Evolutionary divergence between apes and humans may have occurred in Europe, not Africa

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A recent article published in the scientific journal *PLOS One*, "Potential hominin affinities of *Graecopithecus* from the Late Miocene of Europe" (Fuss, Spassov, Begun, and Bohme, 22 May 2017), presents the provocative hypothesis that the earliest human ancestor evolved not in Africa, as all previous evidence indicates, but rather in southeastern Europe.

The article describes two fossil specimens, a mandible from Greece, originally discovered in 1944, and a single tooth from Bulgaria found in 2009, which are both assigned to the genus *Graecopithecus*. The authors propose that these remains, dating to roughly 7.175 and 7.24 million years ago (mya), respectively, represent a very early hominin species (humans and their non-ape ancestors) that existed shortly after the evolutionary split in the common ancestor of both modern apes and humans. No fossils purported to be from this close to the ape/human divergence have previously been reported.

Genetic dating techniques, which compare the degree of difference between ape and human DNA and estimate the time it would have taken for that amount of difference to have developed, have placed the split between the ancestors of these two lineages at somewhere between 5 and 10 mya, recently refined to 7-8 million. This would place *Graecopithecus* in the right time frame.

The fossil record contains specimens which have been found across Africa and Eurasia dating to the Miocene Epoch (roughly 23 to 5.3 mya) that could represent the common ancestor of apes and humans. However, remains that have been interpreted as early hominin (i.e., the earliest human ancestors after the split), dating to around 5 or 6 million years ago, such as *Ardipithicus*, are so far known only from Africa. The more abundant later fossils belonging to the genus *Australopithecus*, that are clearly hominin, including the famous "Lucy" skeleton, ranging in age between about 4 and 2 mya, have also been found exclusively in Africa.

Furthermore, the earliest known members of our own genus, *Homo*, are also from Africa, though it appears that they spread rapidly across Eurasia (e.g. the fossil specimens from Dmanisi, Republic of Georgia). Therefore, the overwhelming preponderance of existing data support the interpretation that hominins originated and spent much of their early evolutionary development in Africa. The new report seeks to challenge that understanding.

A basic tenet in science is that "An extraordinary claim requires extraordinary proof." The basis for the current claim is that certain characteristics of the Greek and Bulgarian specimens, while clearly ape-like in the broad sense, nevertheless have traits indicating a diet adapted to living in grasslands, which is typical of later hominins, rather than in forests, home of primordial apes.

Two categories of data are presented as evidence that *Graecopithecus* is an ancestral hominin—thickness of tooth enamel and tooth root configuration.

The new data presented by the authors is derived from CT scans of the specimens, which were then used to create 3D "visualizations" of their previously unobservable internal structures.

Graecopithecus has thicker tooth enamel than do apes, resembling what is generally typical of hominins. This difference is thought to represent an adaptation on the part of hominins to eating foods available in

grasslands (such as seeds), which require grinding and, therefore, produce more wear on the teeth than results from eating softer foods available to forest dwellers. Thicker enamel would extend the use-life of the tooth.

The canine tooth root is short and slender, suggesting that the canine itself was smaller than is typical of apes, but characteristic of hominins. Large canines impede the sideways motion of the jaw, necessary for grinding food.

The researchers also point to the root morphology of premolars. Humans have a single root, apes have three roots, and the condition in earlier hominins is variable. *Graecopithecus* exhibits a reduction in the numbers of roots, suggesting a trend toward the hominin configuration, which may also be an adaptation to tougher foods.

The hypothesis being proposed by these researchers, that the split between the ancestors of modern apes and humans took place in Europe rather than Africa, rests on only two specimens, a jaw and an isolated tooth, recovered from two different locations. The sample size is thus extremely small and the attributes used to support their interpretation, absent a more comprehensive set of traits, could easily be the result of parallel evolution among a highly variable group of species rather than evidence of a specific ancestor-descendant relationship with later hominins.

Furthermore, given the extreme rarity of possible hominin fossils from the 5 to 10 mya time period, the chance discovery of these two specimens in Europe does not provide a reliable basis on which to postulate where these animals evolved. With the current state of knowledge, it is equally plausible that the hominin/ape split occurred in Africa, with some of the earliest hominins then spreading "Out of Africa," as many members of the genus *Homo* later did.

Nevertheless, the researchers have conducted a very detailed and extensive analysis, which is certainly worthy of consideration and of further investigation, which they themselves call for.

Even if the origin of the hominin lineage is ultimately demonstrated to have been in Europe rather than Africa, or, perhaps, within a species spread over multiple continents, the basic understanding of the pattern of human evolution that has been constructed over the last century and a half remains essentially unchallenged, contrary to some sensationalist, and purposely misleading headlines in popular media.

The interpretation that ancestral humans and apes represent an evolutionary split prompted by the shrinking of forests and concomitant expansion of grasslands during the Miocene and succeeding Pliocene (5.3 to 2.6 mya) epochs is not contradicted. Indeed, analysis indicates that the environment of southeastern Europe, where *Graecopithecus* lived, was savannah, similar to that in the parts of Africa where later hominins are found.

Hominins adapted to the spreading savannah while the ancestors of the modern apes remained in the forests. These differing adaptations led to widely divergent evolutionary trajectories. The reconstruction of broad environmental context and resulting selective pressures is the same. Only the possibility of a change in the geographic setting has been raised.

Whether the substantial fossil record documenting the course of human evolution that has been found in Africa will now be supplemented by new information from Eurasia remains to be seen. The data necessary for paleontological research is subject to the vagaries of preservation. It may simply be that good contexts for the survival of hominin fossils dating to the late Miocene and Pliocene are more abundant in Africa than in Eurasia, perhaps skewing the available data and specifics of interpretation. If the claims made for *Graecopithecus* withstand scrutiny, exploration to discover geologic contexts of the relevant ages in Eurasia will no doubt be intensified.