

# Geneticists Aim to Unravel Where Chimp and Human Brains Diverge

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Six million years ago, chimpanzees and humans diverged from a common ancestor and evolved into unique species. Now UCLA scientists have identified a new way to pinpoint the genes that separate us from our closest living relative – and make us uniquely human. The *Proceedings of the National Academy of Sciences* reports the study in its Nov. 13 online edition.

“We share more than 95 percent of our genetic blueprint with chimps,” explained Dr. Daniel Geschwind, principal investigator and Gordon and Virginia MacDonald Distinguished Professor of Human Genetics at the David Geffen School of Medicine. “What sets us apart from chimps are our brains: homo sapiens means ‘the knowing man.’”

“During evolution, changes in some genes altered how the human brain functions,” he added. “Our research has identified an entirely new way to identify those genes in the small portion of our DNA that differs from the chimpanzee’s.”

By evaluating the correlated activity of thousands of genes, the UCLA team identified not just individual genes, but entire networks of interconnected genes whose expression patterns within the brains of humans varied from those in the chimpanzee.

“Genes don’t operate in isolation – each functions within a system of related genes,” said first author Michael Oldham, UCLA genetics researcher. “If we examined each gene individually, it would be similar

to reading every fifth word in a paragraph – you don't get to see how each word relates to the other. So instead we used a systems biology approach to study each gene within its context.”

The scientists identified networks of genes that correspond to specific brain regions. When they compared these networks between humans and chimps, they found that the gene networks differed the most widely in the cerebral cortex -- the brain's most highly evolved region, which is three times larger in humans than chimps.

Secondly, the researchers discovered that many of the genes that play a central role in cerebral cortex networks in humans, but not in the chimpanzee, also show significant changes at the DNA level.

“When we see alterations in a gene network that correspond to functional changes in the genome, it implies that these differences are very meaningful,” said Oldham. “This finding supports the theory that variations in the DNA sequence contributed to human evolution.”

Relying on a new analytical approach developed by corresponding author Steve Horvath, UCLA associate professor of human genetics and biostatistics, the UCLA team used data from DNA microarrays – vast collections of tiny DNA spots -- to map the activity of virtually every gene in the genome simultaneously. By comparing gene activity in different areas of the brain, the team identified gene networks that correlated to specific brain regions. Then they compared the strength of these correlations between humans and chimps.

Many of the human-specific gene networks identified by the scientists related to learning, brain cell activity and energy metabolism.

“If you view the brain as the body's engine, our findings suggest that the human brain fires like a 12-cylinder engine, while the chimp brain

operates more like a 6-cylinder,” explained Geschwind. “It’s possible that our genes adapted to allow our brains to increase in size, operate at different speeds, metabolize energy faster and enhance connections between brain cells across different brain regions.”

Future UCLA studies will focus on linking the expression of evolutionary genes to specific regions of the brain, such as those that regulate language, speech and other uniquely human abilities.

Source: University of California, Los Angeles

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