We are looking for highly motivated mater's students with a strong interest in neuroscience, behavior, and genetics, to investigate sensory contexts that promote approach in *Drosophila melanogaster*.

Sensory contexts motivating initial approach to another fly

Fruit flies live on food substrates together with many other flies of the same or similar species, where social interactions are abundant. Drosophila males rely on visual cues to approach distant flies (Figure 1A, Ribeiro, et al, 2018), since close proximity enables detection of chemosensory cues that reveal the species, sex and receptiveness of the other fly (Clowney et al., 2015). However, approaching another fly could be nefarious if the other fly is a competitor or a predator. Flies rely on multimodal sensory information to decide whether to approach partners to interact and prevent nefarious consequences. The presence of food might signal a favorable environment, with a high likelihood that conspecifics are around. However, the sensory contexts that prompt a male to approach another fly, and their combination with visual information, remain incompletely understood.

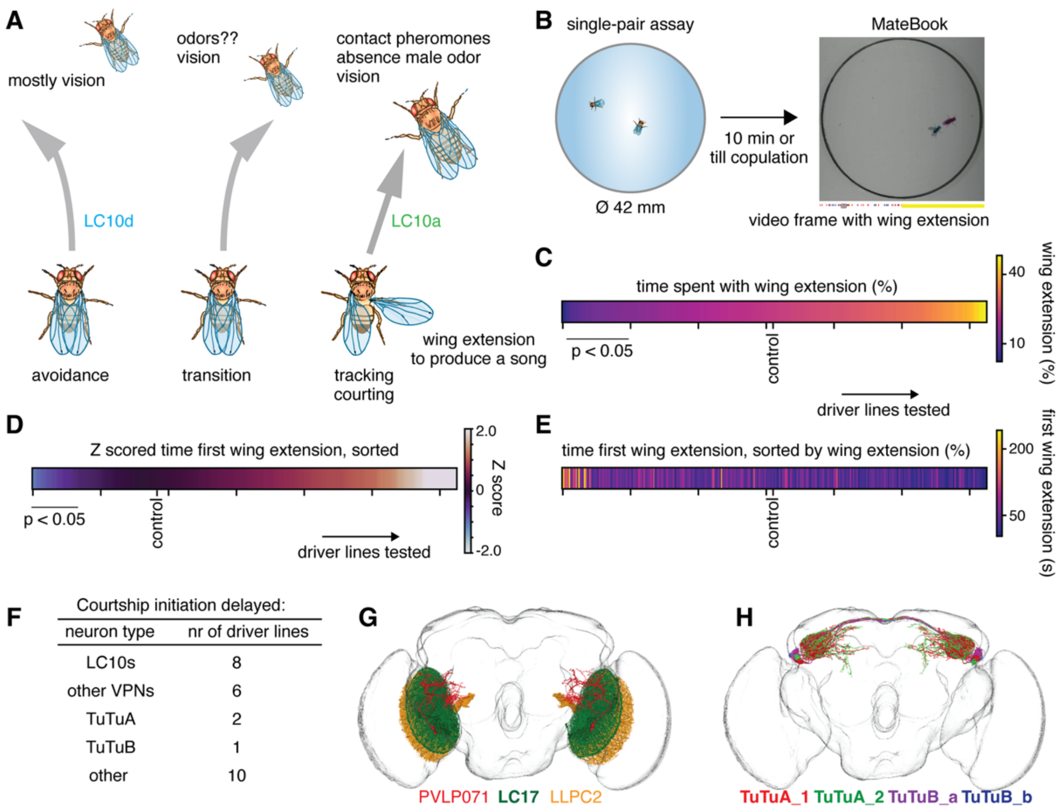

Figure 1: A. Distant animals are perceived as visual objects without a chemosensory profile and are actively avoided. In specific sensory contexts, males stop avoiding and approach another fly. Contact pheromones elicit courtship. **B.** Schematic for single pair assays, with an example of MateBook tracking. **C-E.** 300 tests ranked for mean wing extension percentage (C,E) or Z score for time of first wing extension (D). **F.** List of neuron types and number of driver lines leading to delays in courtship initiation if expressing a blocker of neurotransmission. **G-H.** The two major neuron pathways leading to delays in courtship initiation if silenced.

Drawing on driver lines specific to single neuron types, a robust behavioral paradigm and quantification of behavior (Figure 1B), we are conducting a large silencing screen searching for neurons that result in a delay in initiation of courtship in single pair assays once silenced. The extension of a single wing to produce a species-specific courtship song is a behavioral action that occurs exclusively during courtship. We use the percentage of time the male spends in wing extension to measure courtship intensity, and the time of the first wing extension bout to measure the time the male takes to transition from avoiding a distant fly devoid of a chemosensory profile, to tracking (Figure 1A) (Ribeiro et al., 2026, 2018). We found several driver lines that displayed a significant decrease in percentage of time in wing extension when expressing a neurotransmission blocker, that showed no delay in courtship initiation (Figure 1C, E). The reverse was also true: blocking neurons in several driver lines led to a delay in courtship initiation without a noticeable decrease in wing extension levels. This suggests that courtship initiation can be functionally dissociated from courtship intensity.

Our initial results suggest that there are two major circuit pathways important for the decision to approach another fly: the LC17 visual projection neurons, which projects to PVLP071, along with LLPC2, and the TuTuA and TuTuB interneurons, that regulate the gain of LC10a neurons, known to mediate female tracking during courtship (Chen and Ribeiro, unpublished; Ribeiro et al., 2018; Hindmarsh Sten et al., 2021; Schretter et al., 2025). The goal of this project is to uncover the sensory cues these two circuits integrate. Using single pair courtship assays, the perception of sensory cues will be added or removed with optogenetic activation or silencing of sensory neurons, and courtship initiation assessed. Acute silencing of neuron types in the PVLP071 or TuTuA/TuTuB circuit pathways in combination with the presence or absence of specific sensory cues, like fly or food odors, will also be tested. This project will uncover sensory contexts and the underlying circuits that elicit Drosophila males to boldly approach other flies in order to appraise sex and receptivity and decide whether or not to court.

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Research papers related to this project:

Clowney, E.J., Iguchi, S., Bussell, J.J., Scheer, E., Ruta, V., 2015. Multimodal Chemosensory Circuits Controlling Male Courtship in Drosophila. Neuron 87, 1036–49. https://doi.org/10.1016/j.neuron.2015.07.025

Hindmarsh Sten, T., Li, R., Otopalik, A., Ruta, V., 2021. Sexual arousal gates visual processing during Drosophila courtship. Nature 595, 549–553. https://doi.org/10.1038/s41586-021-03714-w

Ribeiro, I.M.A., Chen, W., Sauter, M., Prech, S., Borst, A., 2026. A multi-input optic glomerulus mediates opposing behavioral responses to visual objects. Manuscript submitted.

Ribeiro, I.M.A., Drews, M., Bahl, A., Machacek, C., Borst, A., Dickson, B.J., 2018. Visual Projection Neurons Mediating Directed Courtship in Drosophila. Cell 174, 607-621.e18. https://doi.org/10.1016/j.cell.2018.06.020

Schretter, C.E., Hindmarsh Sten, T., Klapoetke, N., Shao, M., Nern, A., Dreher, M., Bushey, D., Robie, A.A., Taylor, A.L., Branson, K., Otopalik, A., Ruta, V., Rubin, G.M., 2025. Social state alters vision using three circuit mechanisms in Drosophila. Nature 637, 646–653. https://doi.org/10.1038/s41586-024-08255-6