chimps but 0.14 for the humans.
[22] See (Cook et al. 2012, Belot, Crawford, and Heyes 2013, Naber, Pashkam, and Nakayama 2013).
[23] On heuristics and biases from psychology and economics see (Gilovich, Griffin , and Kahneman 2002, Kahneman 2011, Kahneman, Slovic, and Tversky 1982, Camerer 1989, Gilovich, Vallone, and Tversky 1985, Camerer 1995). For asking the question of how we are so well-adapted given our apparent irrationality, see (Henrich 2002, Henrich, Albers, et al. 2001). For work in non-humans see (Real 1991, Kagel, McDonald, and Battalio 1990, Stanovich 2013, Herbranson and Schroeder 2010).
[24] My discussion of the Franklin expedition draws on material from various sources (Lambert 2009, Cookman 2000, Mowat 1960, Woodman 1991, Boyd, Richerson, and Henrich 2011a).
[25] The Franklin Expedition has been the subject of sustained and intense scholarly interest. Research has suggested that both lead and food poisoning, both associated with the use of the newly canned foods, may have contributed to the Expedition's problems. While the lead-hypothesis has stood up in tests of the human remains from the Expedition, the onset of lead poisoning can only be a relatively small contributor. The food-poisoning hypothesis was not been well-supported, though it's not implausible. Neither of these can-related concerns, nor the incidence of scurvy, would have been a problem if the expedition's men had adopted Inuit lifestyles. The crews of both Ross and Amundsen did well with Inuit-foods supplementing their diets.
[26] This image is from the collection at the UiO: Museum of Cultural History, at http://app.uio.no/khm/gjoa/#. UEM 16008. It has been cropped.
[27] Drawn from Boyd, Richerson and Henrich (2011a).
[28] Drawn from Boyd, Richerson and Henrich (2011a).
[29] It's worth noting that the west side of King William Island is known by the Netsilik to be less productive than elsewhere on the island or nearby regions (Balikci 1989). However, all three of our explorers, Franklin, Ross and Amundsen, ended up in roughly the same area, and Franklin's men located a cairn left by Ross. Moreover, Inuit testimony and archeological remains suggests that Franklin's men eventually broke up into multiple parties, and wandered around both sides of the island (Woodman 1991).
[30] The quotations and statements on clothes, sledges and snow houses come, respectively, from Amundsen (1908, 149, 156 and 142).
[31] This label was coined by Rob Boyd.
[32] This material is drawn from a variety of Burke and Wills resources, including (Phoenix 2003, Henrich and McElreath 2003, Wills, Wills, and Farmer 1863) and several valuable websites: burkeandwills.slv.vic.gov.au and www.burkeandwills.net.au.
[33] Drawn from direct transcriptions of Will's posthumously published journal, the first part of the quotation comes from the entry on June 20, 1861, and the second is from the final entry, which was dated June 26th but may be as late as June 28, 1861. See www.burkeandwills.net.au/Journals/Wills_Journals/Wills_Journal_of_a_trip.htm. Interestingly, the first entry does not appear in its complete form in the version of Will's journal published by his father in 1863. The second part does appear in full on page 302 (Wills, Wills, and Farmer 1863).
[34] Assembled from several sources (Earl and Mccleary 1994, Mccleary and Chick 1977, Earl 1996) and Phoenix's views at http://burkeandwills.slv.vic.gov.au/ask-an-expert/did-burke-and-wills-die-because-they-ate-nardoo.
[35] My account is almost entirely drawn from Goodwin's (2008) recent book, with supplement material on the Karankawa from other sources, including www.tshaonline.org/handbook/online/articles/bmk05
[36] Sadly, this heroine arrived at the mission in Santa Barbara only to find herself still isolated, as no one could speak her language. All of her fellow Nicoleños had died of disease or disappeared. She lasted only a few weeks herself, despite much care and attention. My account is drawn from several sources (Hardacre 1880, Hudson 1981, Morgan 1979, Kroeber 1925). This true story was the basis for the well-known novel by Scott O'Dell, *The Island of the Blue Dolphins*. The quoted phrases come from Hardacre's 1880 article in *Schribner's Monthly*.
[37] Boyd and Richerson (1985) built on the pioneering efforts of Marc Feldman and Luca Luigi Cavalli-Sforza (1981), who led the way in modeling cultural evolution as a separate process from genetic evolution. Other key contributors to this early work on this issue include Durham (1982), Sperber (1996), Campbell (1965), Lumsden and Wilson (1981) and Pulliam and Dunford (1980). Intellectual threads can be traced back to James Mark Baldwin (1896). For valuable and insightful overviews see (Hoppitt and Laland 2013, Brown et al. 2011, Rendell et al. 2011).

[38] Most of the items in this list are covered at some point in this book. For those that are not see: judgment heuristics (Rosenthal and Zimmerman 1978), standards of punishment (Salali, Juda, and Henrich forthcoming) and gods/germs (Harris et al. 2006).
[39] See (Bandura and Kupers 1964).
[40] See (Henrich and Broesch 2011).
[41] For these hunting examples, see (Henrich and Gil-White 2001).
[42] At the University of British Columbia, I was a faculty member in the Department of Economics and the Vancouver School of Economics for nearly a decade. I've also taught MBAs in NYU's Stern School of Business, and been a visiting professor at the Business School at the University of Michigan. Consequently, I'm familiar with both MBAs and economists.
[43] See (Kroll and Levy 1992).
[44] See (Henrich and Gil-White 2001, Rogers 1995b, Henrich and Broesch 2011, Henrich and Henrich 2007: Chapter 2).
[45] Evolutionary models predict that cultural learning should dominate when individual learning is difficult or costly, and when learners are uncertain (Hoppitt and Laland 2013, Laland, Atton, and Webster 2011, Laland 2004, Boyd and Richerson 1988, Nakahashi, Wakano, and Henrich 2012, Wakano and Aoki 2006, Wakano, Aoki, and Feldman 2004).
[46] Thanks to Michael Muthukrishna for pointing this out. See www.forbes.com/sites/moneybuilder/2013/11/14/investing-with-billionaires-the-ibillionaire-index/
[47] See (Pingle 1995, Pingle and Day 1996, Selten and Apesteguia 2005, Henrich and Henrich 2007, Fowler and Christakis 2010, Apesteguia, Huck, and Oechssler 2007, Offerman, Potters, and Sonnemans 2002, Offerman and Sonnemans 1998, Rogers 1995a, Conley and Udry 2010, Morgan et al. 2012).
[48] Work on cultural learning has a long history in psychology (Rosenbaum and Tucker 1962, Baron 1970, Kelman 1958, Mausner 1954, Mausner and Bloch 1957, Greenfield and Kuznicki 1975, Chalmers, Horne, and Rosenbaum 1963, Miller and Dollard 1941, Bandura 1977). See Henrich and Gil-White (2001) for discussion and review.
[49] See (Mesoudi and O Brien 2008, Atkisson, O'Brien, and Mesoudi 2012, Mesoudi 2011a).
[50] This experiment comes from Kim and Kwak (2011). One might worry that, in this particular experiment, the stranger was more active than mom, which might have biased the infants' referencing toward the stranger. However, related work with Swedish (Stenberg 2009) and American (Walden and Kim 2005) infants allays these concerns.
[51] This is from Zmyj et. al. (2010), but also see (Poulin-Dubois, Brooker, and Polonia 2011, Chow, Poulin-Dubois, and Lewis 2008).
[52] In one now paradigmatic experiment, Kathleen Corriveau and Paul Harris (2009b) exposed 3 and 4 year olds to two potential models (adults) who gave their opinions regarding the names (linguistic labels) of four common things, like ducks and spoons, with which the kids would already be familiar. One of the models accurately named all the items, while the other gave incorrect labels. Then, the young subjects saw the potential models name a novel object, unfamiliar to the children. Having heard both models give different object labels, the kids were asked to label the object. Who should they believe? It turns out that not only do kids track who is a competent labeler of things in providing their label for the object, but they remember this information for at least a week: when the same kids were re-tested a week later, without hearing the models label familiar objects again, the children still copied the labels used by the previously more accurate person. The reader should also see (Koenig and Harris 2005, Corriveau, Meints, and Harris 2009, Scofield and Behrend 2008, Harris and Corriveau 2011) for word learning and (Birch, Vauthier, and Bloom 2008) for artifact-function learning. Young children also prefer to learn from more confident models (Birch, Akmal, and Frampton 2010, Jaswal and Malone 2007, Sabbagh and Baldwin 2001).
[53] See Henrich and Gil-White (2001) for a review.
[54] This experiment is drawn from Chudek et. al. (2012) For adults, see (Atkisson, O'Brien, and Mesoudi 2012).
[55] A sampling of evidence for same-sex cultural learning biases comes from (Bussey and Bandura 1984, Bussey and Perry 1982, Perry and Bussey 1979, Basow and Howe 1980, Rosekrans 1967, Shutts, Banaji, and Spelke 2010, Wolf 1973, 1975, Bandura 1977, Bradbard et al. 1986, Bradbard and Endsley 1983, Martin and Little 1990, Martin, Eisenbud, and Rose 1995). For recent work in 6- to 9-month olds, see (Benenson, Tennyson, and Wrangham 2011).
[56] For research on language and dialect cues, see (Kinzler et al. 2009, Kinzler, Dupoux, and Spelke 2007, Shutts et al. 2009, Kinzler, Corriveau, and Harris 2011). Children (Gottfried & Katz, 1977) and adults (e.g., Hilmert, et al., 2006) seem particularly disposed to learn from those who share their existing beliefs. See Buttelmann et al. (2012) for evidence of selective imitation in infant, using ethnic cues (language).

[57] Drawn from (Hoffmann and Oreopoulos 2009, Fairlie, Hoffmann, and Oreopoulos 2011), but also see (Nixon and Robinson 1999, Bettinger and Long 2005, Dee 2005).
[58] For experimental work in children supporting the effects of age and age vs. competence tradeoffs see (Jaswal and Neely 2006, Brody and Stoneman 1981, 1985). Children can use age in sophisticated ways, sometimes using it as cue to competence, and other times deploying it as a self-similarity cue (VanderBorght and Jaswal 2009, Hilmert, Kulik, and Christenfeld 2006). For acquiring food preferences, see (Birch 1980, Duncker 1938). For infants, 14 to 18-month-olds more closely imitate the actions of models that are nearer to them in age (Ryalls, Gul, and Ryalls 2000).
[59] Research in small-scale societies examining how senior-status influences cultural transmission is only just beginning—see work in the Bolivian Amazon by Reyes-García and colleagues (2009, 2008) as well as my work with James Broesch in Fiji (Henrich and Broesch 2011). However, anthropological ethnography across diverse societies reveals a clear association between age and prestige, and prestige has potent effects on cultural learning. Chapter 8 explains how the rate of change in society influences the linkage between age and prestige, which explains why the elderly are not particularly prestigious in our own societies.
[60] Morgan et. al. (2012) and Muthukrishna et. al. (n.d.) provide the best current evidence of conformist transmission in humans, though also see (McElreath et al. 2008, Efferson et al. 2008, McElreath et al. 2005, Rendell et al. 2011, Morgan and Laland 2012). For conformist transmission in fish see (Pike and Laland 2010). For an entry into the theoretical modeling literature, see (Nakahashi, Wakano, and Henrich 2012, Perreault, Moya, and Boyd 2012). This modeling work suggests we should find conformist transmission in many species reliant on social learning.
[61] For cross-national data see: U.S. (Stack 1990), Germany (Jonas 1992) and Japan (Stack 1996). For evidence of prestige and self-similarity effects as well as copying methods see (Stack 1987, 1990, 1992, Wasserman, Stack, and Reeves 1994, Stack 1996, Kessler and Stipp 1984, Kessler, Downey, and Stipp 1988).
[62] For an overview see (Rubinstein 1983). For evidence from the U.S. of adolescent epidemics, see (Bearman 2004).
[63] See (Chudek et al. n.d., Birch and Bloom 2002, Barrett et al. 2013, Scott et al. 2010, Hamlin forthcoming, Tomasello, Strosberg, and Akhtar 1996, Harris and Corriveau 2011, Corriveau and Harris 2009a, Koenig and Harris 2005, Buttelmann, Carpenter, and Tomasello 2009, Hamlin, Hallinan, and Woodward 2008).
[64] See (Byrne and Whiten 1988, Humphrey 1976).
[65] Humphrey (1976) sketched both the Machiavellian Intelligence Hypothesis (Byrne and Whiten 1992) and the Cultural Intelligence Hypothesis (Herrmann et al. 2007, Whiten and van Schaik 2007).
[66] See (Schmelz, Call, and Tomasello 2013, 2011, Hare et al. 2000, Hare and Tomasello 2004).
[67] See (Heyes 2012a). Of course, showing that something can be influenced by experience doesn't tell you much at all about whether its development has been fostered or shaped by natural selection.
[68] See (Heyes 2012b).
[69] See (Whiten and van Schaik 2007, van Schaik and Burkart 2011).
[70] One of the debates in this literature involves opposing "innate" and "learned" in explaining our abilities and behaviors. As we'll see, lots of behavior is both 100% innate and 100% learned. For example, humans have clearly evolved to walk on two legs, and it's one of our species' behavioral signatures. Yet, we also clearly *learn* to walk. From natural selection's point of view, it only cares that the phenotype it 'wants' emerges when it needs it. To get there, it will use learning, attention biases, motivational changes, anatomical adjustments, inferential biases, and pain responses to make sure the required developmental processes run to completion, on schedule. Thus, showing that something is learned only tells us about the developmental process, but not about whether it was favored by natural selection acting on genes. Many people throughout history, for example, have had to figure out sexual intercourse on the fly, with no information from other people, so they clearly had to learn about it for themselves. Yet, to suggest that it has not been shaped by natural selection seems unlikely, despite the importance of learning in the process. To canalize learning about intercourse, natural selection made some things "feel right" and other things not so much. Consequently, most couples can eventually figure out what to put where and for how long, at least well enough for natural selection's purposes. Despite the importance of learning for both walking and sexual intercourse, there are no remote societies studied that only hop or crawl, or who don't make babies. For evidence of differences among human populations in cultural learning, see (Mesoudi et al. 2014).
[71] See (Tomasello 1999). Other important efforts to understand the role of cultural evolution and its influence on genetic evolution are Sterelny (2012a) and Pagel (2012).
[72] See (Roth and Dicke 2005, Lee and Wolpoff 2002, Striedter 2004).
[73] The data in Figure 5.1 are drawn from Miller et. al. (2012). I averaged the fractions for each of the brain regions in their Table S2. I've two concerns about these data. First, the samples are small. Second, it is not clear to what degree

these differences may be due to the relatively enriched environments that humans experience, compared to chimpanzees.

[74] See (Sterelny 2012a).

[75] See (Campbell 2011, Thompson and Nelson 2011, Kaplan et al. 2000, Bogin 2009, Nielsen 2012).

[76] Clancy et. al. (2001) compare the timing of 95 neurological events across nine species to show the developmentally-advanced state of human baby brains at birth. Hamlin (2013a) shows that 8-month olds use intentions in judging others.

[77] The material on food processing and cooking is drawn principally from (Wrangham 2009, Wrangham, Machanda, and McCarthy 2005, Wrangham and Conklin-Brittain 2003)

[78] For fire starting among the Tasmanians, Siriono', and Andaman Islanders see (Radcliffe-Brown 1964, Holmberg 1950, Gott 2002). Kim Hill told me about the Northern Ache.

[79] See (Aldeias et al. 2012, Sandgathe et al. 2011a). Of course, this claim about Neanderthals is controversial (Sandgathe et al. 2011b, Shimelmitz et al. 2014). From my point of view, however, much work in paleoarcheology is plagued by the assumption that once some tool or technology appears in the material record, then our lineage forever has it. As you will see in Chapter 12, this assumption is dubious, and arises from thinking about tools and technologies as the product of individual cognitive abilities rather than as products of cultural evolution.

[80] This schooling in fire-control was particularly discouraging since I was an Eagle Scout, and thought I knew something about campfires. Feeling like a dimwitted child turned out to be a recurrent experience in my anthropological fieldwork.

[81] For polar bear livers see (Rodahl and Moore 1943). The same may be true of marine mammals.

[82] Other species also have a taste for cooked food (Felix Warneken, personal communication), and this probably served as a kind of pre-adaptation that paved the way for cooking (Wrangham 2009). Like other animals, we generally prefer foods that are easier to digest.

[83] See Fessler (2006).

[84] For evidence on the effects of food processing with stone tools, see (Zink, Lieberman, and Lucas 2014).

[85] See (Noell and Himber 1979).

[86] See (Leonard et al. 2003, Leonard, Snodgrass, and Robertson 2007).

[87] Also, avoid any kind of jumping contests with members of the genus *Pan* (Scholz et al. 2006), which includes chimpanzees and bonobos.

[88] See (Striedter 2004) on brains and dexterity. On throwing see (Roach 2014, Roach and Lieberman 2013, 2012, Bingham 1999)

[89] See (Gelman 2003, Greif et al. 2006, Meltzoff, Waismeyer, and Gopnik 2012).

[90] Horses are tough to beat, though they can be beaten as shown in the 22 mile Man vs. Horse Race, which is held annually in Wales. See http://news.bbc.co.uk/2/hi/uk_news/wales/mid_/6737619.stm.

[91] The material on endurance running draws on (Bramble and Lieberman 2004, Lieberman et al. 2010, Carrier 1984, Heinrich 2002, Lieberman et al. 2009, Liebenberg 1990, Liebenberg 2006). For a breezy introduction, see (McDougall 2009).

[92] This does nothing for walking, but cuts the metabolic costs for running in half.

[93] From (Liebenberg 2006, Heinrich 2002, Falk 1990).

[94] See (Carrier 1984, Newman 1970).

[95] See (Liebenberg 1990, Gregor 1977). It is also likely that foragers can identify humans by their tracks. Numerous ethnographies, as well as my own experience in the South Pacific, attest to people's abilities to identify individuals by their tracks. When tracking expert and field ethnographer Louis Liebenberg asked !Xo foragers in the Kalahari desert if they could identify individual animals by their tracks, the group of hunters laughed at such a stupid question. They wondered how someone could *not* be able to distinguish individuals by their tracks. In the South Pacific, over many years of walking along the beaches of Yasawa Island I've also noticed that many villagers have an uncanny ability to predict who we will see when we round into the next cove based entirely on footprints. I've even formally tested villagers by asking them to identify a set of footprints that I had a villager make in secret (and not tell anyone). I ran 10 random adult villagers through my one question test and all 10 got the answer correct.

[96] See (Heinrich 2002, Carrier 1984).

[97] See (Liebenberg 1990, Liebenberg 2006). For a video clip of persistence hunting see http://www.youtube.com/watch?v=826HMLoiE_o

[98] From conversations and correspondence with Dan Lieberman (2013-14).

[99] See (Atran and Medin 2008, Atran, Medin, and Ross 2005, Lopez et al. 1997a, Lopez et al. 1997b, Atran 1998, Medin and Atran 1999, Atran 1993).
[100] See (Atran, Medin, and Ross 2004, Atran et al. 2001).
[101] See (Gelman 2003, Lopez et al. 1997a, Coley, Medin, and Atran 1997, Lopez et al. 1997b, Atran et al. 2001, Atran, Medin, Ross, Lynch, Vapnarsky, Ucan Ek', et al. 2002, Wolff, Medin, and Pankratz 1999, Medin and Atran 2004, Atran, Medin, and Ross 2005).
[102] See (Wertz and Wynn 2014a, b).
[103] The cognitive system for learning about animals also possesses other adaptive content biases, which focus learners on certain kinds of information and away from particular kinds of mistakes. Clark Barrett, James Broesch and I have explored this using a teaching and recall task with children and adults from Fiji, the Ecuadorian Amazon, and Los Angeles. We gave children and adults information about animals that they'd never encountered before, using pictures as visual aids. We then tested what they remembered both immediately after the teaching phase, and then a week later. Our results suggest that often children preferentially recalled the information about dangerousness over other kinds of information, such as that pertaining to the species' habitat or diet. Moreover, when our participants made mistakes of recall about an animals' dangerousness they tended to more frequently recall an animal as dangerous (when it was not) than mistakenly recall it as safe (when it is actually dangerous). Thus, our recall system is adaptively biased to avoid the more costly mistake of thinking a dangerous animal is safe than vice versa (Barrett and Broesch 2012, Broesch, Henrich, and Barrett 2014). Similarly, in the domain of food, Dan Fessler has argued we have an evolved readiness to acquire avoidances for animal foods (e.g., beef) due to the threats posed by pathogens over our evolutionary history. This may explain why taboos on animal foods are so common cross-culturally, and why vegetarians are relatively common, but few people taboo vegetables (Fessler 2003, Fessler 2002, Fessler et al. 2003).
[104] Thanks to Matt Ridley for pointing me to this case. See (Kayser et al. 2008).
[105] See (Jablonski and Chaplin 2010, 2000).
[106] (Eiberg et al. 2008, Sturm et al. 2008, Kayser et al. 2008). Also see http://essays.backintyme.biz/item/4. The genetic variant for blue or green eyes could have been favored by natural selection directly or by sexual selection indirectly. Via sexual selection under the conditions described, any preferences for mating with those with blue or green eyes would have made it more likely for those with such preferences to have children who were better able to synthesize vitamin D from the sun. Such preferences could evolve either culturally or genetically, or both.
[107] See (Carrigan et al. 2014).
[108] See (Tolstrup et al. 2008, Edenberg et al. 2006, Danenberg and Edenberg 2005, Edenberg et al. 2005, Edenberg 2000, Gizer et al. 2011, Meyers et al. 2013, Luczak, Glatt, and Wall 2006). For dating, see (Peng et al. 2010), though see (Li et al. 2011) for a more recent date.
[109] See (Borinskaya et al. 2009, Peng et al. 2010).
[110] See (Peng et al. 2010).
[111] See (McGovern et al. 2004).
[112] The milk of some marine mammals contains little or no lactose (Lomer, Parkes, and Sanderson 2008). Estimates of global lactose persistence range from 30% to 40% (Gerbault et al. 2013, Lomer, Parkes, and Sanderson 2008, Bloom and Sherman 2005). My 68% in the main text is from (Gerbault et al. 2013). For overview and context, see (O'Brien and Laland 2012). The presence of the symptoms of lactose intolerance seem to depend on particular microbiota in the colon. It also may be that Somali nomads possess a gut flora that allows them to drink milk to obtain the calcium and water without being lactose persistent (so, they can't get most of the calories).
[113] See (Ingram, Mulcare, et al. 2009, O'Brien and Laland 2012, Bloom and Sherman 2005, Gerbault et al. 2013, Leonardi et al. 2012, Gerbault et al. 2011, Gerbault et al. 2009). This more recent work builds on early and important work (Simoons 1970, Aoki 1986, Durham 1991).
[114] See (Gerbault et al. 2013, Leonardi et al. 2012, Gerbault et al. 2011, Itan et al. 2010, Ingram, Raga, et al. 2009, Ingram, Mulcare, et al. 2009). The extraction of DNA from Mesolithic European hunter-gatherers and early Neolithic farmers shows that these populations have lactase persistence genes at very low frequencies (Gerbault et al. 2013), making it clear that cultural evolution drove the spread of the lactase persistence gene. Prior to this evidence, it was possible to argue that the cultural practices (herding and milking) may have spread into populations in which the gene was already at high frequencies.
[115] The earliest medical findings date to a journal article in *The Lancet* in 1965 (Cuatreca.P, Lockwood, and Caldwell 1965), where a difference was noted between African- and European-descent Americans in milk processing.

Interestingly, behavioral differences in milk drinking between people of Asian, African and European descent have been noted by researchers since at least 1931. These differences were widely attributed to differences in education or income (Paige, Bayless, and Graham 1972, Paige et al. 1971). A failure to understand the origins of this behavioral variation permitted the U.S. government to promote milk drinking for all, for decades. For the "Got Milk" material see (Wiley 2004). The lesson here is not that income and education are unimportant (they are very important), but rather that what policy makers need is good behavioral science.

[116] See (Laland, Odling-Smee, and Myles 2010) and (Richerson, Boyd, and Henrich 2010, Fisher and Ridley 2013).

[117] See (Perry et al. 2007).

[118] See (Oota et al. 2001).

[119] See (Cavalli-Sforza and Feldman 2003, Brown and Armelagos 2001).

[120] For a textbook treatment of this see Boyd and Silk (2012).

[121] Recently, the journalist Nicholas Wade (2014) has sought to argue that continental races ("races") do indeed capture behaviorally important genetic variation in humans. Wade combines three lines of evidence: (1) analyses of global genetic variation, (2) specific cases of natural selection favoring locally or regionally adaptive traits, as discussed in this chapter, and (3) phenotypic differences in behavior, psychology or biology (IQ, Aggression, etc.). His first line of evidence uses recent analyses of global samples to establish a genetic reality for classical continental races. And, yes, there is continental level genetic variation, but as I'll explain that doesn't imply natural selection is operating to differentiate these continental populations. Then, Wade points to the local cases in which natural selection can be more or less isolated as the cause of particular genetic changes. At this point, he leads the reader to infer that if natural selection caused these local or regional genetic changes, then it's probably also responsible for the continental level genetic variation. Further, he argues, if natural selection explains the continental level variation, then perhaps it also explains the prevalent psychological, behavioral and biological variation observed across continents.

Both of Wade's inferential moves between these lines of evidence are fraught with problems. To understand the issues with the first inference, realize that the genetic variation among different continental populations traces to the spread of humans out of Africa, which occurred relatively recently. These migrations gave rise to evolutionary genetic drift and founder effects, as small samplings (groups) of much larger populations set off to become founding populations on new continents. These migrations created genetic variation, but not functional variation due to natural selection. The genetic variation most suitable for studies of such ancient migration is specifically neutral (not under selection). DNA frequently undergoes mutations that do not operationally change the organism, either because a particular sequence is non-functional or because DNA bases can flip without altering the coding of proteins. Thus, finding continental level genetic variation is precisely what one should expect after such ancient migrations, but this does not imply that any important functional variation exists. Moreover, since no continental-level selection pressures have been identified, there's no evidence that much of this variation is due to natural selection. Then, when Wade points to local or regional examples of natural selection acting on specific genes, he fails to realize that this actually works *against his idea* of continental races. As I explained in the main text, these local processes often make continental races less genetically similar while at the same time increasing the similarity between different continental populations. Thus, natural selection may often operate to reduce the variation between distant populations.

Finally, Wade's inference from behavior and psychology back to genes conflates genes with biology, and thereby reveals a lack of understanding of modern cultural evolutionary theory. He dismisses culture as an alternative explanation for continental-level behavioral, psychological and biological variation without seriously considering what we now know about human learning, development, motivation or cultural neuroscience. For example, he casually points to the fact that, after the American invasion in 2003, Iraqis did not immediately adopt American political institutions as an argument against culture as an explanation. Clearly, he argues, if it was culture, the Iraqis would have immediately adopted American institutions, so it must be their tribal genes. In the coming chapters, as I develop a proper theory of cultural evolution grounded in evolutionary biology, neuroscience, psychology and anthropology, you'll see how profoundly off-target such an argument is. Culture, social norms and institutions all shape our brains, biology, and hormones, as well as our perceptions, motivations and judgments. We can't pick our underlying cultural perceptions and motivations any more than we can suddenly speak a new language.

[122] See (Kinzler and Dautel 2012, Esteban, Mayoral, and Ray 2012a, Gil-White 2001, Moya, Boyd, and Henrich forthcoming, Astuti, Solomon, and Carey 2004, Dunham, Baron, and Banaji 2008, Baron and Banaji 2006).

[123] For a review of the health effects, see (Nhassico et al. 2008).

[124] See (Dufour 1994, Wilson and Dufour 2002, Jackson and Jackson 1990, Dufour 1988b, a). Varieties of manioc respond to drought by massively increasing their cyanogenic output. Bitter manioc supplies 70% of the Tukanoans' calories.
[125] See (Dufour 1984, Dufour 1985).
[126] This appears to have happened in the Democratic Republic of Congo (Tylleskar et al. 1992, Tylleskar et al. 1991).
[127] The emergence of specific negative health impacts is complex, and depends on other factors such as the presence of sulfur in the diet (Jackson and Jackson 1990, Tylleskar et al. 1992, Peterson, Legue, et al. 1995, Peterson, Rosling, et al. 1995, Tylleskar et al. 1993). Jackson and Jackson discuss a processing technique that actually increases cyanogenic content. See Padmaja (1995) for a review of processing techniques .
[128] I replaced all personal names from my ethnographic work with pseudonyms.
[129] See (Henrich and Henrich 2010). Also see (Henrich and Broesch 2011).
[130] See (Henrich 2002).
[131] We also elicited descriptions of any actual cases of fish poisoning that women might have heard. Almost everyone relayed the same few cases. This means that the repertoire of taboos cannot be composed of "case knowledge" with individual women assembling their taboos from stories—most of the tabooed species appear in zero of the reported cases.
[132] See (Katz, Hediger, and Valleroy 1974, Mcdonough et al. 1987).
[133] See (Bollet 1992, Roe 1973).
[134] This is from Bollet (1992). The quotations "'constitutionally resistant'" and "absurd" are on page 217. See (Jobling and Petersen 1916).
[135] See (Whiting 1963, Beck 1992, Mann 2012).
[136] For the Gambler's Fallacy and our problems with randomness, see (Kahneman 2011, Gilovich, Griffin , and Kahneman 2002).
[137] Beaver hips are used for hunting beavers and fish-jaws for locating fish.
[138] See (Moore 1957).
[139] Statistical data shows that rainfall patterns and floods are random, without distinguishable cycles or streaks.
[140] See (Dove 1993) and Henrich (2002). For similar case, see (Lawless 1975).
[141] For arrow making see (Lothrop 1928). For an extended discussion and more examples see (Henrich 2008).
[142] See (McGuigan 2012, McGuigan, Makinson, and Whiten 2011, McGuigan et al. 2007, Horner and Whiten 2005).
[143] See (Lyons, Young, and Keil 2007).
[144] This assumes the relative competence, age and skill of the model is appropriately adjusted. Adult won't over-imitate three year olds…much.
[145] See (Nielsen and Tomaselli 2010, McGuigan, Gladstone, and Cook 2012, McGuigan 2012, McGuigan, Makinson, and Whiten 2011, McGuigan 2013).
[146] See (Horner and Whiten 2005).
[147] For a detailed discussion of this see (Henrich and Tennie forthcoming).
[148] For important lines on work on all these angles, see (Herrmann et al. 2013, Over and Carpenter 2013, 2012, Kenward 2012).
[149] See (Billing and Sherman 1998, Sherman and Billing 1999, Sherman and Flaxman 2001, Sherman and Hash 2001).
[150] The evidence for this is only suggestive at this point (Billing and Sherman 1998, Sherman and Billing 1999, Sherman and Flaxman 2001, Sherman and Hash 2001).
[151] It's worth noting that cultural learning has overcome other aversions that are likely innate. For example, we probably have innate aversions to eating feces, but Inuit foragers will eat deer poop like berries (apparently, they are good in soup: Wrangham 2009), and Hadza hunter-gatherers enjoy picking the partially digested nuts from baboon poop (Marlowe 2010).
[152] See (Rozin, Gruss, and Berk 1979, Rozin and Schiller 1980, Rozin, Mark, and Schiller 1981, Rozin, Ebert, and Schull 1982, Rozin and Kennel 1983). There is some evidence of a weak desensitization to the pain-inducing effects of capsicum, after high levels of capsicum consumption (Rozin and Schiller 1980, Rozin, Mark, and Schiller 1981). However, this doesn't account for the clear enjoyment of the burning sensation, and preferences for chili peppers. Efforts to train rats to like capsicum have failed (Rozin, Gruss, and Berk 1979), though they can be trained to selectively eat capsicum-containing food if the unpleasant burning sensation is correlated with future desirable states (less pain). In Mexico, dogs and pigs, who can only survive by eating chili-laden food garbage, come to be indifferent to capsicum (which is a big step, since otherwise it's innately aversive). The only non-human evidence for

acquiring a taste for capsicum is from two juvenile, human-reared chimpanzees and three pet dogs. Rozin and Kennel (1983) argue that it's the experience of human environments during ontogeny that sets the stage for such taste-acquisitions. This will be important when we consider our species' likely evolutionary pathway.

153 See (Williams 1987, Basalla 1988).

154 See (Meltzoff, Waismeyer, and Gopnik 2012).

155 See (Buss et al. 1998, Pinker and Bloom 1990).

156 See (Boyd, Richerson, and Henrich 2013).

157 See (Boyd, Richerson, and Henrich 2011a).

158 See (Krakauer 1997: 78).

159 See (Radcliffe-Brown 1964: 45). In Northern Canada, the ethnographer Robert Paine summarizes work among Arctic hunter-gatherers by writing: "Acknowledged expertise attracts, though perhaps only temporarily, what we may term a following of dependent persons. These persons will be welcomed as a principal source of prestige—as a capital benefit of the hunter's expertise. Nor is this expertise necessarily reduced or dissipated through having to share it with other persons attached to him" (Paine 1971: 165).

160 Among egalitarian hunter-gatherers in the Kalahari desert in Africa, ethnographer Richard Lee (1979: 343) observes that particularly skilled orators, arguers, ritual specialists and hunters "may speak out more than others, may be deferred to by other discussants, and one gets the feeling that their opinions hold a bit more weight than the opinions of other discussants." In Amazonia, clear descriptions of prestige can also be found in Goldman (1979) and Krackle (1978).

161 This theory is developed in Henrich and Gil-White (2001).

162 For the learner, this prestige-information can then be integrated with their own direct observations of success and skill. Early on, their choice of models may be dominated by prestige information—the patterns of deference they observe. Later, as learners accumulate their own skill, know-how and abilities to assess excellence, their judgments of who to learn from will often shift from relying primarily on observations of others' deference patterns, to their own direct observations.

163 See (Henrich and Broesch 2011, Henrich and Gil-White 2001, Chudek et al. 2012).

164 See (James et al. 2013).

165 See (Boyd and Silk 2012, Fessler 1999, Henrich and Gil-White 2001, Eibl-Eibesfeldt 2007).

166 For the claim that dominance and prestige are genetically evolved forms of social status in humans, it's crucial that both link to higher reproductive success in small-scale societies. However, in the modern world the links between status and reproductive fitness are more complicated due to the demographic transition. Spreading from Europe beginning in the mid-19th century, women began substantially reducing their fertility (number of children). The most educated and richest women have reduced their numbers of children most dramatically. Thus, in the modern world achieving high status may actually be associated with having fewer children, not more children. This may be because having fewer children allows one to achieve greater prestige in a world with meritocratic institutions (Richerson and Boyd 2005).

167 See (von Rueden, Gurven, and Kaplan 2011, 2008). I do worry about how prestige was operationalized in this study, since dominance may contribute to "community influence". However, Chris tries to remove this effect by controlling for fighting ability when he looks at the relationships between community influence and his various fitness proxies.

168 Here, I use these terms in a specific theoretical sense as developed in this literature. Consequently, their usage may not completely correspond with the intuitions of every speaker of English.

169 Many evolutionary researchers now distinguish prestige and dominance, as different types of human status (Cheng et al. 2013, Chudek et al. 2012, Atkisson, O'Brien, and Mesoudi 2012, von Rueden, Gurven, and Kaplan 2011, Horner et al. 2010, Hill and Kintigh 2009, Reyes-Garcia et al. 2009, Snyder, Kirkpatrick, and Barrett 2008, Reyes-Garcia et al. 2008, Johnson, Burk, and Kirkpatrick 2007). Prestige hierarchies arise when deference is freely conferred by others, out of a positive desire to interact with the higher-ups, while dominance hierarchies emerge because others have been compelled to defer by force, or threat of it, to accept the status-quo, at least temporarily. Besides valuable cultural information, like hunting know-how, high status individuals might possess 'goods' that might be traded for deference benefits. For example, a beautiful woman might attract many male suitors—more than she can handle or wants. Other less attractive women might want to be around her in order to hang out where the men are (Pinker 1997). Or, the son or daughter of a former President or Prime Minister might receive deference, not because they are coercive or because of their knowledge or skill, but because of their valuable (inherited) social connections.

Merely being able to hang around them could result in making many important friends and contacts. From this perspective, the informational goods we discuss above might be merely one type of 'good' that can be acquired by paying deference, no different from accessing mates, allies or social contacts.

Understanding these kinds of situations, and the importance of non-informational goods, are certainly features of many diverse human societies, and strongly suggest that a person's prestige-status may be influenced by factors besides the possession of skills and knowledge related to success. However, the idea that the evolutionary pressure to acquire mates, allies or social contacts (and not information) drove the evolution of prestige does not account for many real-world aspects of prestige. First, by contrast with dominant individuals, prestigious individuals are truly persuasive, meaning that their subordinates actually shift their views closer to those of the prestigious individual. It's not clear why exchanging deference for mates or allies should result in actual opinion shifts, rather than merely causing shifts in superficially expressed agreement. Similarly, people preferentially imitate prestigious individuals, using a variety of cues to figure out from whom to copy. People copy everything from food preferences to charitable giving from prestigious people, even when there's no chance they will ever actually meet the prestigious person. Again, it's not clear why a deference-for-allies or deference-for-mate-access exchange should result in such biased imitation. Experimental evidence suggests, for example, that women will preferentially copy mate choice preferences from more attractive women. They learn both which men are attractive, and which elements (clothing styles, conversational choices) attract men (see Chapter 14). Second, the suite of emotions—awe and admiration—and the ethological patterns found in subordinates in a prestige-hierarchy are well-suited to situations in which learners need to seek out and hang around a model for the purposes of learning. They are less readily explained by non-informational exchanges. Finally, since only humans as far as we know have fully developed systems of prestige-status, alternative theories would have to explain why prestige has not strongly emerged in non-human primates, who have to seek mates, build alliances and rely on specific social partners. By contrast, approaching prestige from an "information-goods" viewpoint readily explains this, since only our evolutionary lineage has crossed the Rubicon of cumulative cultural evolution to enter a regime of culture-gene coevolution.

Of course, it's possible that there is a third kind of status that no one has yet isolated, effectively characterized and studied. It would be a kind of prestige, but without all the information-gathering components. Some scholars, for example, have suggested that wealth, income or education might be a kind of status. Famously, the sociologist Max Weber distinguished three types of status, two of which correspond roughly to dominance and prestige. His third type was based on wealth. However, wealth, like income and education, merely acts as a cue to either (1) skill, knowledge and success (prestige), or to (2) control over costs and benefits (dominance). Moreover, from any evolutionary perspective, wealth can only accumulate in the hands of one individual because of a set of social norms and institutions that enforce property rights. In a primate world without social norms, if we have zero bananas and you have 100 bananas, you are only going to be able to keep as many of those bananas as you can defend by force.

[170] The management of *proximity* by subordinates also highlights the contrast between dominance and prestige. In dominance situations, subordinates try to keep their distance from the dominant, since dominants are prone to erratic fits of anger that may have evolved to both remind subordinates and observers of who's boss and potentially to create chronic stress on subordinates as a means to lower their fitness, by damaging their health and cognitive abilities (Silk 2002). By contrast, subordinates in a prestige hierarchy seek proximity, looking to hang around and engage with prestigious individuals. This is why prestigious individuals have a "following."

[171] The measures of prestige and dominance, based on peer reports, were developed and validated in Cheng et. al. (2010). The *Lost on the Moon* findings are from (Cheng et al. 2013).

[172] For discussions of this, see (Gregory, Webster, and Huang 1993, Gregory, Dagan, and Webster 1997, Chartrand and Bargh 1999).

[173] Yes, all this applies to women too (Cheng et al. 2013, Cheng, Tracy, and Henrich 2010).

[174] See (Gregory and Webster 1996).

[175] I'm updating Neal Gabler's "Zsa Zsa Factor", since some readers probably haven't a clue who Zsa Zsa Gabor is. Other relevant terms include "famesque" and "celebutante." See Wikipedia under any of these entries.

[176] See Watts (2011).

[177] For infant research see (Thomsen et al. 2011). Similar work by Mascaro and Csibra (2012) indicates that infants readily infer that dominance relationships are stable across contexts, but do not assume transitivity.

[178] Since prestige evolved long after dominance in our lineage, it's not surprising that it has exapted some of the emotions and displays of dominance (Henrich and Gil-White 2001). Like many human facial and bodily expressions, these displays are part of complex feedback systems in which internal motivations and contextual cues lead individuals to display; but, at the same time, making the displays also causes psychological and physiological feedback. For example, when undergraduates are placed into either expansive or diminutive postures, they subsequently show behavior shifts consistent with high or low status, taking more risks and showing greater pain tolerance in experiments. Dominant and submissive postures may even create predictable hormonal shits in testosterone and cortisol (Bohns and Wiltermuth 2012, Carney, Cuddy, and Yap 2010), though these findings need further testing.
[179] Pride and shame displays are recognized across diverse societies (Tracy and Matsumoto 2008, Tracy and Robins 2008, Fessler 1999) and among young children (Tracy, Robins, and Lagattuta 2005), and they automatically and unconsciously communicate status information to others, or at least the displayers own beliefs about his or her status (Tracy et al. 2013).
[180] This linkage between these facets of pride and prestige and dominance was established by Cheng et. al. (2010). See (Johnson, Burk, and Kirkpatrick 2007) for hormonal evidence.
[181] See (Fessler 1999, Eibl-Eibesfeldt 2007).
[182] See (Brown 2012).
[183] The material on Astor comes from the *New York Times* (3/30/2002, by Alex Kuczynski); also see (Potters, Sefton, and Vesterlund 2005). Similarly, when asked why the university requests permission from donors to announce their contributions, the chairman of Johns Hopkins trustees explained, "fundamentally we are all followers. If I can get somebody to be a leader, others will follow. I can leverage that gift many times over" (Potters, Sefton, and Vesterlund 2001, Kumru and Vesterlund 2010).
[184] Of course, the generosity of high status people is a complex phenomenon, with numerous causes and contributions. In many small-scale societies, for example, successful individuals give generously because if they do not, they will be envied, and envy is often believed to cause negative consequences for its targets, like sickness, injury and death. I suspect that envy is most likely to occur when a person's success is perceived to be disproportionate to their worth, effort, or talent. Nevertheless, in some places, nearly all success is assumed to be disproportionate.
[185] See (Kumru and Vesterlund 2010). For related work see (Potters, Sefton, and Vesterlund 2007, 2005, Guth et al. 2007, Gillet, Cartwright, and Van Vugt 2009, Ball et al. 2001, Eckel and Wilson 2000, Eckel, Fatas, and Wilson 2010).
[186] From (Birdsell 1979).
[187] See (Henrich and Gil-White 2001). For quotation see (Simmons 1945: 79). I also recommend (Silverman and Maxwell 1978). Restricting certain forms of political leadership to older individuals may take advantage of their superior reasoning about social conflicts (Grossmann et al. 2010).
[188] This "information grandparent hypothesis" was developed in the context of culture-gene coevolutionary theory in the supplemental of Henrich and Henrich (2010), though it is closely related to theoretical and empirical lines of research developed by Hill, Kaplan, Gurven and their collaborators (Kaplan et al. 2000, Gurven et al. 2012, Gurven and Kaplan 2007, Kaplan et al. 2010). See Kaplan et. al. (2010) for data and discussion on the long post reproductive period in humans and Alberts et. al. (2013) for a comparison to non-human primates.
[189] See (Sear and Mace 2008).
[190] One of the tricky parts to studying this empirically is that the benefits created by cultural transmission to the children and grandchildren of the older person may be indirect. For example, in the Fijian communities I've studied, older people readily dispense their knowledge and wisdom to essentially anyone from the village (at least), which gives their relatives no particular informational advantage (though it does benefit their community). However, as a consequence, grandparents accrue prestige and obtain the associated deference that accompanies it. This may then convert back to benefits shared more narrowly by the grandparents' own families.
[191] For a review of culture in whales and dolphins see (Rendell and H. 2001), including a discussion of menopause (also see McAuliffe and Whitehead 2005). For the experimental work with killer whales, see (Abramson et al. 2013). For the demographic study see (Foster et al. 2012). For general information see (Baird 2000).
[192] See (Foley, Pettorelli, and Foley 2008).
[193] For field experiments on age and the recognition of male lions, fellow elephants and dangerous humans see (McComb et al. 2001, McComb et al. 2011, McComb et al. 2014, Mutinda, Poole, and Moss 2011). From this work, I think there's probably a case to be made that elephants have a type of prestige-status. Note, however, there is

debate about whether elephants have true menopause or just a rapid decline in fertility. This is interesting, but not really an issue for my point here since the road to the evolution of true menopause would begin with declining in fertility at older ages. It may be that elephant females are more similar to human males' in their fertility decline than to human females.

[194] Even in the Sanhedrin, the speaking order was reversed when discussing issues of purity, see (Schnall and Greenberg 2012, Hoenig 1953). Also, see Chapter IV of Tractate Sanhedrin at http://www.come-and-hear.com/sanhedrin/sanhedrin_32.html#chapter_iv.

[195] In Yasawa, unlike other places in Fiji, one's closest cross-cousins should be avoided for sex and marriage. Also, "Kula" is a pseudonym.

[196] See (Pinker 1997, Dawkins 1976, 2006). Other purely genetic evolutionary mechanisms such as those based on partner choice or "biological markets" (Baumard, Andre, and Sperber 2013) similarly cannot account for human cooperation (Chudek, Zhao, and Henrich 2013, Chudek and Henrich 2010), as they don't address the five challenges (see Chapter 10).

[197] For a more detailed explanation of these and other aspects of cooperation, see *Why Humans Cooperate* (Henrich and Henrich 2007).

[198] For an introduction, see chapters 4 and 5 of *Why Humans Cooperate* (Henrich and Henrich 2007).

[199] You may have read the opposite, that foraging bands are mostly close relatives. Though this is widely repeated, this claim has little or no real evidentiary support. The best available evidence on relatedness in foraging bands is presented later in this chapter.

[200] To enter this literature, begin with Chudek and Henrich's (2010) review.

[201] See (Edgerton 1992, Durham 1991).

[202] See Henrich et. al. (2012), especially the supplemental to that article.

[203] On pair-bonding see (Chapais 2008). For paternal care and paternity certainty, see (Buchan et al. 2003, Neff 2003).

[204] Nevertheless, primates do seem to have some mechanisms to figure out who their paternal relatives are, but these kin identification mechanisms are rather weak (Langergraber 2012).

[205] Male siamangs, a smaller, arboreal ape from South East Asia, help a bit more, by carrying their mate's infants. As expected, monogamously paired males do much more infant carrying than males who share a single female mate (Lappan 2008).

[206] See (Lee 1986, Draper and Haney 2005, Marshall 1976).

[207] This maternal bias has been observed in several modern societies (Gaulin, McBurney, and Brakeman-Wartell 1997, Pashos 2000, Euler and Weitzel 1996). Crucially, this effect vanishes in societies with explicit social norms and beliefs that reduce paternity uncertainty, and favor both males and the male side of descent (Pashos 2000).

[208] See (Garner 2005); this is part of a large literature on name effects, including studies showing that people like products with brand names similar to their own (C. Miguel Brendl et al. 2005). For the use of similarity in appearance to assess relatedness see DeBruine (2002)

[209] See (Hill and Hurtado 1996, Lee and Daly 1999).

[210] Na men and women do still form enduring relationships, but no norms regulate sexual exclusivity, permanence, inheritance, etc. See (Hua 2001).

[211] See (Beckerman and Valentine 2002a, Beckerman et al. 2002, Beckerman and Valentine 2002b, Crocker 2002, Hill and Hurtado 1996, Walker, Flinn, and Hill 2010).

[212] It's not clear why additional fathers beyond two reduces child survival from its peak at 2 fathers. My suspicion is that it may create a diffusion of responsibility. That is, if the primary father dies or is injured, and there is only one father left, the responsibility clearly falls to him. However, if two or more fathers remain, it's not clear who should do what, or who should step up. Among Westerners, psychologists have documented this diffusion of responsibility phenomenon and call it the "bystander effect" (Fischer et al. 2011).

[213] See (Lieberman, Fessler, and Smith 2011, Chapais 2008, Sepher 1983, Wolf 1995, Hill et al. 2011).

[214] See (Fessler and Navarrete 2004, Lieberman, Tooby, and Cosmides 2003).

[215] See (Henrich 2014, Henrich, Boyd, and Richerson 2012, Talhelm et al. 2014).

[216] See (Fiske 1992, Henrich and Henrich 2007).

[217] See (Richerson and Boyd 1998, Simon 1990, Richerson and Henrich 2012).

[218] Several background points are important here. First, hunter-gatherer societies are, in fact, extraordinarily diverse. Many ethnographically and historically known hunter-gatherers were sedentary and had complex divisions of labor, accumulated wealth, hereditary leaders and social classes including slaves. In contrast to the standard view, I suspect

that some of this complexity existed for at least periods during the Paleolithic, prior to the earliest signs of agriculture (Price and Brown 1988). While important for thinking about human evolution broadly, it is enough for me to show here that even mobile foraging populations rely on culture for cooperation. Second, I'm not using these populations as representatives of the Paleolithic or as "primitive." That would be stupid. The few remaining hunter-gatherer societies are not relics from the Paleolithic, and they have been heavily shaped by their own histories, innovations, and interactions with other groups. In the next chapter, you'll see that I take advantage of this very fact, and use it to illustrate some key points. However, at the same time, studies of diverse small-scale societies, including foraging populations, provide a valuable tool to understand what human social life can be like—in all its diversity— in subsistence societies governed by kinship systems, away from modern states, taxes, police, hospitals and industrial technology. When combined with evidence from paleo-anthropology (the stones and bones of ancient populations), primatology and genetics, the full spectrum of insights from diverse small-scale societies immensely enriches our understanding of life in the distant past (Flannery and Marcus 2012), as well as what it means to be human.

[219] See (Hill et al. 2011).

[220] See (Lee 1986), who also notes the Ju/'hoansi do have a term for "friend" or "equal", which is only used when two non-relatives cannot be distinguished by age (which prevents the older-younger terminology from being applied).

[221] For a summary of paleoanthropology see (Boyd and Silk 2012). For the importance of hunting for prestige, see (Henrich and Gil-White 2001).

[222] Some have argued that hunters have to share because they cannot store the meat. However, among the Hadza, we know this is untrue, since hunters who own the meat know how to dry and store it. It's social norms about distribution, and a sense of entitlement from other Hadza, that prevents storage, not a lack of know-how (Woodburn 1982).

[223] There is a large literature on food sharing in foragers (Gurven 2004a, b, Marlowe 2004). Early efforts to explain sharing from an evolutionary perspective focused on genealogical relatedness and reciprocity. While these are clearly play a role for many kinds of foods, the band-wide distribution of large game could not be readily explained. The patterns of meat sharing behavior call for an evolutionary approach that includes social norms (Hill and Hurtado 2009, Hill 2002).

[224] See (Lee 1979, Wiessner 2002).

[225] See (Wiessner 1982, 2002).

[226] See (Schapera 1930). It would be difficult to secretly violate the taboos, since all large game must be brought back to camp and tasted by the headman before portions are allocated. Portions are then cooked and consumed publically, but the different categories of consumers cook at separate hearths.

[227] See meat taboos among the Ache (Kim Hill, personal communication), Mbuti (Ichikawa 1987), Hadza (Woodburn 1982, Marlowe 2010, Woodburn 1998) and on the island of Lembata (Barnes 1996, Alvard 2003) in Indonesia.

[228] See (Fessler et al. 2003, Fessler and Navarrete 2003).

[229] Hadza attribute illness to eating the ritually tabooed *Epeme* meat (God's meat: (Woodburn 1998)). Another reason is that anyone who does figure out that taboo violations don't cause bad things will be forced to eat tabooed portions in secret, to avoid reputational damage, so learners won't be able to copy him. This will inhibit the spread of taboo violations.

[230] See (Marshall 1976, Wiessner 2002, Altman and Peterson 1988, Endicott 1988, Heinz 1994, Myers 1988, Woodburn 1982).

[231] One telling feature of cooperation and sharing among mobile hunter-gatherers involves what happens when a group encounters a novel situation for which they lack sharing norms. The evolutionary researcher Nicholas Blurton Jones tells a story of when he wanted to reward a group of Hadza men for assisting him. Blurton Jones first attempted to pay the group in a lump sum of tobacco, which he assumed they'd readily share, just as they routinely did with meat and honey. The men, however, absolutely did not want to take the payment in a lump sum, and asked Blurton Jones to please create individual shares. They feared that if they themselves had to divide it up, fights would break out and relationships might be damaged (Blurton Jones, personal communication).

[232] See (Wade 2009: Chapter 5, Marshall 1976: 63-90, Biesele 1978).

[233] Biesele (1978: 169).

[234] I'm drawing together recent work on ritual (Whitehouse 2004, Fischer et al. 2014, Xygalatas et al. 2013, Konvalinka et al. 2011, Atran and Henrich 2010, Soler 2010, Alcorta, Sosis, and Finkel 2008, Sosis, Kress, and Boster 2007, Alcorta and Sosis 2005, McNeill 1995, Ehrenreich 2007, Whitehouse and Lanman 2014). For Ibn's work see

(Khaldûn 2005). Of course, the linking of ritual and sociality was most famously made by social theorists such as Durkheim (1915/1965) and Frazer (Frazer 1996).

[235] See (Wiltermuth and Heath 2009). For other relevant work on synchrony see (Hove and Risen 2009, Valdesolo and DeSteno 2011, Valdesolo, Ouyang, and DeSteno 2010, Paladino et al. 2010).

[236] For work with children see (Kirschner and Tomasello 2010, 2009).

[237] See (Spencer and Gillen 1968).

[238] See (Birdsell 1979, Elkin 1964).

[239] See (Spencer and Gillen 1968: 271).

[240] See (Whitehouse et al. 2014, Whitehouse 1996, Whitehouse and Lanman 2014)

[241] See (Chapais 2008, Apicella et al. 2012, Wiessner 1982, 2002).

[242] See (Hill et al. forthcoming).

[243] On the Epeme ritual, see (Woodburn 1998).

[244] See (Wiessner 1982, 2002).

[245] See (Mitani, Watts, and Amsler 2010).

[246] For early work on this idea, see (Darwin 1981, Boyd and Richerson 1990, Boyd and Richerson 1985, Hayek and Bartley 1988).

[247] For an overview of this way of thinking see (Henrich 2004a).

[248] See (Choi and Bowles 2007, Bowles 2006, Boyd, Richerson, and Henrich 2011b, Boyd et al. 2003, Wrangham and Glowacki 2012).

[249] See (Smaldino, Schank, and McElreath 2013). To show that rates of intergroup violence were low, and thus argue that intergroup competition was unimportant, fails to recognize that *only* one type of intergroup competition involves physical violence.

[250] See (Boyd and Richerson 2009) for a theoretical model. See Knauft (1985) and Tuzin (2001, 1976) for the effects of differential migration into more successful groups in small-scale societies.

[251] See Richerson and Boyd (2005), and for a review of the work on religion and fertility see (Blume 2009, Norenzayan 2013, Slingerland, Henrich, and Norenzayan forthcoming).

[252] See (Boyd and Richerson 2002, Henrich 2004a).

[253] See (Wrangham and Glowacki 2012, Wilson et al. 2012, Wilson and Wrangham 2003). For a review on the use of chimpanzees as a model for the common ancestor for chimps and humans see (Muller, Wrangham, and Pilbeam forthcoming). Notably, on current knowledge, our other closest primate relative, the bonobo, does not engage in inter-group violence, so the inference that our common ancestor with chimpanzees and bonobos had intergroup conflicts is far from automatic. However, bonobos are clearly an unusual ape in several ways, so there's a good case to support the use of chimpanzees as providing relatively more insights about our last common ancestor than bonobos (Muller, Wrangham, and Pilbeam forthcoming).

[254] For theoretically-driven comparison of culture in chimpanzees and humans see (Henrich and Tennie forthcoming).

[255] See (Pinker 2011, Morris 2014).

[256] I'm drawing mostly on Bowles' (2006) supplemental, as well as (Keeley 1997, Lambert 1997, Ember 2013, 1978, Ember and Ember 1992). It's not relevant to my concerns here whether some groups also experienced enduring peace, especially since violent conflicts represent only one form of intergroup competition.

[257] By "war" and "warfare", I'm including all sort of violent inter-group interactions, including raiding and ambushes.

[258] See (Ember, Adem, and Skoggard 2013, Ember and Ember 1992, Lambert 1997).

[259] See (Boyd 2001).

[260] See (Wiessner and Tumu 1998: 195-196).

[261] See (Tuzin 2001, 1976). Tuzin argues that Ilahita also acquired their elaborate garden technology for growing yams from the Abelam. He also points out that the transmission was one way, from more successful to less successful. The rich mythology and elaborate hunting magic of the Ilahita Arapesh did not transmit to the Abelam, or anyone else (Tuzin 1976: 79).

[262] See (Sosis, Kress, and Boster 2007).

[263] The ethnographic cases of the effect of intergroup competition on cultural evolution are plentiful (Currie and Mace 2009). For example, Atran et. al. (2002, 2002) have shown how conservation-oriented ecological beliefs spread from locally prestigious Itza Maya to Ladinos in Guatemala, and how highland Q'eqchi' Maya, with tightly bound cooperative institutions and commercially-oriented economic production, are spreading at the expense of both Itza and Ladinos. In New Guinea, using quantitative data gleaned from ethnographies, Soltis et al. (1995) has shown that

even the slowest forms of cultural group selection (conquest) can occur in 500 to 1000 year time scales. In Africa, using ethnohistorical data, Kelly (1985) has demonstrated how differences in culturally acquired beliefs about brideprice fueled the Nuer expansion over the Dinka, and how different social institutions, underpinned by cultural beliefs about segmentary lineages, provided the decisive competitive advantage (Richerson and Boyd 2005). Sahlins (1961) has argued that cultural beliefs in segmentary lineages facilitated both the Nuer and Tiv expansions. Using archeological data, anthropologists are increasingly arguing for the importance of intergroup competition on cultural evolution and political complexity during prehistory (Flannery and Marcus 2000, Spencer and Redmond 2001).

[264] See (Evans and McConvell 1998, Bowern and Atkinson 2012, McConvell 1985, Evans 2012, 2005, McConvell 1996).

[265] See (Evans and McConvell 1998).

[266] See (Elkin 1964: 32-35, McConvell 1985, 1996).

[267] See (McConvell 1996).

[268] See (Maxwell 1984, Hayes, Coltrain, and O'Rourke 2001, McGhee 1984).

[269] See (Spencer 1984, McGhee 1984, Johnson and Earle 2000, Anderson 1984, Briggs 1970).

[270] See (Burch 2007).

[271] See (Maxwell 1984, McGhee 1984, Anderson 1984, Sturtevant 1978).

[272] Cultural transmission did go both ways, with the Inuit acquiring a harpoon design, and perhaps their use of soapstone for lamps and building of snow-houses from the Dorset (Maxwell 1984: 368).

[273] See (Bettinger and Baumhoff 1982, Young and Bettinger 1992, Bettinger 1994). For evidence from oral traditions, see (Sutton 1993, 1986). It's worth noting that some evidence indicates that Numic speaking peoples are part the expansion of the Uto-Aztecan expansion, which moved North out of Mexico. This expansion began with farmers, so our Numic foragers are probably the cultural, if not genetic, descendants of farmers (Jane Hill's piece at lingweb.eva.mpg.de/HunterGathererWorkshop2006/Hill.pdf).

[274] See (Hämäläinen 2008). We know something of Comanche life because the Comanche would kidnap the children of white settlers, and eventually adopt them into the tribe. Once liberated, sometimes against their will after many years, these former captives told their stories (Zesch 2004).

[275] For shifting Paleolithic environments see (Richerson, Boyd, and Bettinger 2001).

[276] Triangulating from other species and small-scale societies, the best inference is that these cases arose from violent intergroup interactions This is opposed to killing and eating one's own community members or peacefully consuming dead relatives at mortuary feasts (Stringer 2012). For "backed blades" see (Ambrose 2001). For bows and arrows as part of the out of Africa expansion, see (Shea 2006, Shea and Sisk 2010). For overall context, see (Klein 2009, Boyd and Silk 2012).

[277] For the rise of complex societies, see (Ensminger and Henrich 2014: Chapter 2, Turchin 2010) For Diamond see (Diamond 1997, Diamond and Bellwood 2003). Following Diamond, Ian Morris (2014) further substantiates the historical case for the importance of war in driving the cultural evolution of complex societies. Unfortunately, Ian focuses too narrowly on war, and fails to realize that war is merely one type of intergroup competition. He also oddly opposes his explanation to "cultural explanations", not realizing that war is in fact influencing cultural evolution (the explanations are not at odds).

[278] While most evolutionary researchers agree that intergroup competition, especially in the form of violent conflict, was likely part of life in ancient hunter-gatherer societies, there are two main alternative views regarding how this competition influenced our genetic evolution. The canonical view, staunchly defended by psychologist Steve Pinker, is that intergroup competition plays no role in shaping either genetic or cultural evolution. An alternative view, recently re-energized is that intergroup competition shaped not cultural evolution—as I argue—but genetic evolution. Under this view, warfare and differential extinction drove genetic evolution and shaped human nature directly (Haidt 2012, Wilson 2012, Wilson and Wilson 2007, Bowles 2006). The first view is contradicted by evidence showing that intergroup competition leads to the differential spread of certain cultural traits, including both social norms and technologies. Intergroup competition also helps account for the intricate and subtle institutions we commonly observe across diverse societies that expand and sustain cooperation. Adherents to the canonical view are stuck arguing that, "yes", intergroup competition was common, but "no", it somehow never influenced which social norms or practices survived, were copied, and spread. You've now only seen the tip of an iceberg of the evidence showing the importance of intergroup competition for cultural evolution (Richerson et al. forthcoming). For Pinker's view on group selection, see http://edge.org/conversation/the-false-allure-of-group-selection. However, be sure to read my commentary on Pinker's piece at the same site.

The other view, that intergroup competition has directly shaped human genetic evolution, need not conflict with what I'm focused on here. However, there are a couple of reasons to suspect that the direct role of intergroup competition on genetic evolution is, at least, secondary to the processes I'm describing, and possibly trivial. Here's the key: for intergroup competition to have any effect on evolutionary processes, be they cultural or genetic, groups have to remain relatively distinct along whatever dimensions are providing some groups with competitive advantages over others. For social norms, this is easy to see. If I move into your group from another group, my kids and I have to adopt your kinship and marriage norms. If we don't, my kids either won't have any relationships (which govern helping, food sharing, sex and trade, etc.) or they will be doing all the wrong things (norm violations). They might, for example, repeatedly make Kula's mistake and violate an incest taboo by sitting near the wrong girl or boy, which will get them sanctioned in some way. However, for genes, if people from different groups have sex, the relevant genetic differences between the groups will quickly go away. Either the initially advantaged groups will get the 'bad genes' from the disadvantaged groups, or the disadvantaged groups will get the 'good genes'. This genetic mixing means the groups will become increasingly indistinct. The point: cultural evolution can sustain differences between groups in a manner that genetic evolution cannot. Acerbating this genetic mixing is the fact that human-style intergroup competition often increases the flow of genes between groups. Victorious groups in warfare frequently take the younger women and girls from the defeated groups as "wives"—in fact, access to "wives" is often the explicit reason why men from one group attack another. This creates a big inflow of genes from the losers to the winners. Or, in the absence of violence, it's still the case that men from more successful groups look for, and often find, their future wives (or short-term mates) in less successful groups. This again causes genes to flow rapidly into the more successful groups—which will wipe out the genetic differences between the groups. The couple's children might adopt all of their father's social norms, by living in his community, but no matter what, they retain half of their mom's genes. This, and other forms of differential migration, deplete genetic differences among groups while not reducing cultural differences. Data on genes and culture from the modern world confirm these stark differences, with many genetically indistinguishable groups remaining culturally quite different, see (Bell, Richerson, and McElreath 2009) for analyses of genetic vs. cultural variation. More generally, see (Henrich 2004a, Henrich and Henrich 2007, Boyd, Richerson, and Henrich 2011b).

Beyond this, our species' capacity for large-scale cooperation is tightly hinged to the presence of culturally evolved reputational and sanctioning systems, and on internalized social norms. Thus, the psychological evidence regarding human sociality and morality is most consistent with innate mechanisms adapted to a culturally-constructed world (see Chapter 11). It's difficult to square this empirical evidence with either of the alternative views described above.

[279] See (Schmidt, Rakoczy, and Tomasello 2012, Schmidt and Tomasello 2012, Rakoczy et al. 2009, Rakoczy, Wameken, and Tomasello 2008).

[280] These insights are gleaned from across many ethnographies, see for example (Boehm 1993, Bowles et al. 2012, Mathew and Boyd 2011, Wiessner 2005).

[281] The parallels between humans and domesticated animals has long been recognized and discussed (Leach 2003). I don't mean to imply that humans intentionally domesticated dogs, any more than human communities intentionally domesticated their members.

[282] Those who exploit a norm-violator are able to remain anonymous because the rest of the community is unmotivated to figure out who committed the crime. When some with a good reputation is harmed, the community energetically engages and the sharing of gossip, which often reveals the culprit (Henrich and Henrich 2014). For a formal model is this evolutionary mechanism, see (Chudek and Henrich n.d.-a).

[283] See (Engelmann et al. 2013, Engelmann, Herrmann, and Tomasello 2012, Cummins 1996b, a, Nunez and Harris 1998) on reputation and the norm-violation detection in children.

[284] On norm psychology see (Chudek, Zhao, and Henrich 2013, Chudek and Henrich 2010). For more discuss on why human evolved to internalize preferences, see (Ensminger and Henrich 2014).

[285] See (Bryan 1971, Bryan, Redfield, and Mader 1971, Bryan and Test 1967, Bryan and Walbek 1970b, Bryan and Walbek 1970a, Grusec 1971, Harris 1971, 1970, Elliot and Vasta 1970, Rice and Grusec 1975, Presbie and Coiteux 1971, Rushton and Campbell 1977, Rushton 1975, Midlarsky and Bryan 1972).

[286] For the enduring effects of modeling, see (Mischel and Liebert 1966).

[287] Of course, none of this is limited to children. In natural settings, providing models to demonstrate social norms has been shown to increase (1) volunteering in experiments, (2) helping stranded motorists, (3) donating to a

Salvation Army kettle, and (4) giving blood. Modeling treatments often increase helping rates by 100% (Bryan and Test 1967, Rosenbaum and Blake 1955, Schachter and Hall 1952, Rushton and Campbell 1977).
[288] For cross-cultural experiments see (Ensminger and Henrich 2014, Henrich, Boyd, Bowles, Camerer, Fehr, and Gintis 2004, Gowdy, Iorgulescu, and Onyeiwu 2003, Paciotti and Hadley 2003). For primate work, see (Silk and House 2011, Silk et al. 2005, Cronin et al. 2009, Jensen, Call, and Tomasello 2013, 2007a, b, Jensen et al. 2006, de Waal, Leimgruber, and Greenberg 2008, Burkart et al. 2007). Of course, some have tried to argue that non-human primates behave like humans in these experiments (Burkart et al. 2007, Proctor et al. 2013, Brosnan and de Waal 2003). Despite their broad coverage in the popular media, these claims fail for a number of methodological reasons, mostly notably that they don't randomly pair strangers or don't pair strangers at all (Henrich and Silk 2013, Henrich 2004c, Jensen, Call, and Tomasello 2013).
[289] Educated westerners over about age 25 typically give half in the Dictator Game. However, many experiments run with students reveal lower offers in the Dictator Game, a fact that has caused great confusion among researchers. This is because Dictator Game offers keep increasing with age, towards one half, until roughly the mid-twenties (Henrich and Henrich 2007, Henrich, Heine, and Norenzayan 2010b). This suggests that it takes a long-time to fully internalize such a motivation for equality towards strangers. Other anomalies emerge from focusing on students, such as the much discussed effect of double-blind conditions on Dictator Game offers (Cherry, Frykblom, and Shogren 2002, Lesorogol and Ensminger 2013). For more on why experimental games measure social norms see (Chudek, Zhao, and Henrich 2013, Chudek and Henrich 2010, Henrich, Boyd, Bowles, Camerer, Fehr, Gintis, et al. 2004, Henrich and Henrich 2014).
[290] See (Henrich 2000, Henrich, Boyd, et al. 2001, Henrich, Boyd, Bowles, Camerer, Fehr, and Gintis 2004, Henrich et al. 2005, Silk et al. 2005, Henrich et al. 2006, Vonk et al. 2008, Brosnan et al. 2009, Henrich et al. 2010, House, Silk, et al. 2013, House, Henrich, et al. 2013, Ensminger and Henrich 2014).
[291] See (Henrich and Smith 2004, Ledyard 1995).
[292] For Rand et. al.'s stuff see (Rand, Greene, and Nowak 2013, 2012, Rand et al. 2014).
[293] Ultimatum Game proposers also make more equal offers when under time pressure (Crockett et al. 2010, Crockett et al. 2008, Cappelletti, Guth, and Ploner 2011, van't Wout et al. 2006).
[294] See (Kimbrough and Vostroknutov 2013).
[295] See (de Quervain et al. 2004, Fehr and Camerer 2007, Rilling et al. 2004, Sanfey et al. 2003, Tabibnia, Satpute, and Lieberman 2008, Harbaugh, Mayr, and Burghart 2007). This is true of simple norm-complying choices (Zaki and Mitchell forthcoming). More complicated situations that tradeoff "goods" (like fairness vs. getting money) activate both these quick intuitive value areas and those associated with reflective control and strategic thinking. It's also the case that giving to charity seems to activate both norm-complying reward areas (the mesolimbic system) as well as the affiliative centers associated with social attachment, quintessentially associated with empathic concerns (Zahn et al. 2009, Moll et al. 2006).
[296] See (Baumgartner et al. 2009, Greene et al. 2004).
[297] See (Cummins 1996b) for this specific example. More broadly, on this point see (Cummins 1996a, Harris and Nunez 1996, Harris, Nunez, and Brett 2001, Nunez and Harris 1998, Cummins 2013). For similar experimental work in adults, see (Cosmides, Barrett, and Tooby 2010, Cosmides and Tooby 1989). Cosmides and her collaborators pioneered this interesting line of work, though they see it as due to a psychology for reciprocal altruism. The problem with this is that it doesn't explain why it seems to work with any costly norm or why the rules can be culturally-transmitted (Henrich and Henrich 2007).
[298] See (Fessler 2004, 1999). For research showing the universality of shame displays see (Tracy and Matsumoto 2008) and for work examining the automatic and unconscious signals communicated by shame and pride in diverse societies see (Tracy et al. 2013).
[299] See (Hamlin et al. 2013, Hamlin forthcoming, 2013b, Hamlin et al. 2011, Hamlin and Wynn 2011, Hamlin, Wynn, and Bloom 2007, Sloane, Baillargeon, and Premack 2012). For work on fairness in infants and toddlers see (Sloane, Baillargeon, and Premack 2012). I've noted the ages in months that these papers find, but there's no reason to suspect these maturational patterns are the same across diverse societies. For the operation of these reputational logics in small-scale societies see (Henrich and Henrich 2014) and (Mathew n.d.). For models predicting these patterns see (Panchanathan and Boyd 2004, Henrich and Boyd 2001, Chudek and Henrich n.d.-b, Boyd and Richerson 1992, Axelrod 1986).
[300] Anthropologists have long argued that talking of "tribes" suggests that everyone belongs to a single discrete, bounded and hermetically sealed group, which never changes and endures through all time. Since this book is all

about the dynamics of cultural evolution, I hope my usage here won't be misinterpreted as to suggest any of this old baggage.
[301] See (Diamond 1997).
[302] See (McElreath, Boyd, and Richerson 2003, Boyd and Richerson 1987, Henrich and Henrich 2007).
[303] See (Shutts, Kinzler, and DeJesus 2013, Kinzler, Dupoux, and Spelke 2007, Kinzler, Shutts, and Spelke 2012, Kinzler et al. 2009).
[304] Consistent with the hard-to-fake features of ethnic markers, simply speaking the language in some way is not enough. You need to speak it 'properly', without an accent (from the learners' point of view). The data here also make it clear that it's not the children's comprehension that is driving these preferences. Also, as we saw in Chapter 8, people of all ages are keenly attuned to prestige differences, and prefer to interact and learn from more prestigious individuals. Thus, when an individual's language or dialect cues prestige for the observer, this too can influence decisions to interact and learn (Kinzler, Shutts, and Spelke 2012).
[305] See our book on this research (Henrich and Henrich 2007). Clearly, Chaldeans resemble many other successful immigrant populations, such as Jews, Koreans and Armenians. Some Chaldeans explicitly pointed to Jews as worthy of emulation on these counts.
[306] See (Gerszten and Gerszten 1995, Tubbs, Salter, and Oakes 2006).
[307] The image is of a painting by Paul Kane taken from Wikipedia:
http://en.wikipedia.org/wiki/Cranial_deformation.
[308] See (Kanovsky 2007, Gil-White 2001, Hirschfeld 1996, Moya, Boyd, and Henrich forthcoming) and (Baron et al. 2014, Dunham, Baron, and Banaji 2008).
[309] Of course, it's possible to get children and adults to react to the norm-violations of out-group people as well, simply by turning up the volume on how bad the violation is. The point is that there is an asymmetric response, which goes to the detriment of fellow in-group members (Schmidt, Rakoczy, and Tomasello 2012). For cross-cultural work with adults, see (Bernhard, Fischbacher, and Fehr 2006, Gil-White 2004).
[310] See (Esteban, Mayoral, and Ray 2012b, a). Dominated by Americans, psychologists have been missing the key fault lines in human psychology by focusing either on laboratory-friendly arbitrary groups (people who all like a certain painting) or on the peculiar Black-White differences in the U.S.
[311] See (Kinzler et al. 2009, Pietraszewski and Schwartz 2014a, b). Where there's antagonism among social categories marked by features like skin color, people may also use such features to mark alliances (Pietraszewski, Cosmides, and Tooby 2014).
[312] For the idea, see (Mathew, Boyd, and van Veelen 2013, Henrich and Henrich 2007). For the Gebusi example see (Knauft 1985).
[313] See (Gilligan, Benjamin, and Samii 2011).
[314] This process doesn't require genetic group selection. Intergroup competition will favor cultural practices that sanction people for norm violations, including those who fail to sanction norm violators (if necessary), even more harshly when groups are under threat. Intra-group sanctioning mechanisms, like a loss of mating opportunities, can be sufficient to favor the relevant genes. If, however, there was sufficiently stable inter-group genetic variation, this could augment the culture-gene coevolutionary process.
[315] See (Bauer et al. 2013).
[316] See (Voors et al. 2012, Gneezy and Fessler 2011, Bellows and Miguel 2009, Blattman 2009). Cassar et. al. (2013) might appear contradictory, but it's is actually supportive of the theory presented here because this civil war pitted neighbor against neighbor, so there was no in-group or local community to bond with. From the psychology laboratory, converging evidence from controlled experiments with undergraduates demonstrates that even the perception of intergroup competition instantly increases cooperation in Public Goods Games (Puurtinen and Mappes 2009, Saaksvuori, Mappes, and Puurtinen 2011, Bornstein and Erev 1994, Bornstein and Benyossef 1994). Similarly, laboratory induced threats of uncertainty or death motivate both greater norm compliance and greater willingness to punish norm violators (Heine, Proulx, and Vohs 2006, Hogg and Adelman 2013, Grant and Hogg 2012, Smith et al. 2007).
[317] See (Bauer et al. 2013).
[318] For the case of the Polar Inuit, see (Boyd, Richerson, and Henrich 2011a, Rasmussen, Herring, and Moltke 1908, Gilberg 1984). I mention the importance of the re-adoption of the technologies because some researchers are inclined to argue that all foraging people are always behaving optimal. Ergo, there must be some minor ecological differences that make all the lost technologies inefficient.

[319] For theoretical work on these process see (Shennan 2001, Powell, Shennan, and Thomas 2009, Henrich 2004b, 2009b, Kobayashi and Aoki 2012, Lehmann, Aoki, and Feldman 2011, van Schaik and Pradhan 2003).
[320] See (Derex et al. 2013).
[321] Kline and Boyd (2010) analyzed a large number of ecological and environmental variables, but found that few showed any relationship with the size of the toolkit or the sophistication of the technology, and none substantially diminished the magnitude of the relationship with population size.
[322] See (Collard, Ruttle, et al. 2013).
[323] By contrast the number of food-related techniques is not readily explained by free time or for the necessity of additional food sources (van Schaik et al. 2003). Also see (Jaeggi et al. 2010). Among chimpanzees, a similar relationship does emerge, but a clear alternative hypothesis can't be eliminated (Lind and Lindenfors 2010).
[324] W. H. R. River's essay is at http://en.wikisource.org/wiki/The_Disappearance_of_Useful_Arts#cite_note-1
[325] See (Henrich 2004b, 2006, Jones 1974, 1976, 1977c, b, Diamond 1978). On fire: the claim is that Tasmanians lost the ability to make fire. They still had fire. While losing the ability to make fire is not unheard of (Holmberg 1950, Radcliffe-Brown 1964), this particular claim is controversial (Gott 2002)
[326] Tasmanian technology is also simple compared to other foraging populations at the same southern latitudes, like the Fuegians at southern tip of South America and the inhabitants of both southern New Zealand and the Chatham islands (Henrich 2006, 2004b).
[327] Paleolithic evidence (McBrearty and Brooks 2000b, Boyd and Silk 2012, Klein 2009): pelagic fishing (O'Connor, Ono, and Clarkson 2011), bone tools (Yellen et al. 1995), stone tools (Jones 1977b, a), arrivals (Boyd and Silk 2012), and hafted stone points (Wilkins et al. 2012).
[328] See (Jones 1974, 1976, 1977c, b, a, Colley and Jones 1988, Jones 1990, 1995, Diamond 1978). I've reviewed the Tasmania case and considered various objections in (Henrich 2004b, 2006).
[329] There is one important set of anomalous data relevant to this line of argument that I've not discussed. Analyzing tool complexity data from human foragers, Collard and his colleagues have argued that they find no relationship between population size or interconnectedness and tool measures of complexity (Collard et al. 2012, Collard et al. 2011, Collard, Kemery, and Banks 2005). Instead, they argue that ecological risk favors more individual investment in *risk-relevant* technological complexity. While important to keep in mind, there are two problems with this effort. First, it's well established that foragers respond to risk by building far-reaching networks of social relationships, which they can turn to when disaster strikes (Wiessner 2002, 1998, 1982). Thus, finding a positive relationship between ecological risk and technological complexity is largely also supportive of the view presented in this chapter, since greater risk will cause individuals to develop broader networks, using their cultural technologies (e.g., rituals, naming, gift giving), which will result in more complex tools as a product (and potentially a byproduct). Evidence for this view is found in Collard et. al. (2013), where ecological risk is positively related to possessing all kinds of technologies, including those that have nothing to do with managing risk. Second, the nature of foraging groups makes determining the population size relevant for information flows about technology tricky and unreliable. In many places, foraging bands are loosely interconnected networks without clear boundaries. This is unlike many populations of farmers and herders who often control and defend territory. Consequently, negative results aren't unexpected for foragers, given the challenge of isolating the relevant pool of learners. This also explains why we see the predicted relationships for farmers and herders, but not for foragers, in Collard's various analyses.
[330] Chimpanzees and capuchins are both interesting because they have relatively large brains, and field studies indicate some simple patterns of cultural variation. For this excellent study, see (Dean et al. 2012).
[331] See (Henrich and Tennie forthcoming).
[332] See (Stringer 2012, Klein 2009, Pearce, Stringer, and Dunbar 2013).
[333] See (Deaner et al. 2007).
[334] On the importance of rich coastal environments, see (Jerardino and Marean 2010).
[335] For an earlier version of this point see (Henrich 2004b). For evidence of differences life length in Neanderthals and subsequent Upper Paleolithic peoples see (Caspari and Lee 2006, 2004, Bocquet-Appel and Degioanni 2013). On population size estimates and variation (Klein 2009, Mellars and French 2011). On projectiles for the expanding African populations see (Shea and Sisk 2010). For a discussion of the differences in trade networks, between Upper Paleolithic peoples and Neanderthals, which suggest a difference social network interconnectedness see Ridley (Ridley 2010).
[336] See (Henrich 2004b).

[337] See (McBrearty and Brooks 2000a). For information on Paleolithic bows and arrows, see (Shea and Sisk 2010, Shea 2006, Lombard 2011). For loss of bows and arrows, boats and pottery see (Rivers 1931).
[338] See (Powell, Shennan, and Thomas 2009).
[339] See (van Schaik and Burkart 2011).
[340] (Gruber et al. 2011, Gruber et al. 2009).
[341] For Australian technology, see Testart (1988). On the wheel see (Diamond 1997). Mayan toys had wheels, which profoundly underlines my point.
[342] See (Frank and Barner 2012). Stripped of their calculators, calculator users typically flounder.
[343] In the 19th century, discussions of the origins of language invited so much undisciplined speculation that in 1866 the influential Société de Linguistique de Paris banned the topic (Deutscher 2005, Bickerton 2009).
[344] For a discussion of this see (Deutscher 2005).
[345] See (Tomasello 2010, Kuhl 2000, Fitch 2000).
[346] See (Webb 1959, Kendon 1988, Mallery 2001 (1881), Tomkins 1936, Kroeber 1958). The Plains Indians had also developed specialized signs for military purposes, and long distance communication. These inspired a host of developments in the U.S. military, including the Signal Corp.
[347] See (Kendon 1988).
[348] See (Busnel and Classe 1976, Meyer 2004). Busnel and Classe argue that the length of human ear canal is actually better calibrated to pick the frequency of whistles than spoken language. To see people conversing in a whistled language see https://www.youtube.com/watch?v=P0aoguO_tvI. Or, see https://www.youtube.com/watch?v=C0CIRCjoICA. For a discussion of drums, horns, etc., see (Stern 1957)
[349] See (Munroe, Fought, and Macaulay 2009, Fought et al. 2004).
[350] See (Ember and Ember 2007, Nettle 2007).
[351] See (Nettle 2007).
[352] For word counts, see (Bloom 2000, Deutscher 2010). It's important to keep in mind that people in small-scale societies are usually multi-lingual, so the total number of words known might be quite large. Nevertheless, the number of words available in any particular language are fewer than in the languages of larger-scale societies.
[353] From W. H. R. Rivers as described in (Deutscher 2010).
[354] See (Kay and Regier 2006, Webster and Kay 2005, Kay 2005, Berlin and Kay 1991, D'Andrade 1995).
[355] See (Deutscher 2010). Following a long history of research on the topic, Brent Berlin and Paul Kay (1969) have argued that basic color terms emerge in response to the cultural evolution of technologies for separating color from its host objects—when color could be picked for clothing and other cultural products. Cultural evolution builds color term inventories in many ways, for example by extracting terms from the objects they previously infused. Words for "green" often derive from the words for "unripe" or "immature" (as in fruit); "violet" comes from words for flowers. Or, terms are simply borrowed through language contact.
[356] There remains some debate on this, see (Kay and Regier 2006, Xu, Dowman, and Griffiths 2013) and (Franklin et al. 2005, Baronchelli et al. 2010). One worry about this work is that it assumes the perceptual contours in human color perception are fixed and universal. This is noteworthy, since the color term maps for some languages do deviate from the predictions of this approach. An outstanding question is what other routes cultural evolution might take to build a color naming system. The dominant world pattern may be only one among multiple possible routes. I also predict that population size and interconnectedness will predict the degree to which a language is optimized to exploit the contours of our visual system.
[357] Vowels sounds may arise through an analogous process (Lindblom 1986).
[358] See (Franklin et al. 2005, D'Andrade 1995, Goldstein, Davidoff, and Roberson 2009, Kwok et al. 2011).
[359] (Gordon 2005, Dehaene 1997). For counting systems in New Guinea, see http://www.uog.ac.pg/glec/thesis/thesis.htm.
[360] See (Pitchford and Mullen 2002).
[361] See (Flynn 2012).
[362] See (Tomasello 2000b, a).
[363] See (Deutscher 2010, Everett 2005).
[364] Not surprisingly, there remains much controversy about this, see (Hay and Bauer 2007, Moran, McCloy, and Wright 2012, Atkinson 2011, Wichmann, Rama, and Holman 2011).
[365] See (Nettle 2012, Wichmann, Rama, and Holman 2011).

[366] See (Goldin-Meadow et al. 2008). Cultural learning provides humans with a final principle: communicative economy. Statements are made with the shared goal of communication, so contextually obvious information need not be included, and basic information should not be repeated. The listener has to assume the speaker is trying to communicate something, and taking what the listener knows into account (though see Pawley (1987)). How do humans come to share each other's' intentions and goals? They copy them—it's a product of cultural learning. If you have a goal of honest communication and I think you are a great model, well worth copying, then I will tend to copy the goal of honest communication. Now you and I have *shared intentionality* (Tomasello 1999) at least about communication.
[367] See (Christiansen and Kirby 2003, Heine and Kuteva 2002a, 2007, 2002b, Deutscher 2005).
[368] See (Fedzechkina, Jaeger, and Newport 2012).
[369] See (Deutscher 2005).
[370] See (Wray and Grace 2007, Kalmar 1985, Newmeyer 2002, Pawley 1987, Mithun 1984). Kalmar argues that a Canadian Inuit language is in the process of evolving a full-blown a subordination tool due to the spread of literacy and writing.
[371] See (Lupyan and Dale 2010).
[372] See (Deacon 1997, Kirby 1999).
[373] Cultural evolution can even explain the emergence of elements as basic as words—or, what linguists call compositionality. Communicative systems may have started without individual words that could be recombined in myriad ways. Instead, sounds or sound combinations might have mapped onto what we can think of as multi-word combinations or phrases. The word "bamakuba" might have meant "cook the meat more", without separate words for "cook", "meat" and "more". With a separate sound or set of sounds for every phrase or sentence, vocabularies can quickly explode and become unmanageable. However, cultural transmission with limited memories favors breaking things down—compositionality—in ways that are easy to remember (Brighton, Kirby, and Smith 2005). Maybe the process was something like how the "–gate" on hotel Watergate got broken off and redeployed to mean "scandal" as in Monica-gate and Climate-gate. Individuals who begin breaking things down in ways that are easily learnable for others will be more successful, and be more likely to be imitated. Languages with compositionality (words) will persist, and outcompete non-compositional languages.
[374] See (Kirby, Christiansen, and Chater 2013, Smith and Kirby 2008, Kirby, Cornish, and Smith 2008, Christiansen and Chater 2008).
[375] See (Striedter 2004).
[376] See (Striedter 2004, Fitch 2000).
[377] Any account of this early culture-gene coevolutionary process is highly speculative. However, this 'gesture first' account of our culturally-transmitted and evolving communicative system is consistent with several empirical facts. First, to the degree that other apes can learn communicative elements, they learn manual gestures (sign systems), not verbalizations or facial expressions. Efforts to teach apes to speak have failed. Apes do communicate with vocalizations, but these vocalizations are a fixed repertoire of sounds that don't vary among groups, unlike their gestures. This suggests that human ancestors would have been much more susceptible to culturally-transmitted gestures, than vocalization (Tomasello 2010). Second, as we've seen, gestures are still part of our communicative systems and many hunter-gathers have both spoken languages and gestural sign languages. Third, infants are just as good, and maybe better, at learning gestural signs for communication compared to speech. Learning a sign language doesn't appear to be any more difficult for children than learning a spoken language. Infants engage in gestural mimicry when learning to make speech sounds. They watch their models' mouths closely, and this influences their performance. Adults will confuse sounds like /b/ and /p/, as in "bat" and "pat", unless they can see the mouth of the speaker (Tomasello 2010, Kuhl 2000, Corballis 2003), so mouth gestures are part of speech processing. Fourth, tool use, gestures and speech all share a substantial swath of neural circuitry.
[378] See (Fitch 2000).
[379] See (Csibra and Gergely 2009, Kuhl 2000). Our team studied pedagogical cues across seven diverse societies, and found the spontaneously use of at least some cues in all seven (Broesch et al. n.d.). However, the frequency of cueing varied substantially, as did which of a small set of specific cues were used. Only instructive pauses were found everywhere. For motherese, some have claimed it doesn't exist in some societies, though these claims were not based on systematic observational data collection and quantitative analysis. Working in my Fijian field site in the South Pacific, developmental psychologist Tanya Broesch (2011) found much lower rates of motherese than among

American mothers, but some motherese was still clearly present. In general, educated westerners are at the high end of the distribution for both the use of pedagogical cues and motherese.
[380] (Bickerton 2009, Christiansen and Kirby 2003).
[381] See (Sterelny 2012b). Wadley discusses this with regard to adhesive manufacturing dating back hundreds of thousands of years (Wadley 2010).
[382] See (Conway and Christiansen 2001). Another feature of languages that impresses philosophers is that we can use it to discuss the past and future, as well as people, things and events that are not present. So, language is "stimulus independent". But, as discussed for hierarchical constructions in language, having the capacity to think and plan independent of stimulus, and about the past and future, may not be that valuable unless others can do it as well. Here, the culture-gene coevolution for tool making, learned skills and social norms might again have led the way for languages. For example, difficult skills, like accurate spear throwing, need to be practiced off-line, but in anticipation of future situations. Unlike language, there need not be anyone else with this capability (for spear-throwing, e.g.) to make it useful. And, selection pressures for practicing will get stronger as tools and skills get more complex, and others start practicing (Sterelny 2012b). Similarly, social norms, like many objects in language, are not visible, but as they emerge, individuals will need to anticipate what happens if they are violated. Thus, the evolution of both skills and norms will then select for minds better able to think about the past and future as well as things not physically manifest like social norms.
[383] See (Conway and Christiansen 2001, Reali and Christiansen 2009).
[384] See (Reali and Christiansen 2009, Tomblin, Mainela-Arnold, and Zhang 2007, Enard et al. 2009). For a more general review of FOXP2 see (Enard 2011).
[385] See (Stout and Chaminade 2012, Stout et al. 2008, Stout and Chaminade 2007, Calvin 1993).
[386] See (Dediu and Ladd 2007).
[387] For modeling work on this see (Lachmann and Bergstrom 2004).
[388] See (Henrich and Henrich 2007, Boyd and Mathew n.d.).
[389] See an introduction see (Henrich 2009a). For experiments on the transmission of counter-intuitive beliefs, see (Willard et. al. nd). For related work, see (Sperber et al. 2010).
[390] More technically, the area is usually called the Visual Word Form Area (Coltheart 2014). I'm drawing "letterbox" from Dehaene (2009).
[391] The exact location of the letterbox does vary depending on writing system. Japanese readers, for example, appear to have separate letterboxes for their syllabic Kana script and their logographic Kanji script. The important point is that location is constrained by demands of the task and the innate neuro-geography of human brains (Coltheart 2014, Dehaene 2014).
[392] See (Dehaene 2009, Ventura et al. 2013, Szwed et al. 2012, Dehaene et al. 2010).
[393] See (Dehaene 2009, Ventura et al. 2013, Szwed et al. 2012, Dehaene et al. 2010, Carreiras et al. 2009, Castro-Caldas et al. 1999).
[394] See (Ventura et al. 2013, Dehaene et al. 2010). This means that the apparent brain asymmetry in face processing in "humans" was due to relying on highly literate participants in experiments.
[395] See (Coltheart 2014, Dehaene 2014).
[396] The figure was created from http://en.wikisource.org/wiki/An_Introduction_to_the_Study_of_the_Maya_Hieroglyphs/Chapter_5#plate12, which is public domain.
[397] See (Downey 2014).
[398] See (Little et al. 2011, Little et al. 2008, Jones et al. 2007, Bowers et al. 2012, Place et al. 2010). See Buss (2007) for an overview of the evolutionary psychology of mating.
[399] See (Zaki, Schirmer, and Mitchell 2011, Klucharev et al. 2009).
[400] See (Plassmann et al. 2008).
[401] On blind tasting, see (Goldstein et al. 2008).
[402] See (Woollett and Maguire 2011, Woollett, Spiers, and Maguire 2009, Woollett and Maguire 2009, Maguire, Woollett, and Spiers 2006, Draganski and May 2008).
[403] See (Hedden et al. 2008).
[404] See (Nisbett 2003).
[405] For the immigration studies, see (Algan and Cahuc 2010, Fernandez and Fogli 2009, 2006, Guiso, Sapienza, and Zingales 2006, 2009, Giuliano and Alesina 2010, Almond and Edlund 2008).

[406] See (Nisbett and Cohen 1996).
[407] See (Grosjean 2011).
[408] See (Benedetti and Amanzio 2013, 2011, Benedetti, Carlino, and Pollo 2011, Finniss et al. 2010, Price, Finniss, and Benedetti 2008, Benedetti 2008, 2009, Guess 2002).
[409] See (Moerman 2002, Moerman 2000).
[410] For review see (Finniss et al. 2010, Price, Finniss, and Benedetti 2008, Benedetti 2008). For a study showing how tactile stimuli is turned into pain via the nocebo, see (Colloca, Sigaudo, and Benedetti 2008).
[411] Of course, being good at self-regulation may have caused people to do other things correctly besides take the medications. See (Horwitz et al. 1990) for an analysis that seek to address these issues.
[412] See (Benedetti et al. 2013).
[413] This experiment is from (Craig and Prkachin 1978). Also, see (Goubert et al. 2011, Craig 1986). For a nice recent experiment showing how powerful observational learning is compared to verbal suggestions or conditioning, see (Colloca and Benedetti 2009).
[414] See (Finniss et al. 2010, Price, Finniss, and Benedetti 2008, Benedetti 2008, Kong et al. 2008, Scott et al. 2008).
[415] See (Phillips, Ruth, and Wagner 1993).
[416] Results like these provide a major challenge to economic theory. The models that economists make of choices have to map people's choices onto their eventual outcomes. For example, if Herb chooses to take Drug Alpha for his back pain, an economist might assume that Drug Alpha will cure Herb with a probability *p* (say, 65% chance) and not cure Herb with a probability 1-*p* (say, a 35% chance). This probability *p* is typically assumed to be a feature of the world. However, what I just explained in the main text is that *p* actually depends substantially on what Herb believes about Drug Alpha, in a real biological way. There's a causal connection between Herb's beliefs about Alpha and the chances of various outcomes (cure or not) in the world. This is not some wacky special case, only applicable to a narrow range of drug choices. As we saw, it affects longevity in California, and probably also influences whole industries of 'traditional', New Age and spiritual healing and health practices, not to mention fad diets and exercise routines. More importantly, in many places in the world, witchcraft is a widespread and remarkably stable set of beliefs. These beliefs may persist in part because they are re-enforced by the operation of the nocebo effect such that perceiving others as angry or envious in the context of witchcraft beliefs actually then causes biological effects that increase the chances of illness. So, in a sense, witchcraft works.
[417] For an introduction, see (Klein 2009, Boyd and Silk 2012). For inferences to the last common ancestor see (Henrich and Tennie forthcoming). For sundry dates on our divergence from our last common ancestor with chimpanzees, see (Suwa et al. 2009, Scally et al. 2012, Klein 2009). The reason I'm using chimpanzees to set an *upper limit* on the cultural abilities of this common ancestor is because one of the selection pressures—climatic variation—that has likely made our lineage more cultural since we split may have similarly influenced other species, including chimpanzees. Much of the mathematical theory underpinning culture-gene coevolution suggests that the kind of relatively rapid environmental variation that has occurred over the last three million years, up to ten millennia ago, should favor a greater reliance on social learning (Boyd and Richerson 1985, Wakano and Aoki 2006, Aoki and Feldman 2014, Boyd and Richerson 1988), making many species more reliant on social learning in adapting to shifting environments. Consequently, since the lineages leading to modern apes experienced these variations as well, they too may have evolved an increased reliance on social learning during this epoch.
[418] See (Klein 2009).
[419] For chimpanzee culture see (Henrich and Tennie forthcoming); for the "brush heads" see (Sanz and Morgan 2011, Sanz and Morgan 2007). For the effects of overall brain size on social learning and other cognitive abilities, see (Deaner et al. 2007, Reader, Hager, and Laland 2011, Klein 2009, Boyd and Silk 2012). For comparative brain sizes, see (Klein 2009, Boyd and Silk 2012).
[420] See (McPherron et al. 2010).
[421] See (Hyde et al. 2009).
[422] See (Panger et al. 2002), though note the *pollicis longus* tendon may have appeared earlier in *Ardipithecus ramidus (White et al. 2009)*.
[423] Check out (Klein 2009, Boyd and Silk 2012).
[424] See (Stout and Chaminade 2012). For Kanzi, see (Schick et al. 1999, Toth and Schick 2009).
[425] See (Klein 2009, Ambrose 2001, Wrangham and Carmody 2010, Boyd and Silk 2012). On fish and turtles, see (Stewart 1994, Archer et al. 2014). Note, fish may have also been used by the hominins that preceded Early Homo.
[426] See (Stedman et al. 2004, Stedman et al. 2003, McCollum et al. 2006, Perry, Verrelli, and Stone 2005).

[427] See (Backwell and d'Errico 2003, Backwell and d'Errico 2002, d'Errico, Backwell, and Berger 2001).
[428] See (Stout and Chaminade 2012, Stout 2011, Faisal et al. 2010, Stout et al. 2008, Klein 2009).
[429] See {Morgan, 2015 #23157}.
[430] See (Stout 2011, Faisal et al. 2010, Stout et al. 2010, Klein 2009, Delagnes and Roche 2005).
[431] For the anatomical changes related to food processing, see (Wrangham and Carmody 2010, Wrangham 2009). For the use of fire see (Goren-Inbar et al. 2004, Klein 2009, Berna et al. 2012).
[432] See (Stout 2002, 2011, Beyene et al. 2013).This newer view is controversial, since many researcher have all claimed this was a period of technological stasis.
[433] See (Roach et al. 2013). The evolution of throwing *Homo erectus* probably benefited from some anatomical pre-adaptation in Australopiths that were byproducts of the evolution of bipedal walking or running.
[434] See Chapter 5 for references.
[435] For change in early Acheulean see (Beyene et al. 2013) and for various techniques that were added cumulatively see (Stout and Chaminade 2012, Stout 2011).
[436] See (Stout et al. 2010).
[437] Anatomically, I referring to the styloid process on the end of the third metacarpal (Ward et al. 2014, 2013).
[438] For evidence and discussion of temporal accumulations in complexity, see (Stout 2011, Perreault et al. 2013). This remains quite controversial, though even fairly conservative approaches distinguish less and more complex variants of both the Oldowan and Acheulean tool industries (Klein 2009).
[439] See (Alperson-Afil et al. 2009, Goren-Inbar et al. 2004, Goren-Inbar et al. 2002, Rabinovich, Gaudzinski-Windheuser, and Goren-Inbar 2008, Goren-Inbar 2011, Sharon, Alperson-Afil, and Goren-Inbar 2011).
[440] See (Wilkins et al. 2012, Wilkins and Chazan 2012, Klein 2009, Wadley 2010, Wadley, Hodgskiss, and Grant 2009, McBrearty and Brooks 2000a). For the ears and the auditory capacities of *Homo heidelbergensis* see (Martinez et al. 2013).
[441] See (Reader, Hager, and Laland 2011, Reader and Laland 2002, van Schaik, Isler, and Burkart 2012, Pradhan, Tennie, and van Schaik 2012, van Schaik and Burkart 2011, Whiten and van Schaik 2007).
[442] See (Boyd and Richerson 1996).
[443] By "individual learning", I'm referring to a broad class of cognitive abilities which allow individuals through their direct experience with the environment to on-average select more adaptive behaviors, or to better achieve their goals or satisfy their preferences. This is also called asocial learning. These abilities need not be either entirely "domain general" or narrowly "domain specific". I expect them to be applicable to many problems, but not all problems.
[444] See (Meulman et al. 2012) for the basic argument here.
[445] Admittedly, this leaves open the question of why bonobos and gorillas don't use tools more than orangutans.
[446] See (Suwa et al. 2009, White et al. 2009) for *Ardipithecus ramidus*. Ground-dwelling apes may be much older than 5 million years, but these details are not relevant for my argument.
[447] On predators, see (Plummer 2004, Klein 2009: 277).
[448] See (Boyd and Richerson 1985, Aoki and Feldman 2014, Boyd and Richerson 1988) for evolutionary models of social learning. For papers combining theoretical and empirical insights, see (Richerson and Boyd 2000b, a). If environments change too quickly, say every generation or every decade, then natural selection will favor individual learning. At the other extreme, if environments are changing very rapidly, say on an hour-by-hour basis, then neither individual nor social learning can help. Natural selection will go back to favoring genes that fix the best trait appropriately averaged across the range of environments experienced.
[449] See (Isler and van Schaik 2012, Isler et al. 2012, Isler and Van Schaik 2009).
[450] See (Langergraber, Mitani, and Vigilant 2009, Langergraber, Mitani, and Vigilant 2007). It is important not to overstate the implications of these data. We do not have equivalent data from other chimpanzee communities, so we shouldn't be too confident that the 'pairing' is being caused by the unusually large group size.
[451] In addition to the effects of group size and social learning, predatory threats especially in the form of raids from other groups, may further reduce the effectiveness of dominance competition. Too many fights and injuries from one's competitors could leave males weakened and ill-prepared to deal with predators.
[452] See (Chapais 2008: 205). In my discussion here, I'm assuming that we are starting with a large primate group in which the females depart and the males stay around, as in chimpanzees. However, this is not crucial. We could start with gorilla-like groups, who already have pair-bonding, and examine what happens when predatory threats force

them into larger groups. Also note that primates do appear to have some limited ability to detect relatives, including paternal relatives, besides through the familiarity mechanisms I've described here (Langergraber 2012).
[453] As pair-bonding spread as a strategy, male-male competition may decline, resulting in a reduction in the large canines males use in fighting each other (Lovejoy 2009).
[454] Part of this kin recognition package is an aversion to sex with these relatives. So, we don't have to worry about daughter's copying mom's sexual desires toward dad.
[455] On alloparenting in hunter-gatherers and other small-scale societies, see (Crittenden and Marlowe 2008, Hewlett and Winn 2012, Kramer 2010, Kaplan et al. 2000).
[456] See (Morse, Jehle, and Gamble 1990, Lozoff 1983). Mothers in many societies toss away the colostrum.
[457] See (Crittenden and Marlowe 2008) for case of the girl who was scolded for not helping with an infant. This case for further enriched by Alyssa in email correspondence. See (Kramer 2010) for a review of data alloparental care.
[458] See (Hrdy 2009, Burkart, Hrdy, and Van Schaik 2009, Burkart et al. 2014). Of course, the prosociality shown in these experiments is limited to very small groups of closely relatives. It cannot begin to explain the patterns of prosociality discussed in Chapter 11.
[459] It's also possible that the boys lacked the required tuber-expertise due to their relative youth and inexperience. Nevertheless, Frank assures me via email that Hadza women are more knowledgeable than men about tubers.
[460] See (Benenson, Tennyson, and Wrangham 2011).
[461] See (Chapais 2008, Hill et al. 2011).
[462] As noted in Chapter 11, cultural learning contributes dramatically to the effectiveness of reciprocity-based cooperation. Consequently, as natural selection improves individuals' cultural learning abilities, reciprocity will become a more effective strategy for sustaining cooperation and establishing enduring social relationships. This can only further fuel the opportunities for social learning from others and the possibilities for alloparental care from mom's friends (Crittenden and Marlowe 2008, Hewlett and Winn 2012).
[463] For orangutans see (Jaeggi et al. 2010) and for chimpanzees see (Henrich and Tennie forthcoming).
[464] See (Maynard Smith and Szathmáry 1999).
[465] See (Buss 1999, Tooby and Cosmides 1992, Pinker 2002, Smith and Winterhalder 1992, Pinker 1997). For the quip about hula-hoops see Buss (1999).
[466] (Buss 2007: 419).
[467] For a review of the evolution of the human body, see (Lieberman 2013).
[468] See (Richerson and Henrich 2012).
[469] See (Flynn 2012, 2007).
[470] See (Basalla 1988, Mokyr 1990, Diamond 1997, Henrich 2009b).
[471] This builds on a metaphor often used by Rob Boyd.
[472] See (Cochran and Harpending 2009) for increasing rates of genetic evolution. For increasingly cultural evolutionary rates, see (Mesoudi 2011b, Perreault 2012). For intergroup competition see (Turchin 2010, Turchin 2005).
[473] For research on the spread of prosocial norms for dealing with strangers after the origins of agriculture see (Ensminger and Henrich 2014: chapters 2 and 4).
[474] The older "rites of terror" were often filtered out general use because they operated to political units that were too small to compete, but still threatened the integrity of new and larger political units (Norenzayan et al. forthcoming).
[475] For research on the evolution of religions with big, moralizing gods, see (Norenzayan 2014, Atran and Henrich 2010, Norenzayan et al. forthcoming).
[476] See (Diamond 1997). Much of famous Diamond argument in *Guns, Germs and Steel* only makes sense in the light of the evolutionary foundations I've developed here.
[477] See (Henrich 2009b), and also my next book.
[478] See (Henrich, Heine, and Norenzayan 2010b, a, Apicella et al. forthcoming, Muthukrishna et al. n.d., Heine 2008).
[479] See (Henrich, Boyd, and Richerson 2012).
[480] See (Chandrasekaran 2006).
[481] See (World Bank Group 2015).
[482] See (Bowles 2008, Gneezy and Rustichini 2000).