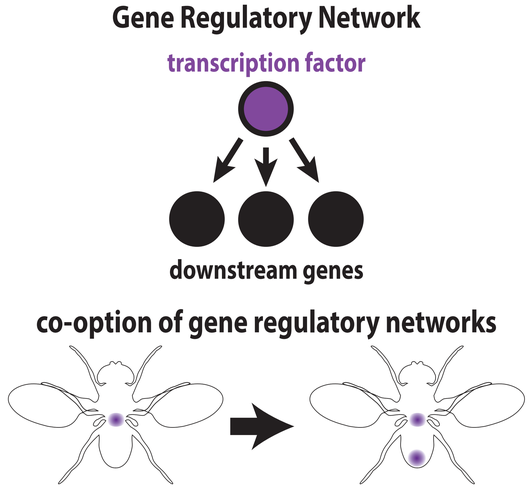
Evolving a novel trait through co-option of the *shavenbaby* gene regulatory network

Gavin Rice*, Kenechukwu Charles-Obi, Mark Rebeiz

Department of Biological Sciences, University of Pittsburgh

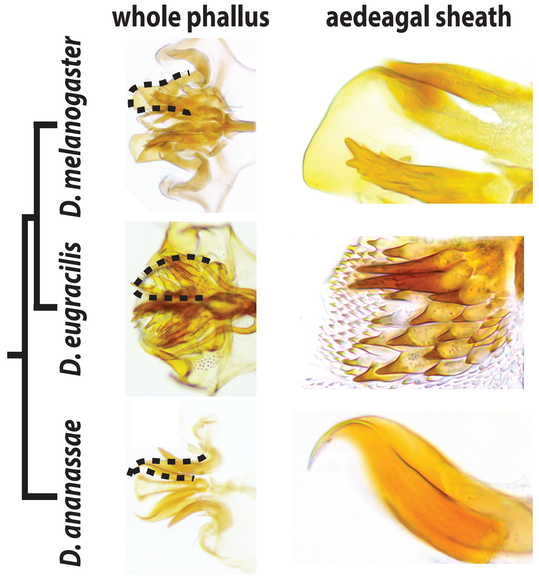
*Corresponding Author: grr24@pitt.edu, @gavinrrice, @rebeizlab

I. How do new traits originate and diversify?



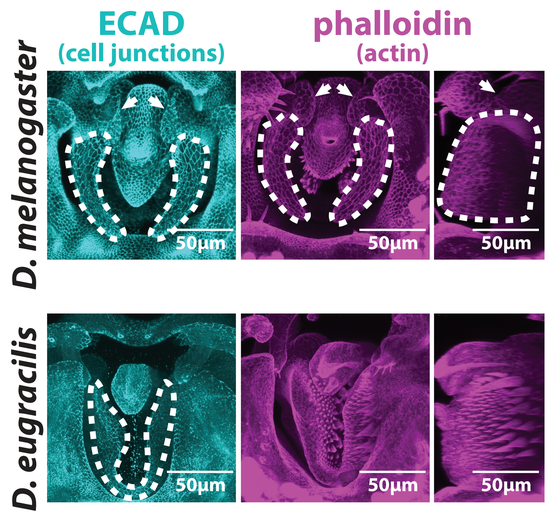
- We study how **gene regulatory networks** (**GRN**), sets of co-regulated genes, are built in recently evolved traits.
- One way to generate a new trait is through **GRN co-option**, where a gene regulatory network is redeployed in a new region of the body or at a new developmental timepoint.

II. Expansion of phallic spikes in *D. eugracilis*



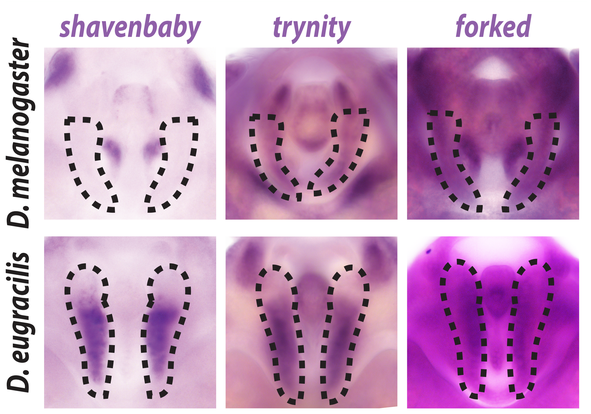
- We investigated the role of co-option in the rapidly evolving genitalia of *Drosophila*.
- **We found that *D. eugracilis* has a dramatic increase in the number of spikes attached to the aedeagal sheath.**

III. *D. eugracilis* spikes are unicellular



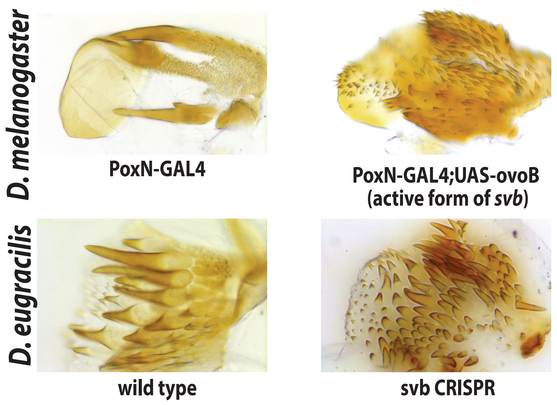
- Despite overt similarity in appearance the phallic spikes of *D. melanogaster* and *D. eugracilis* form through different cellular mechanisms.
- *D. melanogaster* spikes (white arrows) are multicellular while ***D. eugracilis* spikes are unicellular projections.**

IV. Expression of the *shavenbaby* GRN correlates with the origin of unicellular spikes



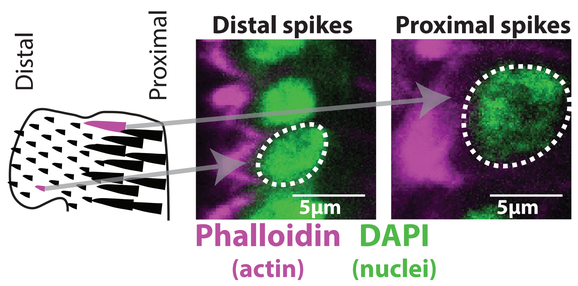
- Work from the Stern and Payre labs found that unicellular projections in *Drosophila* larva are generated by the *shavenbaby* GRN.
- We find that *shavenbaby* and two of its downstream genes (*trynity* and *forked*) have gained expression in the aedeagal sheath of *D. eugracilis*.
- **This indicates that the *shavenbaby* GRN may have been co-opted during the origin of the unicellular phallic spikes.**

V. *shavenbaby* is necessary and sufficient for the formation of unicellular spikes



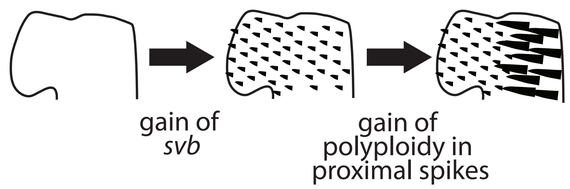
- Expressing *shavenbaby* in the non-spiked *D. melanogaster* induces spikes while CRISPR mediated mutation of *shavenbaby* in *D. eugracilis* reduces its spikes.

VI. Large spikes in *D. eugracilis* show increased nuclear size



- The distal portion of *D. eugracilis* sheath contains small spikes while the proximal portion contains large spikes.
- Nuclei size, as assayed via DAPI, correlates with spike size, indicating that **the large spikes may have increased ploidy**

VII. Points for discussion



- **What is the functional role of phallic spikes?**
- **What genes induce the multicellular spikes seen in *D. melanogaster*?**
- **What molecular mechanisms induce the large unicellular spikes in *D. eugracilis*?**

Acknowledgments

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