'Junk DNA' defines differences between humans and chimps

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Junk DNA defines differences in humans and chimps. Credit: None

For years, scientists believed the vast phenotypic differences between humans and chimpanzees would be easily explained – the two species must have significantly different genetic makeups. However, when their genomes were later sequenced, researchers were surprised to learn that the DNA sequences of human and chimpanzee genes are nearly identical. What then is responsible for the many morphological and behavioral differences between the two species? Researchers at the Georgia Institute of Technology have now determined that the insertion

and deletion of large pieces of DNA near genes are highly variable between humans and chimpanzees and may account for major differences between the two species.

The research team lead by Georgia Tech Professor of Biology John McDonald has verified that while the DNA sequence of genes between humans and chimpanzees is nearly identical, there are large genomic "gaps" in areas adjacent to genes that can affect the extent to which genes are "turned on" and "turned off." The research shows that these genomic "gaps" between the two species are predominantly due to the insertion or deletion (INDEL) of viral-like sequences called retrotransposons that are known to comprise about half of the genomes of both species. The findings are reported in the most recent issue of the online, open-access journal *Mobile DNA*.

"These genetic gaps have primarily been caused by the activity of retroviral-like transposable element sequences," said McDonald. "Transposable elements were once considered 'junk DNA' with little or no function. Now it appears that they may be one of the major reasons why we are so different from chimpanzees."

McDonald's research team, comprised of graduate students Nalini Polavarapu, Gaurav Arora and Vinay Mittal, examined the genomic gaps in both species and determined that they are significantly correlated with differences in gene expression reported previously by researchers at the Max Plank Institute for Evolutionary Anthropology in Germany.

"Our findings are generally consistent with the notion that the morphological and behavioral differences between humans and chimpanzees are predominately due to differences in the regulation of genes rather than to differences in the sequence of the genes themselves," said McDonald.

The current analysis of the genetic differences between humans and chimpanzees was motivated by the group's previously published findings (2009) that the higher propensity for cancer in humans vs. chimpanzees may have been a by-product of selection for increased brain size in humans.

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