



Embargoed: November 15th, 2010, 21:00

A long childhood is of advantage

Synchrotron Reveals Human Children Outpaced Neanderthals by Slowing Down

While it may seem like kids grow up too fast, evolutionary anthropologists see things differently. Human childhood is considerably longer than chimpanzees, our closest-living ape relatives. A multinational team of researchers from the Max Planck Institute for Evolutionary Anthropology, Harvard University and the European Synchrotron Radiation Facility found a similar pattern when human kids are compared to Neanderthals. The specialists applied cutting-edge synchrotron X-ray imaging to resolve microscopic growth in 10 young Neanderthal and *Homo sapiens* fossils and found that despite some overlap, which is common in closely-related species, significant developmental differences exist. Modern humans are the slowest to the finish line, stretching out their maturation, which may have given them a unique evolutionary advantage (PNAS, November 15, 2010).

Evolutionary biology has shown that small changes during early development may lead to differences that result in new species. These changes may take the form of modifications in the sequence or timing of developmental events; thus understanding developmental transformation is key to reconstructing evolutionary history. Anthropologists have documented many differences in adult characteristics among closely related species, such as humans and chimpanzees. Genomic data combined with fossil evidence indicate that these two lineages split six to seven million years ago, and have since been evolving separately. However, we know much less about which changes led to the separate lineages, how these changes arose, and when they occurred. Research during the past two decades has shown that early fossil humans (australopithecines and early members of the genus *Homo*) possessed short growth periods, which were more similar to chimpanzees than to living humans. However, it has been unclear when, and in which group of fossil humans, the modern condition of a relatively long childhood arose.

Max Planck Society
for the Advancement of Science
Press and Public Relations Department

Hofgartenstrasse 8
D-80539 Munich
Germany

PO Box 10 10 62
D-80084 Munich

Phone: +49-89-2108-1276
Fax: +49-89-2108-1207
presse@gv.mpg.de
Internet: www.mpg.de

Head of scientific communications:
Dr. Christina Beck (-1275)

Press Officer / Head of corporate communications:
Dr. Felicitas von Aretin (-1227)

Executive Editor:
Barbara Abrell (-1416)

ISSN 0170-4656



Fig. 1 *State-of-the-art synchrotron imaging of the tiny upper jaw of a Neanderthal child allows scientists to count tiny growth lines inside the first molar teeth and determine that it died at age 3.*

Image: Fossil courtesy: Université de Liège, Belgium; Photo credit: Graham Chedd, Paul Tafforeau, Tanya Smith

One poorly understood change is our unique life history, or the way in which we time growth, development, and reproductive efforts. Compared to humans, non-human primate life history is marked by a shorter gestation period, faster post-natal maturation rates, younger age at first reproduction, shorter post-reproductive period, and a shorter overall lifespan. For example, chimpanzees reach reproductive maturity several years before humans, bearing their first offspring by age 13, in contrast to the human average of 19. "The slow development in children is directly related to the emergence of human social and cultural complexity", says Jean-Jacques Hublin, director at the Max Planck Institute for Evolutionary Anthropology (MPI-EVA) in Leipzig, Germany. "It allows a long maturation of the brain and an extended education period" he explains.

It might seem that life history is invisible in the fossil record, but it turns out that many life history variables correlate strongly with dental development. "Teeth are remarkable time recorders, capturing each day of growth much like rings in trees reveal yearly progress. Even more impressive is the fact that our first molars contain a tiny 'birth certificate', and finding this birth line allows scientists to calculate exactly how old a juvenile was when it died" says Tanya Smith, a researcher from Harvard University and the Max Planck Institute for Evolutionary Anthropology. This forensic approach to the past is possible with a 'super-microscope:' extremely powerful X-ray beams produced at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France (www.esrf.eu), which is one of the largest synchrotron in the world. The ESRF researcher Paul Tafforeau notes: "At the ESRF, we are able to look inside invaluable fossils without damaging them by using the special properties of high energy synchrotron X-rays. We can investigate fossils at different scales and in three-dimensions, ranging from studies of overall 3D shape down to microscopic daily growth lines. This is currently the only place where these studies of fossil humans are possible." Scientists and curators have been quietly visiting the French synchrotron, often with some of the rarest hominin fossils in the world, for imaging with this state-of-the-art technique.

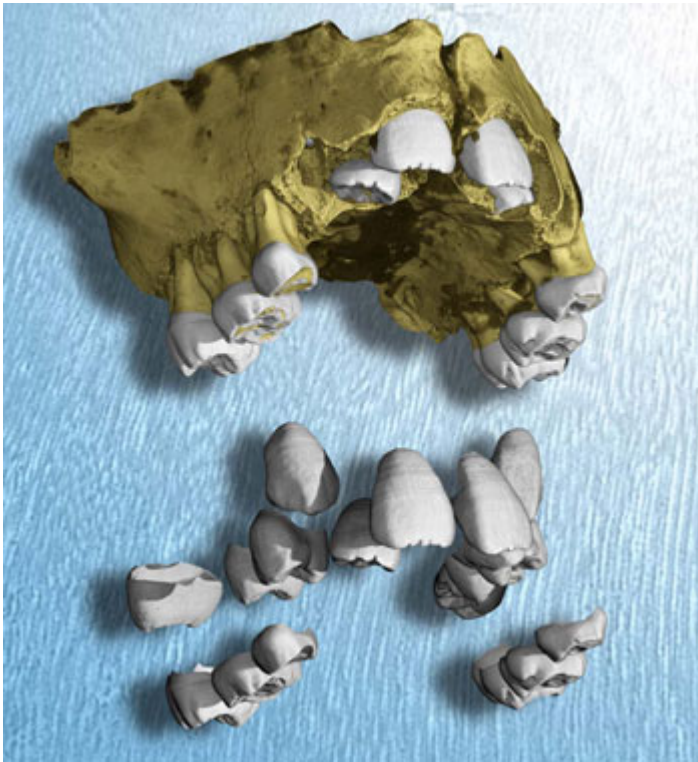


Fig. 2 *Virtually reconstructed dentition of a Neanderthal child from France. Synchrotron virtual histology reveals precise developmental information that is recorded in the form of tiny growth tracks inside the teeth (background).*

Image: Fossil courtesy: National Archeology Museum, Saint Germain en Laye, France; Photo credit: Paul Tafforeau, Tanya Smith

Scientists have been debating whether Neanderthals grew differently than modern humans for decades. An ambitious project on the development of these archaic humans was launched by Jean-Jacques Hublin and colleagues at the Max Planck Institute for Evolutionary Anthropology (www.eva.mpg.de). The study by Smith, Tafforeau and other specialists includes some of the most famous Neanderthal children, including the first hominin fossil ever discovered (Figure 2). This Belgian Neanderthal child, discovered in the winter of 1829-1830, was thought to be 4-5 years of age when it died. Powerful synchrotron X-rays and cutting-edge imaging software revealed that it actually died at a mere 3 years of age. Another invaluable Neanderthal discovered in Le Moustier, France in 1908, barely survived the shelling of its' German repository during the Second World War (Figure 3). A remarkable finding of this five-year study is that Neanderthals grow their teeth significantly faster than members of our own species, including some of the earliest groups of modern humans to leave Africa between 90-100,000 years ago. The Neanderthal pattern appears to be intermediate between early members of our genus (e.g., *Homo erectus*) and living people, suggesting that the characteristically slow development and long childhood is a recent condition unique to our own species. This extended period of maturation may facilitate additional learning and complex cognition, possibly giving early *Homo sapiens* a competitive advantage over their contemporaneous Neanderthal cousins.

Studies by Smith, Tafforeau and a number of scientists at the MPI-EVA are adding to the growing body of evidence that subtle developmental differences exist between us and our Neanderthal cousins. A study recently published in *Current Biology* by Philipp Gunz and colleagues reports that brain development also differs between Neanderthals and modern humans. Moreover, the recent sequencing of the Neanderthals genome by MPI-EVA molecular biologists around Svante Pääbo has provided tantalizing genetic clues that point to differences in cranial and skeletal development between Neanderthals and modern humans. These new methods present a unique opportunity to assess the origins of a fundamentally human condition: the

costly yet advantageous shift from a primitive "live fast and die young" strategy to the "live slow and grow old" strategy that has helped to make us one of the most successful organisms on the planet.

[TS / PT]

Related Links:

- [1] [The brains of Neanderthals and modern humans developed differently](#)
- [2] [Complete Neanderthal Genome Sequenced](#)
- [3] [The Neanderthal within us \(video\)](#)
- [4] [More information \(password required\)](#)

Original work:

Smith, T.M., Tafforeau, P., Reid, D.J., Pouech, J., Lazzari, V., Zermeno, J.P., Guatelli-Steinberg, D., Olejniczak, A.J., Hoffman, A., Radovčić, J., Masrour, M., Toussaint, M., Stringer, C., Hublin, J-J. (2010)

Dental evidence for ontogenetic differences between modern humans and Neanderthals
Proc. Natl. Acad. Sci. USA, November 15, 2010

Contact:

Jean-Jacques Hublin, Department of Human Evolution
[Max Planck Institute for Evolutionary Anthropology, Leipzig](#)
Tel.: +49 (0)341 355 0350
E-mail: hublin@eva.mpg.de

Sandra Jacob, Press and Public Relations
[Max Planck Institute for Evolutionary Anthropology, Leipzig](#)
Tel.: +49 (0)341 355 0122
E-mail: jacob@eva.mpg.de

Tanya M. Smith
[Harvard University, Department of Human Evolutionary Biology](#)
Tel.: +1 617 496 8259
E-mail: tsmith@fas.harvard.edu

Paul Tafforeau
[European Synchrotron Radiation Facility](#)
Tel.: +33 (0)438 88 1974
E-mail: paul.tafforeau@esrf.fr