SURF 2016: First Progress Report

SURF Student: *Allie Hexley*
Project: *Quantitative measurements of olfactory perceptual thresholds in Drosophila*
Mentor: *Elizabeth Hong*

Motivation

I am working on a behavioural project with Professor Elizabeth Hong, investigating the perceptual thresholds of odor detection in *Drosophila*. Previous work has shown the molecular, genetic, and circuit substrates for odor-driven behaviours in *Drosophila melanogaster* (Wilson, 2013), but has yet to make quantitative measurements of the performance limits of odor-driven behaviours, which is a necessary step to understanding the neural codes underlying the behaviour.

Previous studies have shown that *Drosophila* are able to discriminate between two different odors, and after associative conditioning via presenting an odor simultaneously with an electric shock, are able to distinguish between the aversive odor and the non-aversive odor (Parnas et al., 2013). My project aims to further the understanding gained from previous work by probing the perceptual thresholds of odor discrimination and quantifying these thresholds.

Progress

For these first three weeks my main objective has been to construct the chamber in which I will perform my experiments. This chamber must be able to house eight flies, each of which must occupy its own corridor where two different odors are presented to the individual animal (similar to the design in Claridge-Chang et al., 2009). The chamber must also be able to provide an electric shock to the fly, so that the animal may be trained by associative learning to find certain odors aversive. The chamber must also allow for the visualisation of the animals, and as such must be able to be illuminated by infrared red light and imaged by a CCD camera. Finally the chamber must be able to provide two different odors to each corridor where the fly is present, and thus must be air tight to ensure an even distribution of the odors.

After taking all of these factors into consideration I have finalised on a design for the chamber, and completed most of the construction of the chamber (I am still waiting on a few parts to arrive to finish the construction). During the design and construction of the chamber I have learnt a variety of new skills, such as how to use CAD software, how to use a laser cutter, how to work with acrylic, how to design a PCB, how to set up a visual acquisition system on MATLAB, and how to create an LED panel.

One part that I am still waiting for is the PCB which I will use to provide electric shocks to the flies. Originally I had planned to use ITO coated PET, a clear plastic with a

conductive coating, to supply this shock, as I could include this within the layered chamber design and still image the flies through it. However when cutting this material on the laser cutter, the material lost it's conductivity when cut to the desired size, meaning that I had to think of a new method to give the fly a shock. I decided to go back to a method discussed in previous work (Claridge-Chang et al., 2009) which used a PCB connected to a positive and negative electrode to supply the shock. I had never designed a PCB before so spent a lot of time learning how to use PCB designing software and how PCBs worked, before designing a prototype of the PCB to be used in the chamber. I have ordered the PCB and it should arrive by the end of the week.

Goals

Over the next few days while I wait for the PCB to arrive my focus will be to set up machine vision software, such videos taken by the camera imaging the flies will be able to be processed by this software and each individual fly's movements will be tracked. This will mean that I won't have to watch each video and manually plot out the fly's trajectory, allowing me to collect a lot more data for my analysis.

Over the next few weeks I intend to set up the final chamber with the PCB and test whether the animals can be successfully trained, and imaged using my set-up. If these tests are successful I will begin running the actual experiments, presenting the animals with two different odors and collecting data on the perceptual thresholds. My goal is to have the chamber up and running by the end of the month, and to have begun collecting data.

References

1. Moshe Parnas, Andrew C. Lin, Wolf Huetteroth, & Gero Miesenbock. Odor Discrimination in *Drosophila*: From Neural Population Codes to Behavior. *Neuron.* 2013.

2. Adam Claridge-Chang, Robert D. Roorda, Eleftheria Vrontou, Lucas Sjulson, Haiyan Li, Jay Hirsh, & Gero Miesenbock. Writing Memories with Light-Addressable Reinforcement Circuitry. *Cell.* 2009.

3. Wilson RI. Early Olfactory Processing in *Drosophila* Mechanisms and Principles. *Annual Review of Neuroscience.* 2013.