NEWS
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The evolution of the brain in fossil hominins reveals improved olfactory functions in *H. sapiens*

Differences in the temporal lobes and olfactory bulbs suggest a combined use of brain functions related to cognition and olfaction.

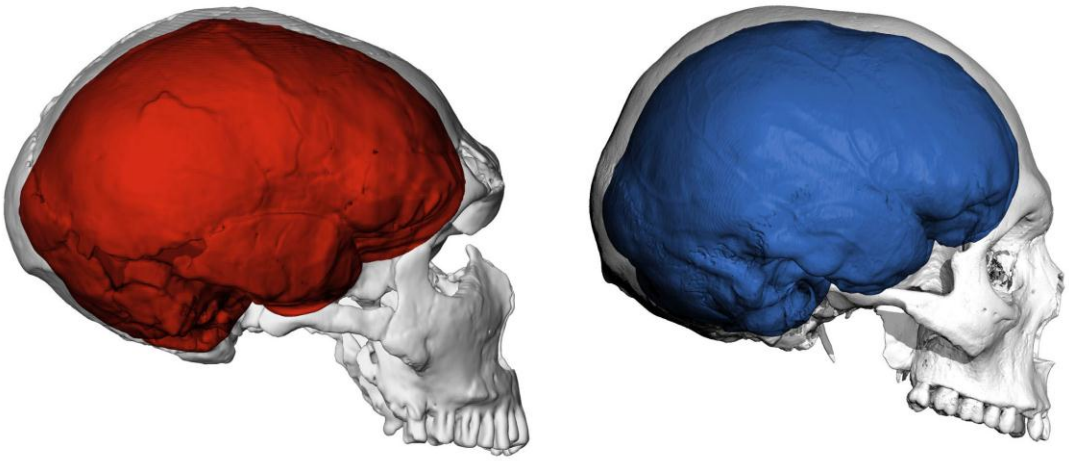

Image: Adult shape difference between modern humans (blue) and Neanderthals (red). (Image: Philipp Gunz, Max Planck Institute for Evolutionary Anthropology)

The increase of brain size is intimately linked to the evolution of humanity. Two different human species, Neanderthals and modern humans, have independently evolved large brains. Whereas the brain sizes of Neanderthals and modern humans overlap, their shapes differ. These shape differences could indicate a difference in the underlying brain organization.

In a study published this week by *Nature Communications*, led by Markus Bastir and Antonio Rosas, of the Spanish Natural Science Museum (CSIC), high-tech medical imaging techniques were used to access internal structures of fossil human skulls. The researchers used sophisticated 3D methods to quantify the shape of the basal brain as reflected in the morphology of the skeletal cranial base. Bastir and colleagues demonstrate that the human temporal lobes, involved in language, memory and social functions as well as the olfactory bulbs are relatively larger in *H. sapiens* than in Neanderthals. Markus Bastir and Antonio Rosas highlight that "*the structures which*

receive olfactory input are approximately 12% larger in H. sapiens than in Neanderthals".

These findings may have important implications for olfactory capacity and human behavior. In modern humans the size of the olfactory bulbs is related to the capacity of detection and discrimination of different smells. Olfaction is among the oldest sense in vertebrates and "*the only one that establishes a direct connection between the brain and its environment*" adds Markus Bastir, the lead author of an international research group. While other senses must pass through different cortical filters, olfaction goes from the environment right into the highest centres of the brain. Also, "*olfaction never sleeps*" adds Antonio Rosas, "*because we always breathe and perceive smells*". The neuronal circuitry of olfaction coincides with that of memory and emotion (the limbic system) "*which explains the enormous memory retention and vital intensity of olfaction-mediated life events*" explain the investigators.

Researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig, who also contributed to the current publication, could recently show differences in the patterns of brain development between modern humans and Neanderthals during a critical phase for cognitive development. "*In the first year of life the brains of Neanderthals and modern humans develop differently*," says Philipp Gunz from the Max Planck Institute of Evolutionary Anthropology in Leipzig. "*Modern humans have smaller faces and smaller noses than their Neanderthal cousins. However, the part of the brain that processes smells, is bigger in modern humans than in Neanderthals*," Philipp Gunz summarizes the intriguing results of the new study. "*Evidence is accumulating that Neanderthals and modern humans independently evolved large brains and that their brains might have worked differently. Our new study offers a glimpse into the functional significance of these developmental differences*," adds Jean-Jacques Hublin, who heads the Department of Human Evolution at the Max Planck Institute of Evolutionary Anthropology in Leipzig.

Olfactory information projects to brain regions directly responsible for processing of emotion, motivation, fear, memory, pleasure and also attraction. Neuroscientists have coined the term "*higher olfactory functions*" to describe those brain functions which combine cognition (memory, intuition, perception, judgment) and olfaction. The greater olfactory bulbs and relatively larger temporal lobes in *H. sapiens* compared to any other human species may point towards improved and different olfactory sense possibly related to the evolution of behavioral aspects and social functions.

Although traditionally olfaction in primates (and humans) has been considered a less important sense, the present study reflects an increasing trend of neurobiological investigation into this sensory modality, which re-evaluates its potential significance for the evolution of humanity.

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