PublisherInfo		
PublisherName	:	BioMed Central
PublisherLocation	:	London
PublisherImprintName	:	BioMed Central

Chimp papers by the barrel

ArticleInfo		
ArticleID	:	5033
ArticleDOI	:	10.1186/gb-spotlight-20050902-01
ArticleCitationID	:	spotlight-20050902-01
ArticleSequenceNumber	:	96
ArticleCategory	:	Research news
ArticleFirstPage	:	1
ArticleLastPage	:	4
ArticleHistory	:	RegistrationDate : 2005–9–2 OnlineDate : 2005–9–2
ArticleCopyright	:	BioMed Central Ltd2005
ArticleGrants	:	
ArticleContext	:	130595511

Ishani Ganguli
Email: iganguli@the-scientist.com

A detailed comparison of the human and chimpanzee genomes reveals that some genes coding for transcriptional regulators may be evolving faster in humans, an international research consortium comprising 67 authors reports today in *Nature*. The paper, arriving a year and a half after the chimp draft, is accompanied by a cluster of studies in *Science*, *Genome Research*, and *Nature* that use this powerful comparative tool to assess gene-expression patterns across different organs, test a prevailing theory about Y-chromosome evolution, and find elements and mediators of genomic variation.

The sequence should expand the scope of chimpanzee research say those involved, and may aid in investigations into what makes humans human. "The chimp genome is exciting because it gives us the raw material to ask that question," said Michael Eisen at the University of California, Berkeley, who did not participate in these studies.

Chimps and humans split from a common ancestor 6 million years ago; the comparison shows that human and chimpanzee genomes are 96% identical, but it is the differences between the species–as many as 3 million of which fall in functional areas of the genomes–on which research now focuses.

According to the main study, the catalog of genetic differences includes about 35 million single-nucleotide changes, 5 million insertion/deletion events, and a number of other chromosomal rearrangements. Members of the consortium assessed deviations from expected mutation patterns. In the human genome, they found evidence of selective sweeps in the past quarter million years in regions containing genes like *FOXP2*—which has been associated with speech acquisition in humans.

Some genes are evolving more rapidly in humans than in chimps, particularly transcriptional regulators, according to the paper. They also found that both humans and chimps have acquired more potentially deleterious mutations than mice, rats, and other rodents—perhaps making them better able to adapt to a changing environment.

In another study, Wolfgang Enard and colleagues at the Max-Planck Institute for Evolutionary Anthropology in Germany looked at protein sequences and expression patterns for genes in various chimp and human tissues and found a gradation of selective constraints on the organs they studied. While the brain showed the fewest differences between the species, genes active in the brain have accumulated more changes in humans than in chimpanzees. The researchers also found evidence of positive selection in human evolution for X-chromosomal genes expressed in testis. According to Enard, this is probably because "it's so directly relevant for reproduction. If I am a sperm and I have a mutation that lets me divide faster…it will have a huge effect on my distribution," he told *The Scientist*.

A group at the Whitehead Institute, which had previously sequenced the human Y chromosome, compared it to the chimp's Y-chromosome sequence to assess the widely held "impending demise" hypothesis: that the 16 unique genes on the human Y chromosome which don't have gene-conversion partners, will completely disappear in the next 10,000 years. Contrary to the hypothesis, they found that all of the genes were actually *maintained* in humans since they diverged from chimps, but that five of them had been inactivated in the chimp's Y chromosome.

For our more "promiscuous" cousins, "sperm competition is intense," said Jennifer Hughes, a postdoctoral scientist at the Whitehead Institute and first author on the study. So her group speculated that the strong selective pressure on the Y-linked genes coding for such male fertility traits–which are found in palindromes that give the genes pairing partners–outweighs the drive to maintain those 16 "partnerless" genes in chimpanzees. Hughes said these unique genes are "civilian casualties in the sperm wars." She told *The Scientist*, "We're hoping this will put the [impending] demise theory to rest once and for all."

Two other studies looked more at elements of genomewide variation. A team led by Evan Eichler at the University of Washington School of Medicine in Seattle showedthat segmental duplications have a much greater impact on genome differences between species than previously realized. They found that these "large-scale genetic events" altered about 2.7% of the genome, while the more commonly studied single base-pair changes account for changing 1.2% of the genome. The researchers found that several duplicated genes associated with developmental disorders in humans were single-copy in the chimp genome, suggesting that the chimpanzees may not be disposed to the same diseases. They also connected much of the species-specific duplications to differences in gene expression.

A study by researchers in Canada and Sweden compared human and chimp genomes with that of the more primitive Rhesus monkey and found that retroelements, or "jumping genes," have been deleted in the course of evolution; they also found a possible mediator of these retroelement deletions and of thousands of insertion-deletion sequence differences between human and chimp genomes: short identical sequences flanking deleted regions.

This work brings us closer to understanding what makes a human, said Chris Gunter, senior editor at *Nature*, a question that, she said, "gets more hits on Google than 'What is the meaning of life?'" Eisen noted, however, "Whether these [genetic differences between humans and chimps] really truly contribute to some esoteric sense of humanness is hard to know."

According to Wen-Hsiung Li, who co-wrote a News and Views accompanying the article, the next steps must involve "functional testing" to determine what genetic changes are "biologically meaningful."

The chimpanzee is the fourth mammal to have its genome sequenced; with the orangutan, gorilla, and macaque genome sequences in the works, scientists will have an even more powerful set of tools to parse human evolution, Li said.

References

1. The Chimpanzee Sequencing and Analysis Consortium, "Initial sequence of the chimpanzee genome and comparison with the human genome," *Nature* doi:10.1038/nature04072, [http://www.nature.com]

2. E. Russo, "Chimp genome released," *The Scientist*, December 12, 2003. , [http://www.the-scientist.com/news/20031212/07/]

3. Michael Eisen, [http://rana.lbl.gov/EisenPeople.htm]

4. P. Khaitovich et al., "Parallel patterns of evolution in the genomes and transcriptomes of humans and chimpanzees," *Science* doi:10.1126/science1108296, [http://www.sciencemag.org]

5. J.F. Hughes et al., "Conservation of Y-linked genes during human evolution revealed by comparative sequencing in chimpanzee," *Nature* doi:10.1038/nature04101 , [http://www.nature.com]

6. Jennifer Hughes, [http://inside.wi.mit.edu/page/Site/LabMembersPage.html]

7. Evan Eichler, [http://eichlerlab.cwru.edu/eichler/]

8. Z. Cheng et al., "A genomewide comparison of recent chimpanzee and human segmental duplications," *Nature* doi:10.1038/nature04000, [http://www.nature.com]

9. L.N. van de Lagemaat et al., "Genomic deletions and precise removal of transposable elements mediated by short identical DNA segments in primates," *Genome Research*, 15:1243-49, 2005., [http://www.genome.org]

10. Wen-Hsiung Li, [http://pondside.uchicago.edu/ecol-evol/faculty/li_w.html]

11. W. Li, M.A. Saunders, "The chimpanzee and us," *Nature* doi:10.1038/nature04072, [http://www.nature.com]