Selfish genes take sides in the battle of the sexes

August 12 2020

The Battle of the Amazons (second version). Credit: Anselm Feuerbach (1873)

Men may have a surprising genetic advantage over women, according to new research carried out at the University of St Andrews.

The study, published today in *Proceedings of the Royal Society Series B*, focused on genes that are present on the X chromosome, which is carried by individuals of both sexes but with females typically having a double dose.

Traditionally, the over-representation of the X chromosome among females has been thought to lead to a genetic blueprint that benefits females at the expense of males. But the St Andrews team have shown that, in many cases, the X chromosome instead sides with males in the battle of the sexes.

Thomas Hitchcock, of the School of Biology at the University of St Andrews, who led the study, said: "A mechanism of 'dosage compensation,' which doubles the expression of X chromosome genes in males relative to females, is present in many tissues and in many species. This can shift the interests of the X chromosome away from what most benefits females and toward what works better for males. In addition, the average ages of mothers and fathers in the population can also tilt the balance of genes' interests in favor of one sex. If, as in humans, the average father is older than the average mother, then our model shows that this will lead almost all genes to shift their interests toward what works best for males."

The research didn't specifically focus on human genetics and instead applies to all creatures that exhibit sex differences. Across the animal kingdom males and females of the same species can differ remarkably in their size, shape, life-history and behavior. Males of the blanket octopus, for instance, are barely the size of the female's eye, and males of the rusty tussock moth grow large ochre wings while females have tiny vestigial ones.

However, despite these striking differences, the two sexes generally share the same genome—the set of genetic instructions that act as a

blueprint for building an organism. This can lead to problems, as the genome that encodes the best male might not be the one that encodes the best female, and any evolutionary advance that better serves the interests of males is likely to come at the expense of females.

The new research has shown how genes themselves can take sides in this battle of the sexes, according to where in the genome they are found and on aspects of the species' lifestyles, such as whether mums tend to be younger than dads.

This new insight might explain a puzzle that has been noted by medical researchers, where, although women tend to live longer than men, they also tend to show faster signs of aging. The "male-female health-survival paradox" could be a result of the genes showing a bias toward males because they tend to have children at an older age.

The researchers also considered the interests of a range of other genetic factions, including the male-only Y chromosome, mitochondria that are carried by both sexes but primarily inherited down the female line, and autosomes that are inherited in a way that is completely unbiased with regards to sex.

Professor Andy Gardner of the School of Biology at the University of St Andrews, who was also involved with the research, added: "In general, these different parts of the genome will disagree about how best to balance the fitness of females against males.

"This can lead to an interesting intragenomic conflict, where an individual's own genes can go to war against each other, and the fallout from that is expected to be harmful for both females and males."

More information: Thomas J. Hitchcock et al. A gene's-eye view of sexual antagonism, *Proceedings of the Royal Society B: Biological Sciences*

(2020). DOI: 10.1098/rspb.2020.1633