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## Chimpanzee cultures — a search for clues

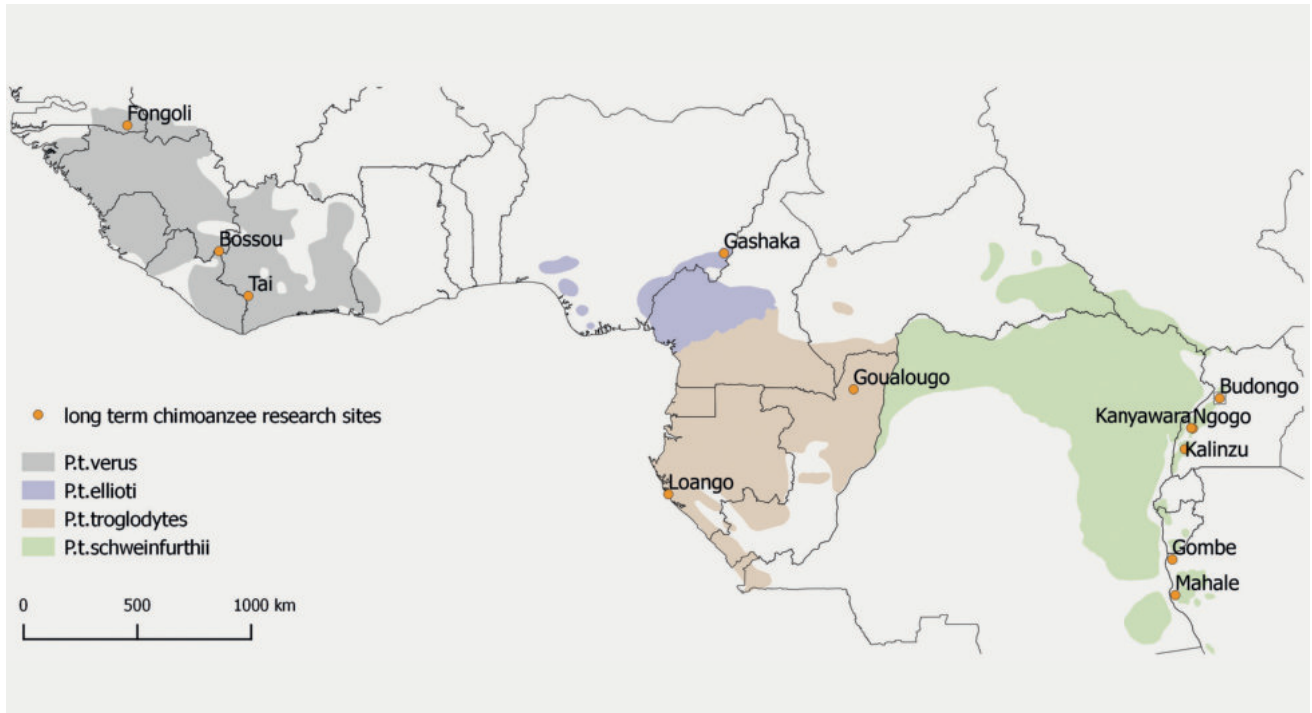
The search for chimpanzee cultures begins. If we start by asking [www.wikipedia.de](http://www.wikipedia.de), our search comes to an abrupt end after the first sentence: “Culture, in the broadest sense, denotes everything that humans create or produce—in contrast to nature, which humans did not create and cannot alter.” According to the authors of the article, culture is a human characteristic. The authors further argue that “the concept of culture can refer to a social group [...]. Commonalities of a group of people or the whole of humanity serve to distinguish this group from others or humans from animals.” So, do animal cultures even exist? Can only humans be cultural beings?

In a biological sense, humans are animals. They are a species that has—undoubtedly—developed unparalleled skills. Despite this, they are simply a species of animal—*Homo sapiens*—whose own evolutionary line of development separated seven to eight million years ago from that of its closest living relatives, the chimpanzees (*Pan troglodytes*) and bonobos (*Pan paniscus*), with whom it shares around 99 percent of the genetic make-up. In fact, chimpanzees are more closely related to humans than to gorillas. So, is a cultural adaptation to the environment something that only developed in the past five to six million years, after our evolutionary line separated from that of the chimpanzees?

In biology, we speak of cultural traditions when behavioral adaptations to the environment are not controlled by genetic (or epigenetic) processes but are passed on from one generation to the next through social learning. The sum of cultural traditions then becomes the culture of a group, which distinguishes it from others. Is this conceivable among our closest relatives, the chimpanzees? Now we begin our search in tropical Africa.

1 The mother cracks a nut with a heavy stone hammer while the offspring watches.





2 Distribution of the four subspecies of chimpanzees (*Pan troglodytes*) in Africa with the corresponding research projects that carry out or have carried out long-term research on chimpanzees.

Fig. 2

## Chimpanzee ecology and tool use

The natural geographic distribution of chimpanzees extends over most of equatorial Africa, from Senegal in the west to Tanzania in the east. Four subspecies of chimpanzees are distinguished: *Pan troglodytes verus*, *Pan troglodytes ellioti*, *Pan troglodytes troglodytes*, and *Pan troglodytes schweinfurthii*. The habitat ranges from tropical rainforests to savannas with varying group sizes from ten to over 150 individuals. Chimpanzees are very territorial and live in mixed-sex fission-fusion communities. This means that the individuals in a group do not always remain together, but rather in changing subgroups, which form and rebuild at will—similar to human societies. Females give birth on average every five years. The juveniles normally stay with their mother until the onset of puberty, between the ages of ten and twelve, and thus develop at a similar rate as humans. When they reach sexual maturity (from around twelve years of age), the females join another group, while the males remain in their maternal group.

Chimpanzees are omnivorous. Although they mainly eat ripe fruits, they also consume meat, insects, nuts, mushrooms, leaves, honey, rotting wood, and much more. Most importantly, chimpanzees are extremely inventive when it comes to exploiting resources. To do this, they use a variety of tools, most of which the chimpanzees adapt to the task at hand:

- (a) They use previously sharpened sticks as a spear to kill and eat nocturnal galagos hiding in tree holes.
- (b) They use sponges made from chewed-up leaves to soak up honey from a hole in a tree trunk.
- (c) They use stones or wooden clubs as hammers to crack open hard nutshells according to the hammer-anvil principle to get to the inside of the nut (see the Infobox Nutcracking). If part of the nut gets stuck in the shell, they prepare a stick into the correct length to poke the remaining part of the nut out of the shell.
- (d) When fishing for termites, some chimpanzees use two different tools: a sturdy stick to make a hole in the termite mound and a flexible twig to then fish for termites through the hole.

*Fig. 3a–d*

Chimpanzees, therefore, use tools to exploit certain resources that they would otherwise not reach or would have difficulty accessing. These tools must have certain properties and are partially manufactured and modified. That's clever, but can we call that culture? We should first consider whether there are differences between chimpanzee populations that are not based on genetics or ecological factors.

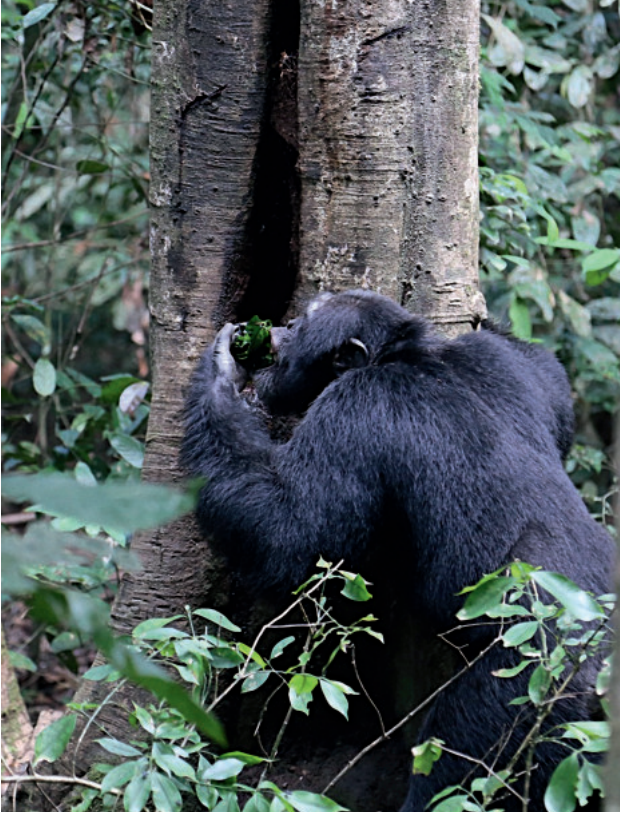
## Differences between populations

The variation of behavior was the first approach to take a closer look at the question of chimpanzee culture. This idea by Christophe Boesch and Andrew Whiten was just as simple as it was ingenious: bring together researchers who have observed chimpanzee communities in the wild for many years and compile a precise description of the observed behaviors. Then assign the observed behaviors to one of three categories:

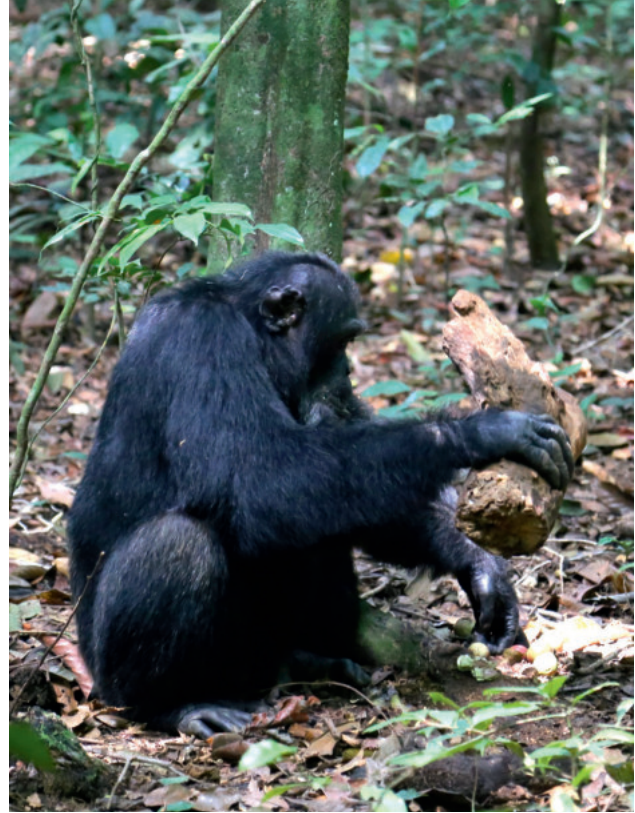
- (I) The first category includes universal behavior that all chimpanzees exhibited.
- (II) The second category includes behavior that not all chimpanzee groups exhibited, which can be explained by ecological reasons. For example, chimpanzees cannot crack nuts if there are no nuts available in their habitat.
- (III) The third category includes behavior, the absence of which in chimpanzee groups cannot be explained by ecological reasons, for example not cracking nuts even though nuts and potential hammers and anvils are available.

Only category III behaviors are serious candidates for cultural traditions, while category I and II behaviors are likely to be the result of genetic and ecological adaptations. In the first study using such an approach in chimpanzees, the researchers identified 38 behaviors that could be classified as category III behavior

*Fig. 4*



(a) A sponge made from chewed-up leaves is used to extract water from a tree cavity.



(b) A wooden hammer is used to crack a coula nut using the hammer-anvil principle.

### 3 Four different tools in action.

by comparing six long-term field studies. These included behaviors such as cracking nuts, fishing for termites, or the rain dance. On the one hand, this study made it possible to investigate cultures among other great apes, on the other hand, a hefty dispute arose about whether ecological or genetic variations were, in fact, the real reason for the behavioral differences between the chimpanzee populations. So, are there really no behavioral differences based on cultural traditions?

## Experimental approach

If simple observations do not provide answers, an experiment may help. But how to begin? An elegant approach was proposed by Thibaud Gruber from the working group around Klaus Zuberbühler. If behavioral differences are not based on cultural traditions, then a new problem presented to two different chimpanzee groups in an identical manner should provoke similar solution patterns. This is where the behavioral experiment began.

The researchers worked with two chimpanzee groups in Uganda. The Sonso group in Budongo Forest only uses leaves, not sticks, as tools. One could say that the Sonso chimpanzees live in a leaf culture. The Kanyawara group in Kibale





(c) A stone hammer is used to crack the hard shell of a panda nut.



(d) A toolset composed of a tough stick used to open the termite hill (right hand) and a flexible twig used to fish for the termites through the hole (in the mouth).

National Park about 200 km further south uses both leaves and sticks as tools. Researchers placed tree trunks with 16 cm deep holes filled with honey into the territories of both communities. To optimally exploit the honey, it should be spooned out of the hole using a sufficiently long stick. This is exactly what the Kanyawara chimpanzees did. The Sonso chimpanzees, on the other hand, who had never used sticks to extract food before, made a sponge out of leaves that they stuck into the hole and then pulled out again. Each group responded to the problem with their traditional techniques. Even when researchers demonstrated the optimal solution to the Sonso chimpanzees by placing a stick into the honey hole, the stick was cast aside, and leaves were used to extract the honey.

One possible explanation is that both techniques are equally suitable for obtaining honey and that there is no advantage of one technique over the other. Even if this is unlikely and there are clear advantages of using one technology instead of another in terms of how long the chimpanzees had to work to exploit the honey, there are still doubts. So, given the same effectiveness, do chimpanzees simply stick to the behavior variation that is more familiar to them?

*Fig. 5a*

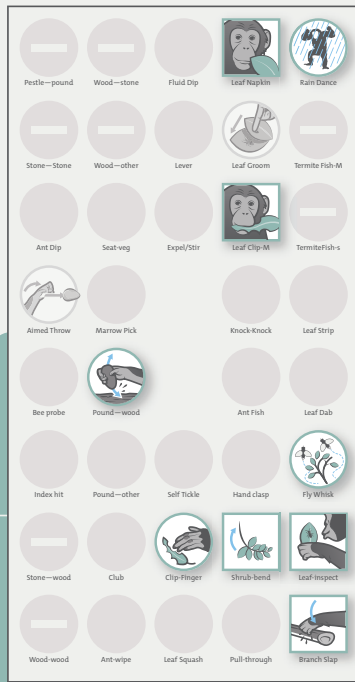
*Fig. 5b*



Bossou (Guinea)

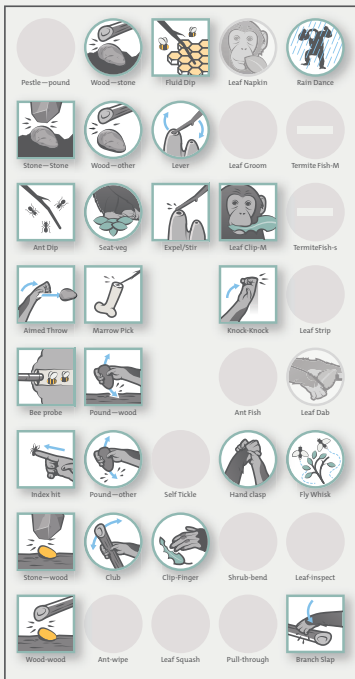


Kibale (Uganda)

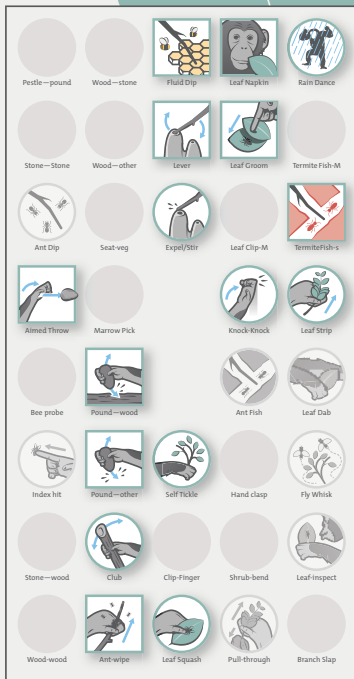


Budongo (Uganda)

Tai (Ivory Coast)



Gombe (Tanzania)



Mahale (Tanzania)



## Adaptation to the cultural tradition of a new community

Here again, observations help us. Chimpanzees in the Taï National Park in the Republic of Côte d'Ivoire crack coula nuts (*Coula edulis*) from December to March. In December, when the fruits are fresh and hang on the trees, the chimpanzees use stone hammers to crack the hard nutshells. Later in the season once the fruits fall from the trees and begin to dry out, it is easier to crack the shells, so the chimpanzees now use wooden hammers. This makes sense since stone hammers are rare, while wooden hammers are readily available in the forest. In a typical chimpanzee community in Taï, the proportion of stone hammers changes over the course of the nutcracking season from 60 to 70 percent in the early weeks to 10 to 20 percent at the end of the nutcracking season, i.e., after around 20 weeks.

But there are also Taï chimpanzees who continue to prefer stone hammers. Lydia Luncz from Christophe Boesch's working group studied three neighboring communities, two of which follow the ecologically prescribed switch from stone to wooden hammers, while the southern group continues to use stone hammers in the twentieth week. They do this, although stones are not more numerous in the south than in the territory of the northern or eastern group. It looks as though two different hammer selection cultures exist: an alternating hammer selection culture, depending on how easy the nuts are to crack, and a stone hammer culture, which always uses stone hammers regardless of the degree of hardness of the nuts.

But what happens if a female from a hammer selection culture migrates to join the southern group with the stone hammer culture? Such migration was observed by our team in Taï National Park a few years ago. Within a few nutcracking seasons, the immigrant females had adapted to the predominant local culture and cracked the nuts according to the stone hammer culture predominant among the southern group. This cultural conformism in wild chimpanzees, which has already been shown in behavioral experiments with zoo chimpanzees, clearly shows that female chimpanzees adapt to their new culture.

Fig. 6

### 4 Distribution of the 38 behaviors observed during the six long-term research projects identified as possible cultural traditions by the authors.

<i>Rectangular symbol:</i>	common behavior (all or most of the members of a group display this behavior)
<i>Round symbol:</i>	frequent behavior (exhibited by several members of the group)
<i>Pale gray symbol:</i>	behavior present (but rarely observed)
<i>Symbol without a picture:</i>	behavior was not observed
<i>Symbol without a picture with a bar:</i>	behavior does not exist for ecological reasons



## Conclusion

Our search for chimpanzee culture has shown that the foundations of human culture do already exist among them, even if chimpanzees are not building cities, singing operas, or flying to the moon. Chimpanzees shape sticks and leaves into functional tools and intentionally use stones as hammers. The use of tools is learned and sometimes takes many years to perfect. Some of these behaviors occur in one community, but not in another, for no apparent genetic or ecological reason. Ultimately, chimpanzees adapt to a new predominant culture, even if it would be more effective to persist in their old culture.

Perhaps the result of our search shows that we must accept that the chimpanzees do have their own culture. This only seems logical when we see how long it takes for chimpanzee children to reach certain developmental stages and that the use of tools is not easily learned on an individual basis. For some feats, chimpanzees need a role model from whom they can learn—such as the mother with whom the juveniles roam the jungle for years.

## Acknowledgments

I would like to thank the Ministère de l'Enseignement Supérieur et de la Recherche Scientifique, the Ministère des Eaux et Forêts in Côte d'Ivoire, and the Office Ivoirien des Parcs et Réserves for forty years of research into chimpanzee behavior in the Taï National Park. Thanks also to the Centre Suisse de Recherches Scientifiques en Côte d'Ivoire and to the staff of the Taï Chimpanzee Project for their ongoing collaboration. My special thanks go to Christophe Boesch, Cedric Girard-Buttoz, Thibaud Gruber, Lydia Luncz, Dave Morgan, Crickette Sanz, and Liran Samuni for discussions about tool use and providing illustrations.



5 (a) Sticks used by the Kanyawara chimpanzees to extract honey from a tree cavity.



(b) Leaf sponges used by the Sonso chimpanzees to solve the same problem: extracting honey from a tree cavity.

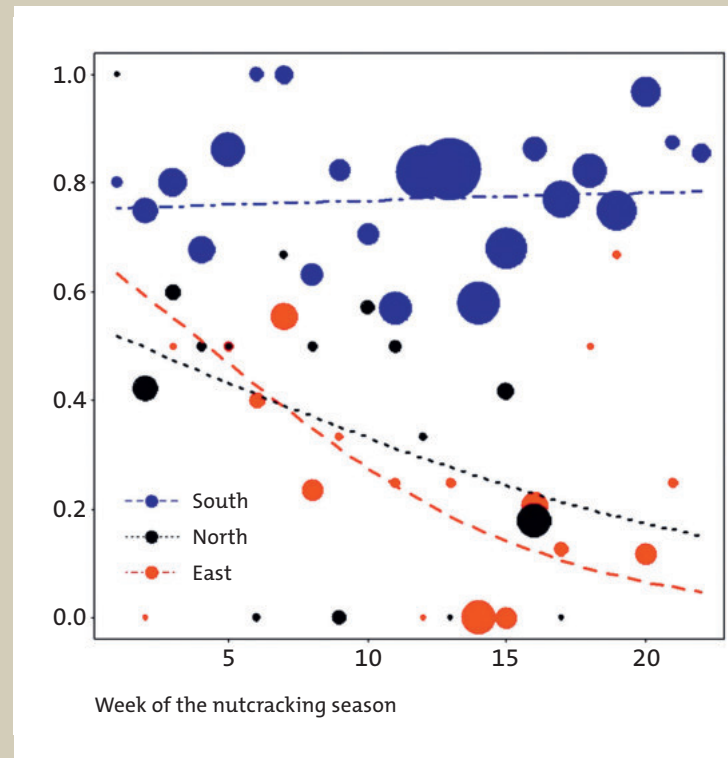
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# Nutcracking

"Bum, bum—crack" echoes through the Taï National Park along the Ivory Coast on the border with Liberia. Two thumps and a loud crack. A group of chimpanzees is sitting under a *Panda oleosa* tree, cracking the hard-shelled seeds of the panda nuts to reach the soft inside core. Again, "bum, bum—crack". This time, a mature female chimpanzee cracked open one of the hard nuts. The female carefully lifts a large stone, weighing around 7 to 8 kg, about 30 to 40 cm with both hands and a foot, and then drops it like a hammer to crack the nut with one forceful blow (see Fig. 3c). A dull "bum" resounds. But the nut is still not open; a heavy hammer is not enough; she needs a corresponding anvil. The combination of the force of the blow and the matching strength of the anvil is required to crack the nut. She takes the nut from the anvil and, with the back of her hand, pushes aside the remains of the soft orange pulp of the panda fruit and places the nut back into the small hollow that the hard shells of previous panda nuts have carved into the root after years of use as an anvil. She lifts the stone and forcefully drops onto the nut—"bum"—and again—"bum"—and again—"crack"! Finally, the shell bursts. She puts the stone aside and brings part of the opened nutshell to her mouth to pull the soft white nutmeat out of the shell with her finger and tongue. At the age of five, her daughter is still too young to handle the heavy hammer herself. She lacks the necessary precision and strength. She sits across from her mother and watches every movement with great interest. Cracking nuts is not an easy matter. It takes many years of learning, and some Taï National Park chimpanzees do not become efficient nutcrackers until they are ten.



**6** Proportion of stone hammers (vertical: the number of stone hammers divided by the number of all hammers) used by the Taï chimpanzees to crack open coula nuts throughout the nutcracking season (weeks). The groups from the north and east use fewer stone hammers over the course of the season as the nutshells become softer, while the group from the south continues to use stone tools (80 percent) throughout the season.

View the videos on Taï Chimpanzee Project Youtube-channel:  
<https://www.youtube.com/channel/UC1tvBgBAV5Xlmm5Vh5GwUlw/videos>.



In search of the beginnings of culture  
at Lake Manyara in Tanzania.



# Homo sapiens

## Profile

### Discovery

In 2017, the circa 300,000 year old, and therefore also the oldest-known, fossil remains of an anatomically modern human were discovered at Jebel Irhoud in Morocco. Until this discovery, the 195,000 year old skeletal finds from the Omo Valley in Ethiopia were the oldest-known representatives of *Homo sapiens*.

### Spread

Worldwide

### Age

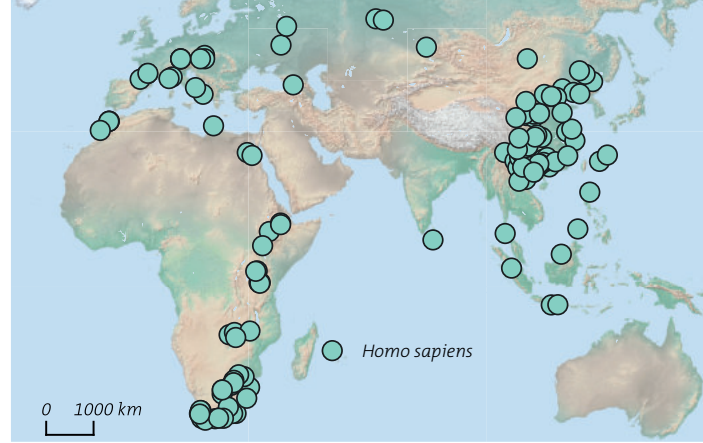
since circa 300,000 years.

### Brain size

circa 1,100–1,900 cm<sup>3</sup> (on average circa 1,350 cm<sup>3</sup>).

### Characteristics

Although *Homo sapiens* is the only species of all hominins still living today, genetic studies show small proportions of genes from Neanderthals, Denisovans, and other ancient humans in our genome. Our skulls are characterised by the relatively small, vertical face, a high forehead, a protruding chin, and a large cerebral skull. The skeleton has long leg bones, an opposable thumb for fine motor tasks, and a barrel-shaped chest. The s-shaped spine and the slightly tilted pelvis perfect the bipedal locomotion. Anatomically modern humans were the first to colonise the whole world, including Australia, the Arctic, North and South America, and Oceania. The extremely variable use of tools allows humans living today to enjoy very different forms of lifestyle, nutrition, and resource use. As a species, we are capable of unprecedented environmental changes, but also of cross-regional to global cooperation.



Skull Qafzeh IX, Israel



Virtual skull reconstruction of Jebel Irhoud, Morocco