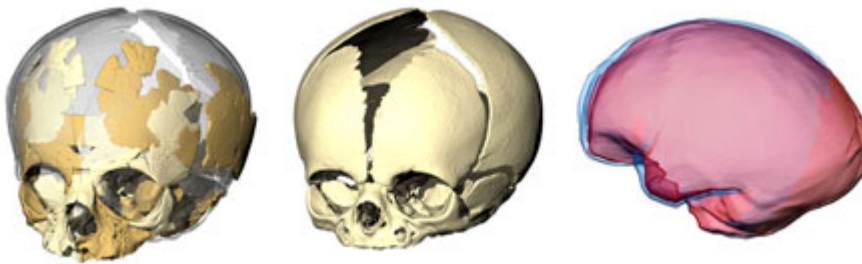




Embargoed: November 9th, 2010, 18:00

The brains of Neanderthals and modern humans developed differently

Researcher at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany have documented species differences in the pattern of brain development after birth that are likely to contribute to cognitive differences between modern humans and Neanderthals.



The brains of Neanderthals and modern humans are very similar at the time of birth. A reconstruction of a Neanderthal baby is compared to a modern human newborn. While the face of the Neanderthal is already larger than in a modern human at the time of birth, their brain shapes and volumes are very similar. Internal casts of brain cavities of skulls (Neanderthal: red; modern humans: blue) provide information about the relative size and form of the brain.

Image: Max Planck Institute for Evolutionary Anthropology

Whether cognitive differences exist between modern humans and Neanderthals is the subject of contentious disputes in anthropology and archaeology. Because the brain size range of modern humans and Neanderthals overlap, many researchers previously assumed that the cognitive capabilities of these two species were similar. Among humans, however, the internal organization of the brain is more important for cognitive abilities than its absolute size is. The brain's internal organization depends on the tempo and mode of brain development.

Based on detailed measurements of internal shape changes of the braincase during individual growth, a team of scientists from the MPI has shown that these are differences in the patterns of brain development between humans and Neanderthals during a critical phase for cognitive development.

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

Discussions about the cognitive abilities of fossil humans usually focus on material culture (e.g. the complexity of the stone tool production process) and endocranial volumes. "The interpretation of the archaeological evidence remains controversial, and the brain-size ranges of Neanderthals and modern humans overlap," says Jean-Jacques Hublin, director of the Department of Human Evolution at the MPI-EVA in Leipzig where the research was conducted. Hublin adds, "our findings show how biological differences between modern humans and Neanderthals may be linked to behavioural differences inferred from the archaeological record."

Nature of the evidence: As the brain does not fossilize, for fossil skulls, only the imprints of the brain and its surrounding structures in the bone (so called "endocasts") can be studied. The researchers used state-of-the-art statistical methods to compare shape changes of virtual endocasts extracted from computed-tomographic scans. The distinct globular shape of the braincase of adult *Homo sapiens* is largely the result of a brain development phase that is not present in Neanderthals.

One of the key pieces of evidence was the skull reconstruction of a Neanderthal newborn. In 1914, a team of French archaeologists had excavated the skeleton of a Neanderthal baby at the rock shelter of Le Moustier in the Dordogne. The original bones of the skeleton had been lost to science for more than 90 years, until they were rediscovered among museum collections by Bruno Maureille and the museum staff. The restored original baby bones are now on permanent display at the Musée National de Préhistoire in Les Eyzies-de-Tayac-Sireuil. The museum's director Jean-Jacques Cleyet-Merle made it possible to scan the delicate fragments using a high-resolution computed-tomographic scanner (μ CT). Using computers at the Max Planck Institute's virtual reality lab in Leipzig, Philipp Gunz and Simon Neubauer then reconstructed the Neanderthal baby from the digital pieces, like in a three-dimensional jigsaw puzzle. "When we compare the skulls of a Neanderthal and a modern human newborn, the Neanderthal's face is already larger at the time of birth. However, most shape differences of the internal braincase develop after birth," explains Gunz. Both Neanderthals and modern human neonates have elongated braincases at the time of birth, but only modern human endocasts change to a more globular shape in the first year of life. Modern humans and Neanderthals therefore reach large adult brain sizes via different developmental pathways.

In a related study the same team of MPI researchers had previously shown that the developmental patterns of the brain were remarkably similar between chimpanzees and humans *after* the first year of life, but differed markedly directly after birth. "We interpret those aspects of development that are shared between modern humans, Neanderthals, and chimpanzees as conserved," explains Simon Neubauer. "This developmental pattern has probably not changed since the last common ancestor of chimpanzees and humans several million years ago." In the first year of life, modern humans, but not Neanderthals, depart from this ancestral pattern of brain development.

Establishing when the species differences between Neanderthal and modern human adults emerge during development was critical for understanding whether differences in the pattern of brain development might underlie potential cognitive differences. As the differences between modern humans and Neanderthals are most prominent in the period directly after birth, they likely have implications for the neuronal and synaptic organization of the developing brain.

The development of cognitive abilities during individual growth is linked to the maturation of the underlying wiring pattern of the brain; around the time of birth, the neural circuitry is sparse in humans, and clinical studies have linked even subtle alterations in early brain development to changes in the neural wiring patterns that affect behaviour and cognition. The connections between diverse brain regions that are established during this period in modern humans are important for higher-order social, emotional, and communication functions. It is therefore unlikely that Neanderthals saw the world as we do.

The new study shows that modern humans have a unique pattern of brain development after birth, which separates us from our closest relatives, the Neanderthals. This uniquely modern human pattern of early brain development is particularly interesting in light of the recent breakthroughs in the Neanderthal genome

project. A comparison of Neanderthal and modern human genomes revealed several regions with strong evidence for positive selection within *Homo sapiens*, i.e. the selection occurred *after* the split between modern humans and Neanderthals. Three among these are likely to be critical for brain development, as they affect mental and cognitive development.

"Our findings have two important implications," says Philipp Gunz. "We have discovered differences in the patterns of brain development that might contribute to cognitive differences between modern humans and Neanderthals. Maybe more importantly, however, this discovery will tell us more about our own species than about Neanderthals; we hope that our findings will help to identify the function of some genes that show evidence for recent selection in modern humans."

Related Links:

[1] [The Neandertal in us \(Film\)](#)

Original work:

Philipp Gunz, Simon Neubauer, Bruno Maureille, and Jean-Jacques Hublin
Brain development after birth differs between Neanderthals and modern humans.
Current Biology, November 9, 2010

Maureille, Bruno
A lost Neanderthal neonate found.
Nature (September 5, 2002) doi: 10.1038/419033a

Neubauer, S, Gunz, P, and Hublin, JJ
Endocranial shape changes during growth in chimpanzees and humans: a morphometric analysis of unique and shared aspects.
J Hum. Evol. (August 18, 2010). doi:10.1016/j.jhevol.2010.06.011

Green, Richard E, Krause, Johannes, Briggs, Adrian W, Maricic, Tomislav, Stenzel, Udo, Kircher, Martin, Patterson, Nick, et al.
A draft sequence of the Neandertal genome.
Science (May 7, 2010) doi:10.1126/science.1188021

Contact:

Dr. Philipp Gunz, Dept. of Human Evolution
[Max Planck Institute for Evolutionary Anthropology, Leipzig](#)
 Tel.: +49 341 3550 853
 E-mail: gunz@eva.mpg.de

Sandra Jacob, Press and Public Relations
[Max Planck Institute for Evolutionary Anthropology, Leipzig](#)
 Tel.: +49 341 3550 122
 Fax: +49 341 3550 119
 E-mail: info@eva.mpg.de