6

WHY HUMAN EVOLUTION MATTERS

0:01–0:49

NATURAL SELECTION

Hi, I'm Emily Graslie, and welcome to Crash Course Big History, where today we'll be discussing a tweak in our evolutionary traits that led us to innovate so rapidly in the last 250,000 years.

Natural selection is no slouch at innovating. We've moved from a planet populated by single cell organisms just 700 million years ago to all the wondrous multi-celled giants that we see around us: mammals, birds, bivalves, insects and invertebrates, reptiles, amphibians, plants, and it goes on. There have been millions upon millions of species past and present.

Yet natural selection requires death, extinction, random variation and non-random selection to innovate. It is a process that takes an arduous amount of time - small changes, generation after generation, and ultimately epoch after epoch. Mistakes and successes mount up over thousands, millions, and billions of years.

0:49–1:39

CULTURAL EVOLUTION

Cultural evolution, on the other hand, takes innovation out of the hands of the more sluggish DNA and evolutionary instincts and into the marketplace of ideas. Good ideas, bad ideas, can be tinkered with, exploited, and improved within a single generation at rates that random variations in our DNA cannot.

Racing down the path of adaptation, instead of a horse and cart on a dirt road, we are soaring ahead in a private jet, and higher rates of complexity are the result. It's a rise with no immediate end in sight.

The Latin name for our species, *Homo sapiens*, means "wise man" which is kind of an arrogant name to give yourself. But it isn't just being "wise" that has led to the massive rise of complexity in human societies over the past 250,000 years.

1:39–2:21

COLLECTIVE LEARNING

In the last season of Crash Course Big History, we covered "collective learning" — the ability of a species to accumulate more information with each passing generation than is lost by the next. Eventually these innovations stack up. *Homo sapiens* went from stone tools to skyscrapers, rather than living in the same ecosystems and living the same lifestyles as we did a quarter of a million years ago.

The history of rising human complexitles involves tinkering with some form of prior knowledge rather than spontaneous genius. Cultural evolution rarely makes leaps. The Rolex watch wasn't invented overnight when an early human spilled her dinner on a bear-skin blanket and it just so happened to resemble the shape of a wristwatch. The Rolex was the result of centuries of tinkering and slight improvements over generations.

2:21–2:53

BILLIONS OF POTENTIAL INNOVATORS

The higher the population, the more potential innovators you have. Which is why things began to snowball after the invention of agriculture, and even more after the Industrial Revolution in the 18th and 19th centuries. Instead of small tribes of a few dozen, potential innovators became groups of thousands, millions, and now billions.

Not everybody in a human society thinks up new ideas: some ideas are forgotten, and some people come up with bad ideas. The self-pedalling shower, for instance, or hydrogen blimps like the Hindenburg, or mullets… these are all… not great ideas.

But on a long enough time scale, every generation you get a population of skilled inventors with new ideas. The good ideas that stick are remembered by humans, perhaps set to writing, then adjusted and explored generation after generation, and improved once again.

As a result, you probably aren't out carving your own stone tools right now. You are watching me.

2:53–3:43

HUMANS ARE DIFFERENT

Why humans evolved the capacity for collective learning remains a mystery. But like all mysteries in history and evolutionary biology, this one must be explored on the basis of the evidence. Basically, we wanna know, "What makes humans different?", at least in an evolutionary sense.

The differences don't just stem from our adept use of communication. Plenty of animals communicate with each other. This might be done visually, like a male peacock displaying its brightly coloured feathers as a courtship gesture. It might be a dog baring its teeth, as a sign of aggression. It might be audible, like a gopher letting out a warning squeak that a predator is nearby.

It might be a smell, like ants communicating through pheromones. It might even be something as intricate as whale songs that carry over large distances. Here you have transmission of information, but no steady accumulation generation after generation, thus no collective learning.

3:43–4:31

HOMO SAPIENS

And it's not just because we're exceptionally good teachers. Sperm whales teach their calves the dialects of their particular language: the specific clicks, moans, and frequencies. Meerkats that feed on scorpions demonstrate how to carefully handle their venomous prey. Baboons teach each other more efficient ways to hunt. And chimpanzees educate their young on how to fish termites out of the ground for an afternoon snack.

But still, there's no tinkering, or improvement, and no accumulation. Thus, it's not collective learning.

But the seeds of this communication and learning were there for a long time in the evolutionary tree, since those traits are present in many other species. At some point between our separation from our last common ancestor with chimpanzees 5-7 million years ago, and the emergence of *Homo sapiens* 250,000 years ago, evolution built up these skills for communication and learning and allowed it to be stored in the collective memories of human groups.

4:31–5:21

INCREASING BRAIN SIZE

And while our big brains provide use with very useful hardware, large brain sizes wouldn't have evolved either, unless there was a very specific evolutionary pressure for it. Brains need energy to run, and a big brain needs a lot of energy. Gathering food takes time, effort, and even increases our chances of risk. So there would have to be an evolutionary incentive for it that outweighed the potential costs.

The original increase in primate brain size relative to body mass in the ancestors of monkeys and apes, was the need to process 3D visual information from when we were living in trees- mostly so we didn't tumble down to our deaths. Let's go to the Thought Bubble.

We also know that in all groups of primates, brain power is needed to navigate their fairly complex social hierarchies and alliances. These hierarchies often determine access to food, mates, and ultimately to the continual survival of an individual's DNA. The higher you are in the hierarchy, the better your evolutionary opportunities are.

5:21–6:05

COMMUNICATION

And it takes a lot of care to maintain your place in such a hierarchy…. like in pre-modern aristocracies, modern politics, celebrity circles, and, unfortunately, sometimes in high school. As such, skills at communication and learning, along with the brain power to keep up with those social pressures, were useful neurological traits to evolve.

Chimpanzees, for instance, are able to communicate a wide range of information and can even be taught to recognize quite a few symbols, on par with a human toddler. But, their larynxes only allow them to vocalise a limited range of sounds.

This seems to have remained the case in the early hominids Australopithecines and Homo habilis. There is even some debate whether even the Neanderthals had more limitations on sound than humans.

That said, much of primate communication is done, like with many other animals, through gesticulation. And even today, gesture is a large part of day-to-day human communication to convey information.

6:05–6:47

LANGUAGE

Everything from moving your hands while you talk, to a cheerful thumbs up, to more offensive hand gestures communicate meaning. There's also your facial expressions and your body posture, which aid in expression.

Still, without language, our hominid ancestors were able to communicate information, adapt to new environments, use tools, and travel across the world.

Thanks, Thought Bubble. Humans do communicate successfully with gestures- but there's a huge capacity for complex language and abstract thought as well. And at some point in our evolutionary history, this went into overdrive.

In order to solve this mystery, scientists have assembled a gaggle of hypotheses that to this day are being evaluated by careful scrutiny of the evidence.

Perhaps complex human language evolved because better communication between mothers and their offspring favoured the survival of infant primates.

6:47–7:30

BEHAVE YOURSELF!

So, maybe 3.5 million years ago when Australopithecus became bipedal, mothers stopped carrying infants on their backs as often, like chimpanzees do.

Instead mothers would need another way to look after their young when looking for food - like, talking in order to exchange information. "Are you in

danger? Behave yourself! Stop throwing things at your brother."

Perhaps somewhere between the evolution of Homo habilis 2.8 million years ago and *Homo erectus* 1.9 million years ago, groups got bigger thanks to the use of their tools. And bigger groups meant the old ways of forming alliances in most primates became more difficult.

Namely, grooming. You can't give everyone a haircut. Instead, another way of forming bonds emerged. There was gossip and banter- perhaps first as sounds, then later evolving into more precise exchanges of information.

7:30–7:57

COMPLEX IDEAS

This progression of complex ideas may come down to our increasing consumption of meat. In some parts of East Africa for the past few million years, vegetation may have at times been scarce.

Our ancestors started scavenging more and more meat from corpses. Meat packs more energy per bite than vegetables, and this boost to our metabolisms might have increased brain size.

Or maybe it's as simple as when Homo habilis and its descendants started using tools with their hands more frequently. They had to evolve stronger vocalizations in order to communicate effectively hands-free.

7:57–8:50

SEXUAL SELECTION

Yet another option is that advanced communication may have evolved as a form of sexual selection. It is possible that hominine females preferred mates that were capable of two things: either expressing themselves in a range of ways, such that the male essentially "talked" their way into a relationship, and that females may have preferred males that were able to both transmit and receive pertinent information so they increased their chances of survival and their ability to provide for their young.

But all of these hypotheses presume some sort of environmental change that endangered the survival chances of our ancestors, making these evolutionary traits grow stronger more rapidly.

And indeed we know that the climate of Africa was fluctuating very rapidly over the past 4 million years, meaning our ancestors had to adapt faster in order to survive. Something must have made the benefits of operating a larger and more flexible brain outweigh the costs of stocking up on food and keeping it humming with energy. Afterall, natural selection doesn't do anything for free.

8:50–9:32

OUR COUSINS

When it comes to testing these theories, only a limited amount of evidence can be yielded from fossils and discoveries of ancient toolkits. Those research endeavours in Africa have only just scratched the surface.

Another way of testing those theories is to look at our evolutionary cousins today, particularly the great apes, in order to understand the dominant and useful traits that may have been shared by our ancestors.

It could be that all of the hypotheses we covered are valid and were working under evolutionary pressures simultaneously. Or perhaps it's something we haven't considered yet. The big question is, when did our capacity for learning and communication begin to resemble collective learning?

There's evidence that *Homo erectus*, which existed 1.9 million years ago, made small improvements to early tools, but that happened over several hundred thousand years.

9:32–10:08

IMPROVED TECHNOLOGIES

There is significantly more evidence that the species in between us and *Homo erectus* improved their technologies much more quickly.

There's very little doubt that the newcomer, *Homo sapiens*, was really good at collective learning. But we aren't even completely sure where we fit with all these other species on the evolutionary tree. Were our immediate predecessors also very gifted at collective learning? We won't know until more digs are performed and more discoveries are made. And it pushes back the genesis of collective learning to a very special set of conditions and traits that existed 2 to 3 million years ago.

Like any history book, the pages of the grand narrative are filled with blank spots that require more research, fact-finding, and interpretation.

10:08–11:29

HUMANS FOUND THEIR NICHE

It would be very convenient if we had an existing species or an extinct species in the fossil record with a similar degree of collective learning to compare to humans. But it is possible that if such a species had existed on Earth previously – dinosaurs building skyscrapers and sharing pictures on Instagram – that there may not have been room for our species to enter the same evolutionary niche.

In the past 3.8 billion years of Earth's history, this sort of behaviour is unprecedented. We humans seem to have stumbled into it by some mysterious quirk of natural selection. And until we're able to observe our evolutionary cousins a little more, the blank pages of human evolution will stay blank, awaiting the day when another potential innovator tinkers, improves, and adds their own piece of collective learning upon them.

Thanks for watching, see you next time.