The paradox of different house flies with few genetic differences

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Richard Meisel, University of Houston assistant professor of biology and biochemistry, is reporting slight genetic differences in male house flies from the north and south. Credit: University of Houston

In the steamy, often filthy world of the humble house fly, (the Musca domestica) clear division exists among the males of the species. Though not a civil war, there are differences, to be sure, between males in the

north and those that hail from the south. Finding out why those differences appear in the genetic sequences of the northerners and southerners is key to understanding nothing less than sex determination, but there is an essential paradox: The genetic difference is trivial.

"We are seeing a physical difference and that tells us we will see a genetic difference that gives rise to the physical difference, but we find very little genome differences," reports Richard Meisel, UH assistant professor of biology and biochemistry, in the September cover article of *Genetics* journal. The physical alteration suggests temperature is a meaningful difference between the two types of males.

"We want to know how these things that are so physically different in an evolutionarily meaningful way can have such similar genetics," said Meisel.

The heart of Meisel's work is sex determination. Scientists understand it relatively well in humans—a gene on the Y chromosome initiates the male developmental process, and the process is the same in almost all mammals. But outside the class of mammals, sex determination operates differently. The house fly has substantial variation in how the male/female decision is made. There are two common ways that male development can be initiated, and they differ in their geographical distributions. One male-determining variant predominates at northern latitudes, and the other is more common in the south.

Y is why

Though minute, the difference between the two types of flies is the position of the Y chromosome in the sequence of the genes.

"If Y is the reason then there has to be something genetically about that chromosome that allows it to be that reason," said Meisel. "It's hard for

us to wrap our heads around how that trivial amount of difference in the genome sequence causes this variation," said Meisel, adding that evidence indicates natural selection maintains sex determination in the house fly.

Along with graduate student Jae Hak Son, Meisel examined Y chromosomes by performing mRNA-sequencing experiments to measure gene expression in male house flies carrying different Y chromosomes. The exploration allows him to identify candidate phenotype differences between males upon which natural selection can act to maintain the variation in sex determination.

"Our results suggest that, if natural selection maintains polygenic sex determination in house fly via gene expression differences, the phenotypes under selection likely depend on a small number of genetic targets," he said.

More information: Jae Hak Son et al, Minimal Effects of Proto-Y Chromosomes on House Fly Gene Expression in Spite of Evidence That Selection Maintains Stable Polygenic Sex Determination, *Genetics* (2019). DOI: 10.1534/genetics.119.302441

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