Scientists find a key to growth differences between species

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Two Nasonia wasps, *N. giraulti* (left) and *N. vitripennis* (right), have significantly different wing sizes. Credit: Mike Osadciw/University of Rochester.

The tiny, little-noticed jewel wasp may provide some answers as to how different species differ in size and shape. And that could lead to a better understanding of cell growth regulation, as well as the underlying causes of some diseases.

Using the wings of these insects as a tool to study how growth is regulated, biologists at the University of Rochester have discovered that changes in expression of a well-known cell regulator gene called "unpaired" (upd) accounts for wing growth differences between males of closely related species. Unpaired is distantly related to a class of genes called "interleukins'" which affect cell growth and specialization in humans. The discovery illustrates the principle that animals—from

insects to humans—often use the same "genetic toolkit," despite immense differences in their biology. The findings are being published in the current issue of the journal *Science*.

Prof. John (Jack) Werren and doctoral student David Loehlin isolated the gene causing the wing difference through a technique called positional cloning. The large-winged N. giraulti and small-winged N. vitripennis wasps were crossbred, resulting in hybrid wasps with mixed chromosomes. Afterwards, the offspring with the largest wings were crossbred with pure N. vitripennis wasps, until, after ten generations, Werren and Loehlin had pure N. vitripennis wasps, with one exception: The young wasps now had DNA for large wings. They then used the same method to "break" the isolated genetic material into parts, in order to investigate how DNA flanking the gene affected its regulation and growth of the wings.

"The NIH had already supported sequencing of the genomes of the wasps, so we had the necessary tools to do the work," said Werren. Specifically, Werren and Loehlin found that the change in wing size wasn't due to the gene, but to the regulation of the gene.

"The DNA sequence next to the gene controls where in the wing the gene is turned on or off," said Loehlin, the first author of the research project. "This is one of the first cases where scientists have found genetic material responsible for naturally-occurring growth differences in animals."

Normal growth regulation is also required for an animal to develop, and inappropriate regulation of growth causes disease, including cancer. "This work is another clear example that regulating the activity of genes contributes to the incredible diversity of life on Earth," said Susan Haynes, Ph.D., who oversees developmental biology grants at the National Institutes of Health's National Institute of General Medical

Sciences, which partially funded the work. "In this case, modulating the activity of a gene for cell growth reshapes and resizes a wasp's wing. Because insects and humans use similar genetic networks to create organs, this research could help us better understand our own development and the underlying causes of certain diseases."

Nasonia are emerging as a model insect for research because the male wasps are haploid, which means they have only one set of chromosomes, while the females are diploid, having two sets of chromosomes. Since a single gene in a male wasp controls a given trait—without consideration for whether that gene is dominant or recessive—the result is that physical changes to the male wasps showed up more quickly from one generation to the next.

More information: "Evolution of Shape by Multiple Regulatory Changes to a Growth Gene," by D.W. Loehlin, et al, *Science* (2012).

Provided by University of Rochester

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