Hi! We're paleoanthropologist John Hawks and astronomer Eric Wilcots at UW–Madison and we're trying to uncover the origins of humankind and galaxies by partnering with our South African colleagues. Ask Us Anything!

HawksandWilcots [1] and r/Science AMAs[1]

[1]Affiliation not available

April 17, 2023

Abstract

Edit: Thanks everyone! We're stepping away for now but might check back for new questions later. This was a blast, thanks for the great questions! -Eric and John Hi! I'm John Hawks and I'm a paleoanthropologist at the University of Wisconsin–Madison. I study the fossil and genetic evidence for human origins. I've done fieldwork around the world, most recently in South Africa with Lee Berger, where our team has uncovered the fossils of Homo naledi in the Rising Star cave system. Our origins are a big topic, and I'm here to share some of the new perspectives on human origins coming from fossil and genetic discoveries. Many old ideas have changed in the face of new evidence, and it's an exciting field that changes every day. Where did we come from, and how did we get here? That's what we're studying. I'm on Twitter @johnhawks. And I'm Eric Wilcots and I'm a professor of astronomy at UW–Madison. I study how galaxies acquire the gas they need to form stars, and what role the environments of galaxies play in the process. My work involves a number of telescopes around the world, including the Southern African Large Telescope (SALT) in Sutherland, South Africa. UW–Madison is the second-largest partner outside the South African government in maintaining and running the telescope, which became operational in 2005. I have been involved since 2000 and I am currently a member of SALT's board. At SALT and other telescopes around the globe (including radio telescopes, too), my team and I ask questions that are helping us understand the ecology of galaxy groups, which is the most common environment in which galaxies reside. It's a bit different from the observing I did with my first telescope as an 8-year-old kid in Philadelphia, but it's been rewarding all the same. I'm especially passionate about working with students and sharing astronomy with people who don't necessarily study it. In fact, one of my favorite public outreach events is Universe in the Park, a free, weekly "star party" in state parks all over Wisconsin. It attracts more than 4,000 people each summer! I also help steer the annual Wisconsin Science Festival, which brings science into communities all over the state. I suppose I would be remiss if I did not also mention that I once made an appearance as a "Way Cool Scientist" in an early episode of Bill Nye the Science Guy. Along with my graduate student, Julie Davis, John, our colleague Clark Johnson in geoscience and tons of other partners in Wisconsin and South Africa, I've been part of UW–Madison's Origins storytelling project for the last year. We're really excited to share this project with you by answering questions today about some of the biggest mysteries in nature, like where everything we see around us comes from. You can check out more at origins.wisc.edu.

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REDDIT

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HAWKSANDWILCOTS R/SCIENCE

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CORRESPONDENCE:

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According to the Origins website, the primary reasons for "Why South Africa?" are that it's in the southern hemisphere and the skies have good observing conditions. Where are some of the best places to look at the night sky in the United States?

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adamjs9

Eric here.

Great question! Astronomers need high and dry places as far from lights as possible for an optical telescope like SALT. So, in the continental U.S., most of the major observatories are in Arizona. Hawaii also has excellent conditions at the top of Mauna Kea. If you are looking to just enjoy the night sky, get as far away from city lights as you can. The best sky I've ever seen in the U.S. was in Yosemite National Park. There are many places around the country that are going for official Dark Sky status - check out http://www.darksky.org/idsp/reserves/ for a list of places that are great for seeing the sky.

I have a question for Mr Hawks. Given the recent discovery of hominin presence in the Philippines, do you think that paleoanthropologists have been underestimating the extent of behaviour possible by archaic humans as far as possibly Homo Erectus?

traject_

For people who may not be familiar with this story yet, a study in Nature this week by Ingicco and colleagues (http://dx.doi.org/10.1038/s41586-018-0072-8) reports on the butchered remains of an ancient rhinoceros from a place called Kalinga, on the island of Luzon. The bones have cutmarks and at least one percussion mark, and were found with some stone flakes, and one hammerstone. The remains are around 700,000 years old.

This is very interesting because the islands of Indonesia today had very different geographic connections in the past. Java, Borneo, and Sumatra are large islands that were connected to the Asian mainland during periods when the sea level was 120 meters lower than today. That's why they had (and still have) animals like rhinoceros, tigers, and orangutans that were also common in Southeast Asia. Java, at least, also had Homo erectus populations starting as early as 1.8 million years ago, and lasting up to a half million years ago.

But the Philippines were never connected to the Asian mainland. The animal species there must all have crossed water at some point to get there. This was definitely possible for many non-human species, and the Philippines had both extinct forms like rhinoceroses and stegodonts, and surviving forms like tarsiers. All of them must at some point in the past have made one or more water crossings to get to these islands. The tarsiers have been there for more than 30 million years, so we're not looking at one pulse of events leading to today's species, at all -- ancient humans and modern humans were both part of a much longer story.

This seems like a parallel case to the island of Flores, where hominins were living and making stone tools by a million years ago. Some of those Flores hominins survived, and we find their remains as Homo floresiensis, with one fragment of jaw 800,000 years old, and more skeletal remains in the period leading up to 65,000 years ago from Liang Bua cave.

Many archaeologists doubt that any hominins 700,000 years ago, or a million years ago, or even Neandertals 100,000 years ago, had the cultural and cognitive ability to make boats. They think it is more likely that some "lucky" individuals were caught up in a tsunami, and washed across the sea from Java or Borneo to these islands.

To support this idea, they point to the 2004 tsunami that affected Aceh, Sumatra, and washed many people far out to sea. Some of them survived for many days before being rescued:

https://www.telegraph.co.uk/news/worldnews/asia/indonesia/11309717/Boxing-Day-tsunami-I-survived-nine-days-alone-in-the-Indian-Ocean.html

Nothing about that idea is impossible, but it seems to give early hominins very little credit for knowledge of their environment. It's an idea, sure, that we cannot assume "complex" behavior without extraordinary evidence. But what is "complex"? Is it hard to imagine that a medium-sized mammal species, which relies on foraging across 100 square kilometers or more for high-energy foods, would be aware of islands that are in sight?

Personally, I have a different opinion. I think we have to recognize a continuum of abilities, and extraordinary ideas and abilities probably existed in most ancient populations. Today, in our very large population with huge economic and social incentives for innovation and discovery, those abilities can change the world. But in the past, in low-density populations living on the edge of survival, most innovations just did not become sustained, long-term traditions that leave an abundance of archaeological evidence.

When you look at these places in island Southeast Asia with early hominin activity, ancient sea levels were much lower and all these islands are one or two small hops across narrow straits. Palawan is an island between Borneo and the Philippines, and today these water crossings are hundreds of kilometers, but in the past they may have been as narrow as ten kilometers. That's not far to imagine hominin individuals making crossings, if they were already playing with very basic ways of crossing rivers and using near-beach water resources.

I have a couple questions for Dr. Hawks!

The Solutrean Hypothesis is making a disturbing comeback, thanks to white supremacist ideologies being back in the mainstream. I know it's been debunked by actual data but it won't go away (didn't Nat Geo air a documentary about it??)! Can you briefly discuss the most widely accepted theories in the field for the diaspora of Homo out of Africa, and the peopling of the Americas? And what can the next generation of scientists do to combat the spread of pseudoscience that bolsters racism?

Thank you!!

young_alse

Thanks for asking this question! The documentary was from the Canadian Broadcast Corporation, and it was rebroadcast recently on some American stations.

For those who don't know, the "Solutrean hypothesis" is the idea that the first Americans may have come across the North Atlantic, taking boats along the edges of the ice sheets. This idea was proposed by Dennis Stanford from the Smithsonian Institution, and he focused on some similarities between the Clovis points made in the continental U.S. before 13,000 years ago and the Solutrean points made in Europe prior to 18,000 years ago.

Today we know that the DNA of people in Beringia before 12,000 years ago was closely connected to all living native peoples of the Americas, both in North and South America. One ancient genome from a Clovis-associated skeleton, Anzick-1, was also closely connected to all Native American peoples and this Beringian population. The Clovis tradition was not the earliest cultural tradition in the Americas, it was a widespread technological pattern in the Eastern U.S., extending into the West over a quite narrow interval of time. Earlier sites in the Western U.S. may represent some of the first colonists south of the ice sheets, but it is also quite possible that we have yet to find the first traces of New World peoples. That Beringian sample inherited some of its genetic heritage from a north Eurasian population that existed prior to 18,000 years ago, and is represented by a genome from Mal'ta, near Lake Baikal. This "Ancestral North Eurasian" population also contributed some genetic ancestry to today's Europeans, so there are genetic similarities that stretch from those early populations of Eurasia connecting Europe and the Americas.

So if we understand all this, why do people still reject the evidence that Native Americans came primarily from Asia and not across the North Atlantic from Europe? There's no single answer to this question. Some people want there to be hidden connections that reflect ancient voyages. Other people have strong feelings about claims of residence or rights that people have as the first inhabitants of the Americas. Some are just excited by the idea of fascinating discoveries.

The thing that people should know is that scientists are also excited by fascinating discoveries! The possible evidence that ancient people were at Monte Verde, Chile, as early as 18,000 years ago is really exciting. That prompts us to do better, explore for more sites, and to document evidence to test claims about very early sites. That's what has given rise to tremendous debate with the paper last year describing a possible mastodon butchery site near San Diego, California, which some say shows human activity as early as 118,000 years ago. It's also why we are so interested in the recent suggestions that a small fraction of ancestry in indigenous people in Brazil came from an ancient population resembling Andaman Islanders. All these hints and possible pieces of evidence are things that scientists examine, follow up, and test in every way we can think of.

We're a skeptical bunch. But if you want to make advances that help us to understand the origin of human populations, you have to work across disciplines, build strong evidence where you can, and keep an open mind.

Is the recent redating of "anatomically modern humans" and the reclassification of North African Archaics in part a response to the finding of the introgressed A00 haplogroup?

GruffbaneJoe

John here --

This is a great question. It's hard to say exactly what goes into the background of people's thinking. The data that tell us something about "early modern" humans has just changed enormously in the last five years.

The A00 haplogroup was described by Fernando Mendez and colleagues back in 2013 (https://doi.org/10.1016/j.ajhg.2013.02.002). It is a Y chromosome branch that seems to diverge from the rest of the modern human Y chromosome tree between 240,000 and 580,000 years ago. It's found today in some Mbo men from present-day Cameroon, and some African-American men.

That's very early compared to the rest of the Y chromosome tree. It is not very early compared to the autosomal genome, which shows that African populations started to become genetically differentiated around 300,000 years ago or so.

There's a suspicion that this haplogroup may have entered recent human populations by interbreeding with a more ancient, diverged branch of archaic humans. It's possible. The story of African "archaic" humans today is intricate, because we have just enough data to raise questions and not enough data to answer those questions.

For example, the Iwo Eleru skull fragment, from Nigeria, is a specimen that we now recognize is less than 16,000 years old, but is archaic-looking in some details of its anatomy (https://doi.org/10.1371/journal.pone.0024024). Maybe this is a late-surviving pre-modern human population in West Africa that contributed to today's people in some degree.

There is evidence for "ghost population" contributions to West African people, and central African hunter-gatherers. All of this evidence comes from statistical examination of genomes of living people, and different research groups have come to different conclusions -- some point to multiple admixtures, from very ancient, diverged groups that may have been as different as today's people from Neanderthals, but all within Africa. Others point to a possible "pre-modern" population, an outgroup to

all of today's modern people but maybe only 400,000 or 500,000 years diverged, that contributed a much bigger fraction of West African genetic ancestry today. It's going to be a while before these studies start to converge on a single picture, because they've been using different samples and different methodologies.

Honestly, I think the Y chromosome haplotypes are not coming into people's thinking. The reason for this is that most people now recognize that the uniparental lineages, the mtDNA and Y chromosome, are not very helpful once you get back into the initial stages of diversification of today's African populations.

The A00 haplogroup does not seem to mark that early diversification, because it isn't in Khoesan as far as we know. And if our mtDNA mutational timeline is correct, the autosomal differentiation of Africans started long before the mtDNA "Eve" lived. Personally, I think these uniparental systems are probably reflecting natural selection on various haplogroups, and the introgression dynamics are driven by their fitness in different environments and genetic backgrounds.

According to everything I've read, anthropologists suspect the origins of language had something to do with the ability to mass produce weapons, argue effectively, and spout a good line of crap. Do they have any opinions about humor and the origin of language?

wuliheron

This is a great question -- John writing here --

Humor is enormously important in the social systems of living hunter-gatherers. Anthropologists focus a lot on the egalitarianism of these societies, and part of that means that individuals are "taken down a peg" by humor in their social interactions. Contrast that with the incredible aggression that can characterize social interactions in some of our closest relatives among the primates. Humans can defuse tense social situations using humor.

Laughing AT other people may have been really important to becoming human!

Dear Mr. Hawks and Mr. Wilcots, have you observed much overlap between the studying of Paleoanthropology and Astronomy? What kind of joint theories about creation might arise from such a partnering of disciplines?

EurekaScience

Hi, this Eric.

This is a hard question! I'll include thinking about our geology colleagues in this as well. What our disciplines have in common is thinking about changes and and what drives those changes. I don't think there are joint theories, but there are ways to think about our approach to science - our approach to understanding origins - that come from interactions between the disciplines.

Is there life on other planets?

create9442bagle

Hi, this is Eric! The short is answer is that the only life we know of is here on Earth. We have not found life on any other planet. That doesn't mean it doesn't exist elsewhere, but we have not found it.

Any news on the Mystery Hominid? 4 years ago I read the genome would come out "sometime next year." Is it associated more with Microcephalin D or the 3 million year old segments of "Denisovan" introgression in S. Asians, SE Asians, and the Pacific? Could it be from the "Hobbit?" Are the "Upper Paleolithic tools made by the Hobbit that "could only have been made by modern humans" still considered the work of the Hobbit, or have the associations changed with the dates?

GruffbaneJoe

Right now there are several different "ghost hominins" that scientists have inferred from genetic evidence. Some of those are African populations that once existed, and we can trace them only from their shadow of mixture into the genomes of living African peoples.

One of them represents an ancient group that contributed around 5 percent of the ancestry of the Denisova 3 genome. We don't know what that is, because the age of the introgressing segments can only be determined accurately if the proportion is known precisely, which can't be done easily from its preservation in a single genome. It could be Homo erectus in principle, although it doesn't have to be. My own suspicion is that Homo erectus is not a single population in the sense we've been talking for a hundred years, but instead a cluster of quite different populations, some closer to modern humans than others.

As far as the "hobbits", or Homo floresiensis, the reports of sophisticated tool use that were promoted back in 2004-2005 were erroneous. Later examination of the tools by Adam Brumm, Mark Moore, and others (https://doi.org/10.1016/j.jhevol.2008.10.006) have really helped to clarify that the tool technology on Flores reflects local continuity from 800,000 years ago to around 65,000 years ago, that the hobbits used a combination of techniques found among Lower Paleolithic toolmakers in Africa and Eurasia, and that they focused on some activities, like the production of "perforators".

In other words, it wasn't a matter of complexity so much as it was a matter of specific activities reflected in the toolkits.

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Hi! Being in college now, I was wondering when it was that you knew you wanted to go into these fields. Was there a specific class or an internship that piqued your interest? Did you start out pursuing different goals? Now that you're as successful as you are, what is it that you're most proud of?

quietlypassing

Eric here! I was one of those kids that decided to be an astronomer at an early age, but I did have great internships in college that really confirmed my interest. A lot of astronomers got their start by liking physics and moving to astronomy from their. I've had some students who were simply hooked by taking an intro course just because it sounded interesting. What am I most proud of in my career? For one, I'd say my students - I've had the good fortune to work with a lot of great students, both undergraduate and graduate, and seeing their success is great. And being able to advance our understanding of the Universe a bit. Another thing is just being able to contribute a bit to advancing science in South Africa.

I went to the science on tap at the nomad last night. You guys talked about seeing a supernovae when visiting SALT. Was that something you guys were specifically looking to observe or did it just happen to happen when you were there? Also how often do you get to observe supernovas?

smeyer24

Hi, Eric here.

Good question. That just happened to be what was being observed at that point on that night. SALT is what we called queue scheduled. This means that the SALT astronomers have discretion on what to observe (based on the proposals that have been submitted) on a given night depending on the exact conditions. Conditions were right for looking at the supernova that night.

Supernova are pretty rare. We ought to have a few every 100 years in a galaxy like the Milky Way. Now, there are a lot of galaxies so there are quite a few per year in a nearby galaxy like the one we saw at SALT.

Astronomers study some of the most interesting phenomena in the universe and they've named their tools:

South african large telescope

Very large array

Square kilometer array

Acatama large millimeter array...

Eric, can we get a promise that more creativity will be used in the future?

NeedMoreMegadesk

Eric here.

Great question! I can't make any promises - it would be nice.

That being said, there are a few astronomical facilities with more creativity names. NASA has historically named their great observatories after well-known astronomers like Hubble and Kepler. And we can proudly say that the official name of the VLA is actually the Karl Jansky Very Large Array, named after UW-Madison alum Karl Jansky.

Professor Wilcots, Based on you're knowledge of galaxy evolution, do you know if the large and small Magellanic Clouds formed in or very near to the Milky Way Galaxy, or if they formed somewhere far further and drifted into orbit around the Milky Way? What do you expect to happen to the Magellanic Clouds over time, will they stay in a stable orbit, or be torn apart and accrete onto the disk of the Milky Way?

GMiller9

Eric here.

This is another great question and one we are really trying to understand. The latest thinking is that the Magellanic Clouds are essentially a binary galaxy system that is "falling" into the Local Group (our neighborhood) and interacting with each other and the Milky Way. In this dance they are likely to eventually merge together or collide with the Milky Way (don't worry, it'll be awhile before that happens). If you look in the radio part of the spectrum you can detect a stream of gas that loops around the Milky Way that is likely the result of this interaction.

It looks dusty in SALT's neighborhood. Do the telescope's mirrors need to be spotless to get full and accurate images? How do they keep the mirrors clean?

chrisbarncard

Hi - Eric here!

Good observation! Yes, we worry about dust - a lot. The mirror is made of 90 segments and we have a cleaning cycle for cleaning a few segments every month. We need to take them out of the telescope to clean them, so it is a bit time consuming. We've also had to open up the main instrument and clean its optics. Does the mirror need to be spotless? No, but dust decreases the sensitivity of the telescope so we do want to keep it as clean as possible.

Question for all: does finding out where we come from, whether we're talking from dust in the galaxy or through evolution on earth, have a spiritual meaning for you? How does this connect you to your own sense of wonder about how we got here? And how do you foster that sense of wonder in others?

marvelousmarks

This is John --

In our research team, we talk about these issues a lot, and all of us have different feelings and approaches to these big questions of spirituality and place in the universe.

Personally, I feel something very powerful when I stand in the places where we have evidence of ancient humans, or human relatives. The connection between past and present is being forged by

science, and that gives us a way to allow ancient people to speak through us, and tell us about their lives and times. That is very meaningful to me. The power of the past is that it echoes into the present in many ways we don't recognize. The connectedness is there whether we recognize it or not, but bringing light to it can help overcome barriers we have in the present.

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marvelousmarks

This is Eric, so I'll add a little to John's great answer. I think the search for our origins is one of the oldest human pursuits. Every society has had its origin story and there's deep meaning in being in a field that continues that quest today. That search connects us all in, as John says, ways we don't always recognize. That sense of wonder comes in part from astronomical images - for me one of those amazing pictures is one returned from the Cassini satellite as it was orbiting Saturn. There's an image of the small, bluish dot of the Earth as seen from Saturn. It is really remarkable.

Are modern humans a new species that have branched out and replaced previous older populations, or are modern humans current forms of older global species that have become intermingled through time?

The_impericalist

Great question! John here.

Modern humans are a mix. Everybody in the world today is "modern", which means we share anatomical features related to the shape of the skull, and a basic pattern of genetic similarity coming from the expansion of an originally small population from Africa.

But different populations of modern people also have a small fraction of mixture from more ancient humans, that anthropologists call "archaic" humans. Neanderthals make up 2-3 percent of the genetic ancestry of most people whose recent ancestors come from Eurasia, Australia, and the Americas; an ancient population called the "Denisovans" contributed a tiny fraction of 0.2 percent of the ancestry of East Asian and Southeast Asian people, and a larger fraction -- up to 5 percent -- of Melanesian and Aboriginal Australian ancestry. Within Africa, we can see genetic echoes of ancient mixture from other populations we can't yet connect to fossil remains.

What this means is that modern humans are *both* a new population with a distinct origin and history of expansion, *and* a repository of some ancient lines of ancestry from even more diverse groups, which are now extinct. It may seem like a paradox, but this is the picture we are increasingly finding for many species, from ancient elephants and bears to human relatives like chimpanzees and bonobos.

What do you think is the most likely explanation for the Fermi paradox, that extraterrestrial life seems probable, yet we haven't detected it?

pensivebadger

Eric here. This is a really good question. The Fermi paradox really relates to intelligent life. Most likely explanation? There's a good book by Ward & Brownlee called "Rare Earth" that goes through a lot of good scientific arguments why intelligent life in the Galaxy is rare. To put things in perspective, life has been around on the Earth for at least 3.2 billion years. For the vast majority of that time, life was

microbial. And if you just want to considered how long life has existed on the Earth in a state that would be detectable by some other intelligent species it has been less than 100 years. So it is really, really hard to detect life elsewhere and it takes a very long time for life to evolve to a point where it can be detected from afar.

What do you think is the most surprising story about human origins to come out in recent years?

pensivebadger

John here --

I've been lucky to have been directly involved in some really exciting new discoveries. I don't think that anyone would disagree that the most surprising new discovery was Homo naledi. The idea that a very ancient, primitive branch of hominins still existed when modern humans were arising, in the very continent where we evolved, was just a total shock to paleoanthropologists. And to have that species represented not by just one jaw or a set of teeth, but by one of the largest samples of fossil hominins ever found, that was incredible.

It has told all of us that there is so much out there still to find. This discovery came from an area where we have literally 80 years of exploration, and multiple hominin caves within 2 kilometers from the site. If we can find a discovery like this where we've been looking hard for 80 years, imagine what we have not yet found in places without that kind of exploration!

I have 2 questions for Professor Hawks!

Do we have an Idea of where Naledi may be on the tree of hominin evolution? Did we perhaps share a distant ancestor with Homo Naledi?

Also I've watched some of your YouTube videos on Neanderthals and due to the fact that humans interbred with Neanderthals what degree of cultural and technological transmission did we have with them? Is it safe to assume that the last Neanderthals may have been using spear throwers or a bow?

Australopithecus98

We definitely share ancestors with Homo naledi. Our team has two questions we're investigating:

1. When did the Homo naledi lineage start? Some evidence suggests that it diverged much earlier than Homo habilis or Homo erectus from the line leading to modern humans. A recent study suggested that it was actually closer to modern and archaic humans than Homo erectus. The evidence seems to be divided, and that's really a neat scientific problem. If we can't work out the place of Homo naledi, which is represented by abundant fossil material, why do we think we know the place of some of these species represented by a single skull, or a fragment of a jaw?
2. Did Homo naledi hybridize with other species of archaic or modern humans? We can't test directly for hybridization or introgression yet without DNA from Homo naledi fossils, and so far the technology is not good enough to yield DNA from these fossils. But the odd mixture of features we are seeing in H. naledi may actually be easily explained if there was mixture between these ancient groups sometimes. But if they could mix, why didn't they all blend together? How did a form as different as H. naledi survive for so long, with other archaic and modern humans in the African landscape? These are total mysteries right now.

I have 2 questions for Professor Hawks!

Do we have an Idea of where Naledi may be on the tree of hominin evolution? Did we perhaps share a

distant ancestor with Homo Naledi?

Also I've watched some of your YouTube videos on Neanderthals and due to the fact that humans interbred with Neanderthals what degree of cultural and technological transmission did we have with them? Is it safe to assume that the last Neanderthals may have been using spear throwers or a bow?

Australopithecus98

The H. naledi answer is up above, so I'll focus on the Neandertal question here.

We have come to a much greater appreciation of the symbolic and cultural potential of Neandertals. They were using pigments to paint themselves, and objects, and cave walls. They wore ornaments and collected feathers. Some of their technologies, like pitch extraction, required a complex series of skills and actions.

There are some suggestions that projectile points may have been found as early as 50,000 years ago in the Rhône valley. That research hasn't really come to a point where I can evaluate it. I don't think there's anything impossible about Neandertals making arrows or atlatls, but then there are many modern humans who haven't used those specific techniques. And some modern human groups had atlatls in prehistoric periods and then lost them or stopped making them.

Personally, I think there was a short time when the "last Neandertals" were basically indistinguishable from the "modern" population that was engulfing them. I don't think they were behaviorally distinct as "races" at the points where they were in contact. I think it was a much more subtle change that would have been hard to see on the ground at that moment.

Why is there such a huge gap in the fossil record between early humans and modern anatomical ones?

create9442bagle

John here -- that's a great question!

The idea of a "gap" between archaic and modern humans was one of the big ideas supporting an African origin of our species. We have known for more than 50 years that Neandertals in Europe before 40,000 years ago were pretty different from the modern humans that followed them after 20,000 years ago. That difference made many anthropologists suspect that modern humans had originated somewhere other than Europe.

Of course, when most of the fossil record was European, the picture in other parts of the world was hardly known at all. And when up to 20,000 years separated the populations we knew the most about, it was not hard to overlook evidence of continuity.

The evidence is vastly better today, and is getting better all the time. We now have a series of fossils in Africa that demonstrate a mosaic of "modern human" and "archaic human" traits, representing times from 350,000 years ago up to 100,000 years ago. We can't assume these are all part of any single hominin population; in fact, they probably represent a range of populations that include some modern human ancestors and other related lineages, and possibly mixtures and hybrids of them. But there is no "gap" separating archaic and modern, there is a continuum.

The same is now true in Europe. Early modern humans before 20,000 years ago have a higher incidence of traits otherwise found in Neandertals. The latest Neandertals resemble early modern humans in some traits. And the first known modern European specimen, from Oase, Romania, around 45,000 years old, has a genome that is around 10% Neandertal, more than anyone else we've ever seen.

In other words, modern human anatomy arose gradually within Africa, in a complex set of populations, with different "modern" features arising at different times. And when some of those modern humans entered Eurasia, they mixed with archaic humans, picked up genes and some traits, and those have changed over time as well.

For Eric:

In light of the recent observations of the TRAPPIST system of earth-like planets in the habitable zone, what kinds of galactic environments would be most conducive to the evolution of life?

How different was the formation of the TRAPPIST system from our solar system?

aClimateScientist

Great question!

If we consider galactic environments, it is likely that the innermost parts of the Galaxy are not conducive to the evolution of life simply because of the harsh radiation environment. There's also a gradient in the abundance of the heavy elements that we need to make terrestrial planets across the Galaxy, so the outer part of the Milky Way may be too "metal-poor" for rocky planets to exist in abundance. So that's leaves the middle ring, where the Sun is. Conditions aren't too harsh and there is a good abundance to the things like Si, Fe, Mg etc that we need for rocky planets like the Earth.

We think that planets form in disks around stars (check out a great image from ALMA of an object called HL Tau). We simply don't yet have a good understanding of the process of how micron-size particles grow into planet-sized objects and what determines the spacing. TRAPPIST's disk was able to make a lot of rocky planets in a pretty narrow region. So the formation process was probably quite similar but there is enough randomness in it to sometimes yield something that looks like TRAPPIST and other times something like looks more like our own solar system.