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TITLE Evolution of olfactory circuits

ACRONYM EVONEURO

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Nervous systems have undergone remarkable diversification in their structure and function as animals have adapted to distinct ecological niches. What are the genetic mechanisms underlying neural circuit evolution? The project addresses this fundamental question in the Drosophila olfactory system, a superior ""evo-neuro"" model for several reasons: (i) as in mammals, the Drosophila olfactory system has a modular organization, with individual olfactory receptors functionally and anatomically defining discrete sensory circuits that can be traced from the periphery to the brain; (ii) these circuits are dynamically evolving, with frequent acquisition (and loss) of receptors, olfactory neurons and odor-evoked behaviors with the ever-changing landscape of environmental volatiles; (iii) Drosophila offers unparalleled experimental accessibility to visualize and manipulate neural circuits; (iv) a wealth of insect genomes permits comparative studies to relate intra- and interspecific genotypic and phenotypic variation. Five aims address distinct aspects of olfactory circuit evolution:

1. Evolution of receptor specificity;
2. Evolution of receptor expression;
3. Evolution of sensory neuron targeting;
4. Evolution of interneuron wiring;
5. Evolution of olfactory behavior.

This multidisciplinary project uses cutting-edge approaches in comparative genomics, electrophysiology, neurogenetics, transcriptomics, behavioral tracking and population genetics. By addressing how particular olfactory circuits and behaviors have evolved in Drosophila, it will provide general insights into the genetic mechanisms of nervous system evolution relevant both for other brain regions and for other species. We also anticipate that determining how brains have been sculpted through random mutation and natural selection in the past may enable future directed manipulation of the connectivity and activity of neural circuits, to enhance our understanding of brains and our ability to repair them.