Origin of the X Chromosome

by Craig Paardekooper

In my previous investigations of the Y chromosome, I had found that, of all primates, the human Y chromosome was most similar to the gorilla Y chromosome, and was LEAST similar to the chimp Y chromosome out of all known primates. See here. This was a surprise, and suggested that the human X chromosome might also be of uncommon descent.

Method

So, with an open mind, I looked at the X chromosome from 10 different primates, to see which was most similar to the human X chromosome.

I counted the frequency of occurrence of each of the 64 codons in – chimpanzees, bonobos, gorillas, orangutans, baboons, gibbons, marmosets, green monkeys, rhesus monkeys and lemurs.

The software used was created by myself, and able to loop through each chromosome in chunks of 300 x 70 bases, and count the frequency of each codon at a rate of 2 million bases per second.

Results

Species	Number of codon changes	% change
Chimpanzee	2,288,248	4.66%
Bonobo	1,995,112	3.74%
Gorilla	7,764,265	13.12%
Orangutan	2,777,045	5.12%
Gibbon	4,994,846	10.76%
Baboon	3,832,635	8.06%
Rhesus	610,717	1.2%
Marmoset	3,195,093	6.63%
Green Monkey	980,475	1.94%
Lemur	27,716,727	116.97%

The % change is the absolute difference in each codon frequency summed, then divided by the total size in codons of the primate chromosome. So, it represents the % of the primate chromosome that must change in order to generate a human X.

This is a quantitative measure, and does not include differences in ORDER of the codons, which would further amplify differences.

The excel files, with graphs are all available as a zip file here.

Human X is most similar to rhesus X.

Discussion

In every species examined, the codon frequencies follow an octave pattern where –

- Octave 1 = octave 5
- Octave 2 = octave 6
- Octave 3 = octave 7
- Octave 4 = octave 8

Current Research

Current research confirms that human X is close to rhesus X –

- https://monkeys.alloftheanimals.com/how-similar-are-human-genes-to-those-of-rhesus-monkeys.html
- https://science.psu.edu/news/analysis-rhesus-monkey-genome-uncovers-differences-humans-chimps

Animal Models

Perhaps this is why rhesus monkeys are often used by pharma in chemical experiments – because they provide a closer animal model to us. (Such experiments are highly unethical – we have no right to subject any animals to such suffering regardless of our hypothetical needs).

Natural Law

When we look to nature for clues as to what is natural behaviour, it makes sense that we should not look at insects, reptiles, fish, amphibians or even at mammals in general; rather we should look at the behaviour of those creatures closest to ourselves. In the case of the X and Y chromosomes this would be the rhesus and the gorilla respectively.

Will we conclude that nature is "red in tooth and claw"? Does nature support the idea that a kind of prolonged, psychopathic, predatory individualism, is the norm?

To answer this, we can look at the behaviour of the gorilla and rhesus, and compare it to the behaviour of the chimp from whence we are supposed to have "evolved".

Species	Behavioural Traits	Social Structure
Chimp	Highly intelligent and manipulative. Tool use and deception. Display of aggression and territoriality	Fission-fusion societies with shifting alliances. Frequent dominance struggles and violent outbursts. Known for "chimp wars" and lethal raids
Rhesus	Rich behavioural repertoire. Strong vocal facial communication. Hierarchical, peaceful. Less inclined to violence.	Rigid dominance hierarchies especially among males. Grooming and posturing used to maintain order. Aggression is ritualised and less lethal.
Gorilla	Gentle, emotionally expressive. Strong familial bonds. Rarely aggressive unless provoked	Led by dominant silverback who mediates and protects. Stable troops with low internal conflict. Play and grooming reinforce social harmony.

Gorilla Males

"The Silverback's Reign: A Portrait of Male Gorilla Life

In the mist-laced forests of equatorial Africa, the silverback gorilla reigns not as a tyrant, but as a guardian and guide. Towering in stature and cloaked in a mantle of silvery hair that marks his maturity, the silverback is the patriarch of his troop—a cohesive family unit typically comprising several adult females, their offspring, and occasionally subordinate males known as blackbacks.

His role is multifaceted and deeply relational. As the troop's leader, the silverback makes all critical decisions: when to rise, where to forage, when to rest, and how to respond to threats. He is the arbiter of disputes, the sentinel against predators, and the emotional anchor of the group. Despite his formidable strength and imposing presence, aggression is rare and often ritualized—chest-beating, hooting, and bluff charges serve more as deterrents than declarations of war.

Social harmony is his currency. He maintains close bonds with each female, often grooming and reassuring them with gentle gestures. The young cling to him with trust, climbing over his broad back or nestling beside him during midday rests. His authority is not enforced through fear, but earned through protection, consistency, and calm dominance.

Yet his reign is not eternal. As blackbacks mature, they may challenge his leadership or quietly depart to form their own troops. The silverback's legacy, then, is not only in the genes he passes on, but in the stability he fosters—a living testament to the power of peace, presence, and paternal care in the heart of the wild".

https://www.insidebwindiforestnationalpark.com/mountain-gorilla-social-behavior.html

Rhesus Females

"The Matrilineal Web: A Portrait of Female Rhesus Life

In the bustling social tapestries of rhesus macaque troops, it is the females who weave the threads of continuity and cohesion. Born into tightly knit matrilines, female rhesus macaques remain in their natal groups for life, anchoring the troop's structure with inherited rank and enduring alliances. Their social world is hierarchical, but not rigidly oppressive—dominance is expressed through subtle cues, ritualized gestures, and strategic grooming rather than brute force.

Each female's status is largely determined by her mother's rank, and daughters inherit not only position but also allies. Grooming is the currency of trust, exchanged generously among kin and cautiously with non-relatives. High-ranking females enjoy priority access to resources and social support, while lower-ranking individuals navigate the hierarchy with deference and diplomacy.

Conflict, though present, is often buffered by the strength of familial bonds. Females form coalitions to defend their kin, and disputes are resolved through reconciliation behaviors like grooming and proximity. Emotional temperament plays a role too—pairs with similar nervous or emotional profiles tend to experience smoother interactions, suggesting a nuanced social intelligence that favors compatibility over mere dominance.

Communication is rich and layered. From expressive facial signals to nuanced vocalizations like coo calls, females convey familiarity, intent, and emotional state. These calls even reflect social experience more than genetic relatedness, hinting at a culture of learned resonance within matrilines.

In this matrilineal web, female rhesus macaques are not just participants—they are architects of social stability, emotional nuance, and generational continuity. Their lives unfold in a dance of dominance and diplomacy, where kinship is both shield and scaffold, and where the quiet strength of maternal lineage shapes the rhythm of the troop."

https://www.mdpi.com/2076-2615/11/8/2452

https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0161133

Chimpanzee Males

> *"The Calculated Brotherhood: Male Chimpanzee Social Life and Conflict*
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> *In the dense forests of equatorial Africa, male chimpanzees live within a fission-fusion society that pulses with tension, strategy, and shifting alliances. Unlike females, who often disperse from their natal groups, males remain rooted in their birth communities for life, forming the political and territorial backbone of chimpanzee society. Their social world is hierarchical, but not static—dominated by an alpha male whose status is constantly challenged by ambitious rivals.*
>
> *Dominance among males is not simply a matter of brute strength. It is earned and maintained through a complex interplay of aggression, alliance-building, and social intelligence. Pant-hoots, charging displays, and ritualized aggression signal rank and intent, while grooming serves as both a social balm and a political currency. Males form coalitions—temporary, strategic partnerships designed to elevate status or unseat a rival. These alliances are fluid, often dissolving when power shifts or when betrayal offers a better reward.*
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> *Conflict is woven into the fabric of male chimpanzee life. Within the group, dominance disputes can escalate into violent confrontations, though they are often resolved through post-conflict reconciliation behaviors such as grooming or proximity. Between groups, aggression takes a darker turn. Male chimps conduct coordinated boundary patrols, moving silently through the forest in search of intruders. When they encounter isolated individuals from rival communities, they may launch lethal attacks—acts of intergroup warfare that reflect both territorial defense and strategic elimination of competition.*
>
> *Despite their reputation for aggression, male chimpanzees are emotionally complex. They mourn the loss of companions, engage in playful interactions with juveniles, and show empathy in moments of distress. Their behavior reflects a blend of instinct, learned strategy, and social nuance—an evolutionary mirror to the roots of human conflict and cooperation.*
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> *In this world of calculated brotherhood, male chimpanzees navigate a landscape where dominance is earned through foresight, timing, and the ability to read both allies and adversaries. Their lives are a constant negotiation of power, trust, and survival—an intricate dance of politics played out beneath the forest canopy."*
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> *https://www.africangorilla.com/information/chimpanzee-behavior/*
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> *https://dukespace.lib.duke.edu/bitstreams/dbb6a98c-1fa1-4a29-bcf7-61e7f275d1a5/download*
>
> *https://wildezoo.com/articles/male-chimpanzee-behavior-ecological-role/*
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> *https://wildezoo.com/articles/male-chimpanzee-behavior-ecological-role/*

If we share male and female behaviour with those primates that are closest to us, then we may have inherited the greater stability and peace of rhesus and gorilla, rather than the opportunistic violence and instability of more distant chimps.

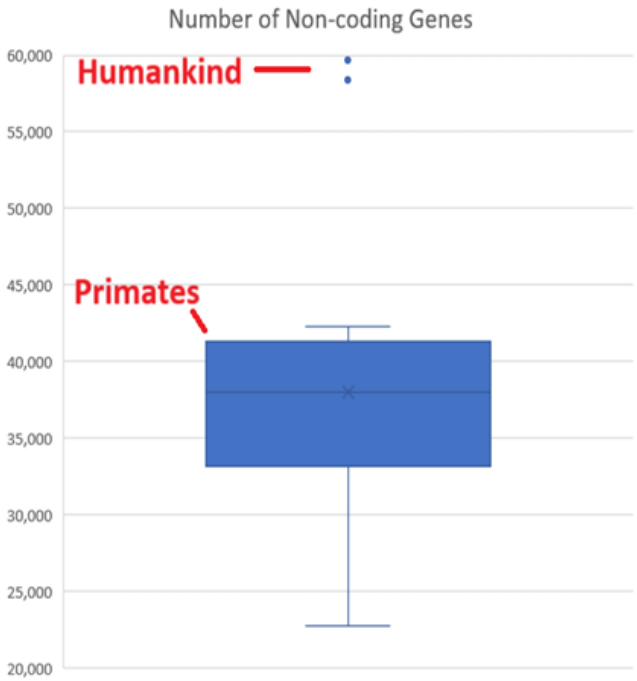
Mother X, Father Y and Mystery Z

The frequency of codons provide a means of measuring similarity between chromosomes, yet this disregards the codon order. In particular it disregards the number of unique genes found in each species.

Humans possess some genes that are missing from apes. Amongst protein coding genes these include genes for brain development, speech development, tail loss, hair loss and manual dexterity, amongst others. There are also non-coding genes involved in gene regulation that we do not share with apes – see https://howbad.info/gene-distribution.pdf

Comparator	Species	Protein Coding genes	Non-Coding genes	Reference	Chromosomes shown
	Human	20,078	59,715	Human Genome 1	All
	Human	20,071	58,422	Human Genome 2	All
1	Bonobo	22,890	38,533	Bonobo Genome	All
2	Chimpanzee	22,561	41,789	Chimpanzee Genome	All
3	Gorilla	22,640	41,169	Gorilla Genome	All
4	Orangutan	22,085	37,497	Orangutan Genome 1	All
5	Orangutan	22,189	41,736	Orangutan Genome 2	All
6	Gibbon	22,102	38,417	Gibbon Genome 1	All
7	Gibbon	20,527	33,914	Gibbon Genome 2	All
8	Baboon	21,087	39,274	Baboon Genome	All
9	Lemur	19,990	30,858	Lemur Genome	All
10	Green Monkey	20,783	35,179	Green Monkey Genome	All
11	Rhesus Monkey	21,121	40,304	Rhesus Genome	All
12	Marmoset	22,867	42,308	Marmoset Genome	All
13	Tarsier	20,017	28,305	Tarsier Genome	None
14	Mangabey	20,614	30,556	Mangabey Genome	None
15	Colobus Monkey	20,103	27,654	Colobus Genome	None
16	Snub-Nosed Monkey	21,094	34,842	Snub Nosed Genome	No X or Y
17	Siamang	22,102	38,417	Siamang Genome	All
18	Aotus	21,779	37,568	Aotus Genome	None
19	Capuchin Monkey	21,544	36,525	Capuchin Genome	None
20	Sifaka	19,391	22,796	Sifaka Genome	None
21	Crab-Eating Macaque	21,291	40,596	Crab Macaque Genome	All

Clickable links are found at https://howbad.info/gene-distribution.pdf



Protein Coding Genes: The number of human protein coding genes is (20,078), which is 1.22 standard deviations from the mean for the primates.

Non-Coding Genes: The number of human non-coding genes is (59,715), which is 4.42 standard deviations from the mean for the primates.

Degree of Divergence from a "Common Ancestor": Primates (including humans) barely diverge from a hypothetical common ancestor for the protein-coding genes, since these are the basic building blocks for all mammals. However, for non-coding genes, humans far exceed the divergence of other primates by more than 4 standard deviations.

Nature of the Divergence: The primary difference between humans and primates lies in the non-coding genes that regulate how and when the protein coding genes are expressed.

Even if we have inherited an X and Y from primates, about one third of our non coding genes are unique to humans and therefore outside any primate lineage.

To mother X and father Y we can add a mystery Z, which we might consider our non-physical lineage – our Father in Heaven.