What gave us the advantage over extinct types of humans?

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This image shows Hebrew University researchers (from left to right): Prof. Eran Meshorer, Dr. Liran Carmel and David Gokhman, plus an unidentified ancient "friend." Credit: Juan Schkolnik

In parallel with modern man (*Homo sapiens*), there were other, extinct types of humans with whom we lived side by side, such as Neanderthals and the recently discovered Denisovans of Siberia. Yet only *Homo sapiens* survived. What was it in our genetic makeup that gave us the advantage?

The truth is that little is known about our unique genetic makeup as distinguished from our archaic cousins, and how it contributed to the fact that we are the only species among them to survive. Even less is known about our unique epigenetic makeup, but it is exactly such

epigenetic changes that may have shaped our own species.

While genetics deals with the DNA sequence itself and the heritable changes in the DNA (mutations), epigenetics deals with heritable traits that are not caused by mutations. Rather, chemical modifications to the DNA can efficiently turn genes on and off without changing the sequence. This epigenetic regulatory layer controls where, when and how genes are activated, and is believed to be behind many of the differences between human groups.

Indeed, many epigenetic changes distinguish us from the Neanderthal and the Denisovan, researchers at the Hebrew University of Jerusalem and Europe have now shown.

In an article just published in *Science*, Dr. Liran Carmel, Prof. Eran Meshorer and David Gokhman of the Alexander Silberman Institute of Life sciences at the Hebrew University, along with scientists from Germany and Spain, have reconstructed, for the first time, the epigenome of the Neanderthal and the Denisovan. Then, by comparing this ancient epigenome with that of modern humans, they identified genes whose activity had changed only in our own species during our most recent evolution.

Among those genetic pattern changes, many are expressed in brain development. Numerous changes were also observed in the immune and cardiovascular systems, whereas the digestive system remained relatively unchanged.

On the negative side, the researchers found that many of the genes whose activity is unique to modern humans are linked to diseases like Alzheimer's disease, autism and schizophrenia, suggesting that these recent changes in our brain may underlie some of the psychiatric disorders that are so common in humans today.

By reconstructing how genes were regulated in the Neanderthal and the Denisovan, the researchers provide the first insight into the evolution of gene regulation along the human lineage and open a window to a new field that allows the studying of gene regulation in species that went extinct hundreds of thousands of years ago.

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