The Correlation Between Cuticle Coloration and Negative Geotaxis in *Drosophila melanogaster*

Nicholas Tan, Aidan Callender, Lauren Campbell, Sarah N. Ruckman, and Kimberly A. Hughes
Department of Biology, Florida State University

Introduction

- Previous research has shown a genetic correlation between cuticle color and aggressive behavior in *Drosophila melanogaster* potentially through the dopamine synthesis pathway. Dopamine is used to produce melanin pigmentation and can affect multiple behaviors (1).
- Negative geotaxis is the movement of individuals against gravity. Geotaxis measures movement ability with slower rates associated with a loss of motor development (2).
- As such, individuals that are more aggressive should be more active and have higher rates of geotaxis movement (1).

Hypothesis:

- Since we found a positive correlation between cuticle color and aggressive behavior, our group predicts a similar positive correlation between cuticle color and faster negative geotaxis times.

Methods

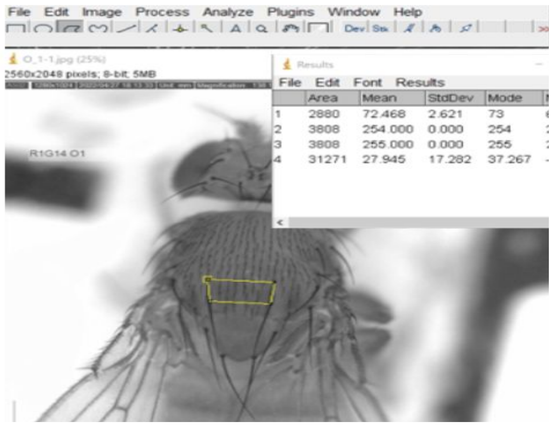


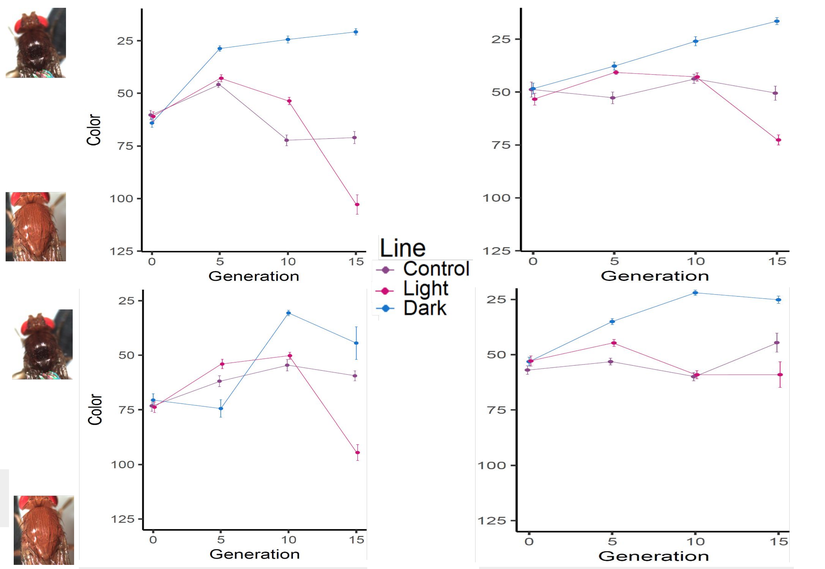
Figure 1: ImageJ software is being used to calculate mean grey scale values. For this *D. melanogaster,* the mean grey scale value is 27.945.

- We selected for darker and lighter cuticle color for 12 generations. As well as maintained a control population.
- To measure geotaxis, flies are placed in a vertically sealed tube and timed for how quickly they climb to a predetermined mark at 3 inches from the bottom of the tube.
- To measure the color of the flies, we used ImageJ to determine the mean grey-scale value of the dorsal thorax (Figure 1).

Results

Male *D. melanogaster* Color Evolution Replicates 1 and 2.

Female *D. melanogaster* Color Evolution Replicates 1 and 2.



Replicate 1 Male

Line*Gen: $F_{2,665} = 74.9$, $p < 10^{-5}$
Line*Gen^2: $F_{2,665} = 43.1$, $p < 10^{-5}$

Replicate 2 Male

Line*Gen: $F_{2,518} = 16.6$, $p < 10^{-5}$
Line*Gen^2: $F_{2,518} = 45.6$, $p < 10^{-5}$

Replicate 1 Female

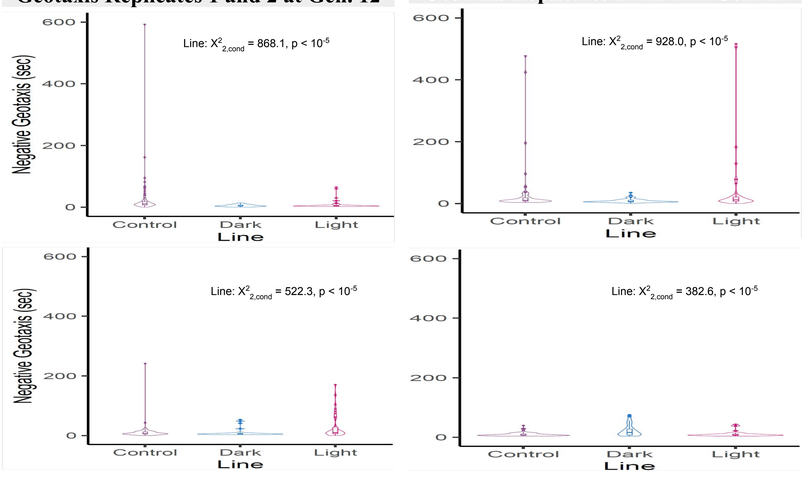
Line*Gen^2: $F_{2,633} = 5.4$, $p = 0.0046$
Line*Gen: $F_{2,633} = 43.1$, $p < 10^{-5}$

Replicate 2 Female

Line*Gen: $F_{2,660} = 23.0$, $p < 10^{-5}$
Line*Gen^2: $F_{2,660} = 21.2$, $p < 10^{-5}$

Male *D. melanogaster* Negative Geotaxis Replicates 1 and 2 at Gen. 12

Female *D. melanogaster* Negative Geotaxis Replicates 1 and 2 at Gen. 12



- Dark selected flies are significantly darker than both the control and light selected flies. The light selected flies were significantly lighter than controls for both sexes. Using a beta regression, there was a significant Line-by-Generation and Line-by-Generation squared effect within each sex.
- In Replicate 1, Dark selected flies are significantly faster than light selected and control flies. Light selected flies were significantly slower than controls.
- In Replicate 2, dark selected flies are significantly faster than light selected flies, but not controls for the males. Light selected male flies were also significantly slower than controls. For females, dark selected flies are significantly faster than both light selected and control flies. However, light selected flies were not significantly slower than controls.

Conclusion & Future Directions

- We found a sex difference in geotaxis behavior. Females did not significantly change their behavior based on color. Males selected for both light and dark were significant faster than control flies.
- This data does not support our prediction that darker flies would be faster than both light selected and control flies.
- Cuticle color may not constrain the independent evolution of negative geotaxis behavior.
- More individuals need to be tested to determine the relationship between color and geotaxis.
- We plan to repeat this experiment in a second population of *D. melanogaster* and in two populations of *D. simulans*.

References

1. Takahashi, A. (2013). Pigmentation and behavior: Potential association through pleiotropic genes in *drosophila*. *Genes & Genetic Systems*, *88*(3), 165–17

2. Cao, W., Song, L., Cheng, J., Yi, N., Cai, L., Huang, F., & Ho, M. (2017). An Automated Rapid Iterative Negative Geotaxis Assay for Analyzing Adult Climbing Behavior in a Drosophila Model of Neurodegeneration. *Journal of Visualized Experiments*, *127*.

Acknowledgements

HUGHES FLY LAB
FLORIDA STATE UNIVERSITY

These research is supported by the Hughes Lab and Saltz Lab in Rice University. Along with our fellow STEM students Paulina Montes, Addison Crews, and Tara Fuchs.