Chilling new discovery: Heritability of cold-sensitivity in *D. melanogaster*

Celina Ortiz, Jason Swinderman **Reed College**
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Previous Research:

Fruit flies are known to thrive in a variety of thermal environments in the wild (1). *D. melanogaster* has specific gene loci relating to thermotolerance that are phenotypically expressed as a resistance to high- and low-temperature extremes (2).

Hypothesis:

Selectively breeding cold-resistant flies and cold-resilient flies after inducing a chill-coma will result in a strain of thermo-resistant and a strain of thermo-sensitive flies.

At freezing temperatures, *D. melanogaster* falls into a chill-coma state due to an inability to maintain muscle resting potentials (3). The relative speed of recovery from a chill-coma is used as a measure of an individual's **chill-tolerance**.

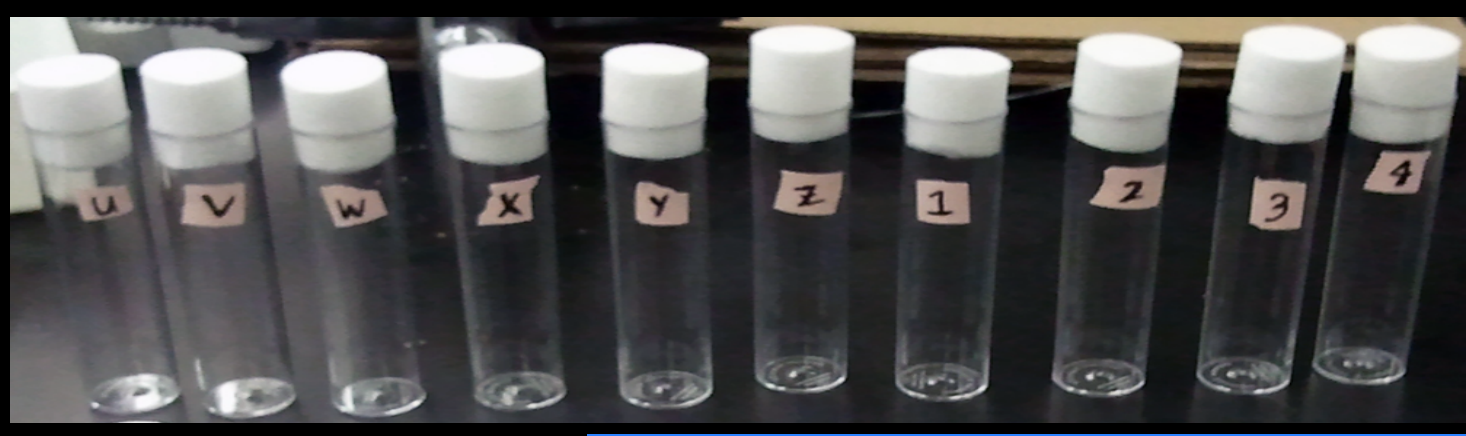
D. melanogaster are ideal subjects for this study because they…
- Reproduce in captivity.
- Mature rapidly.
- Pose few ethical concerns

Experimental Design and Results:

3 chill-coma assays were measured, one assay every 12 days. Latency to recover from chill-coma was recorded and used as a measure of temperature sensitivity.

Chill Coma

- 90 minutes
- 1 fly per tube
- Held at 0ªC



COLD RESISTANT STRAIN

The 15 *fastest* flies to recover were isolated and interbred.

COLD SENSITIVE STRAIN

The 15 *slowest* flies to recover were isolated and interbred.

Trend in generational cold-resistance of the cold-sensitive strain between P, F1, and F2 subjects

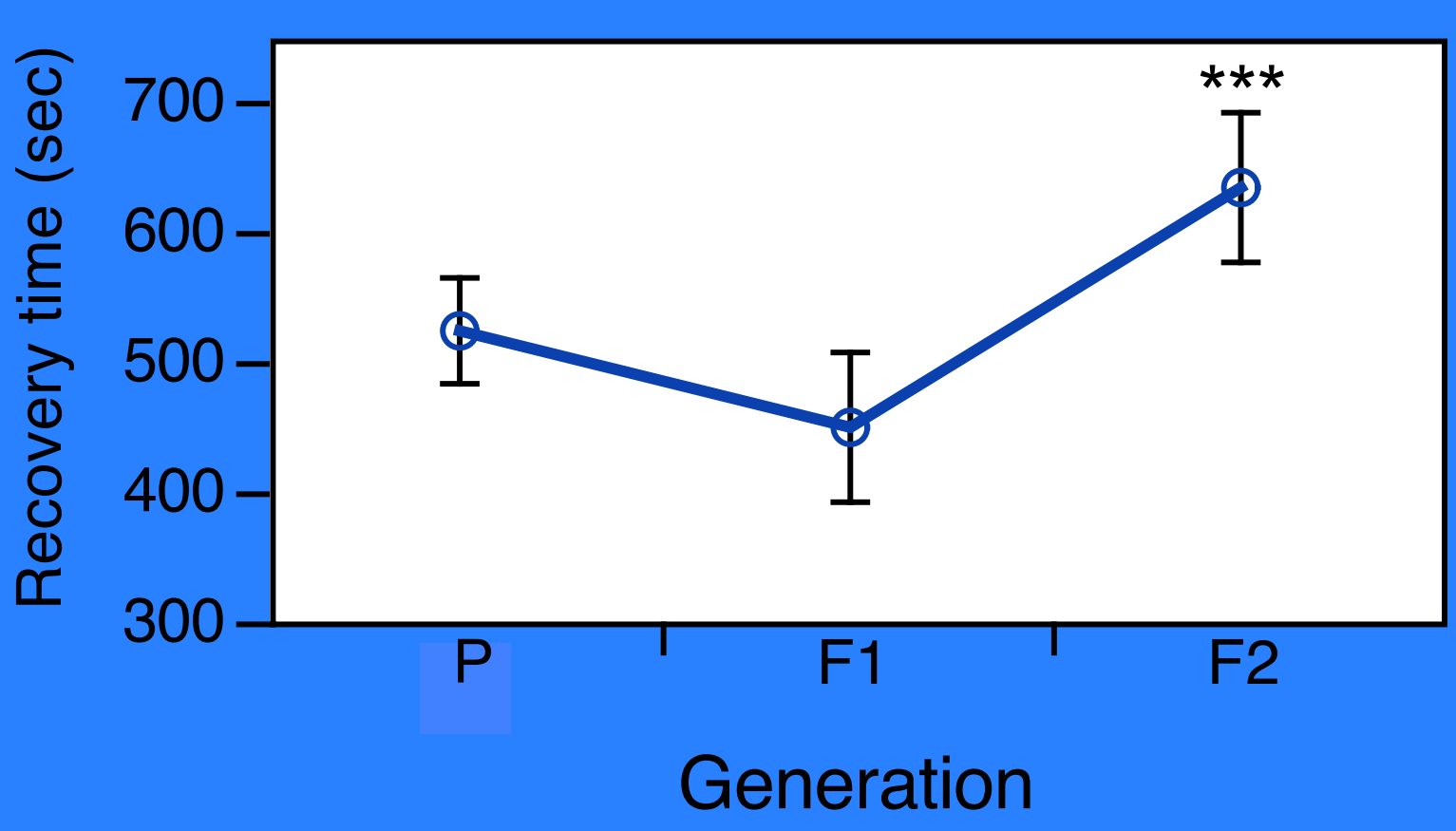


Figure 1: Cold coma recovery time as a function of cold-sensitive generation. The parental generation P (n=30) had not been selected for cold resistant individuals. F1 and F2 (n=15) had each been selected and interbred for cold sensitivity. Flies were kept at 0ºC for 90 minutes and then their latency to recover (return to all 6 legs and move) was measured.

Continued Results:

There was a highly **significant** ($p>0.0001$) increase in cold sensitivity in the F2 generation with respect to the parental and F1 generation.

✓ **There was a significant decrease in recovery time for the cold-sensitive strain**

✗ **There was no significant increase in recovery time for the cold-resilient strain.**

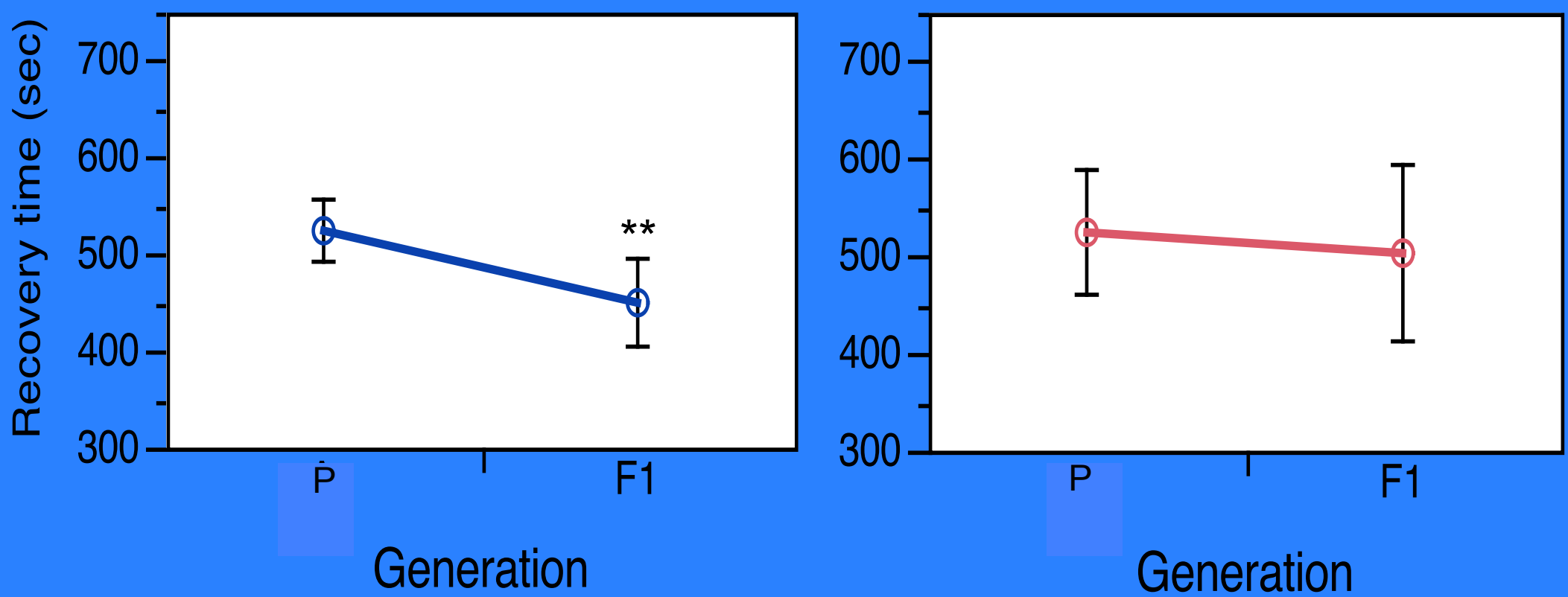
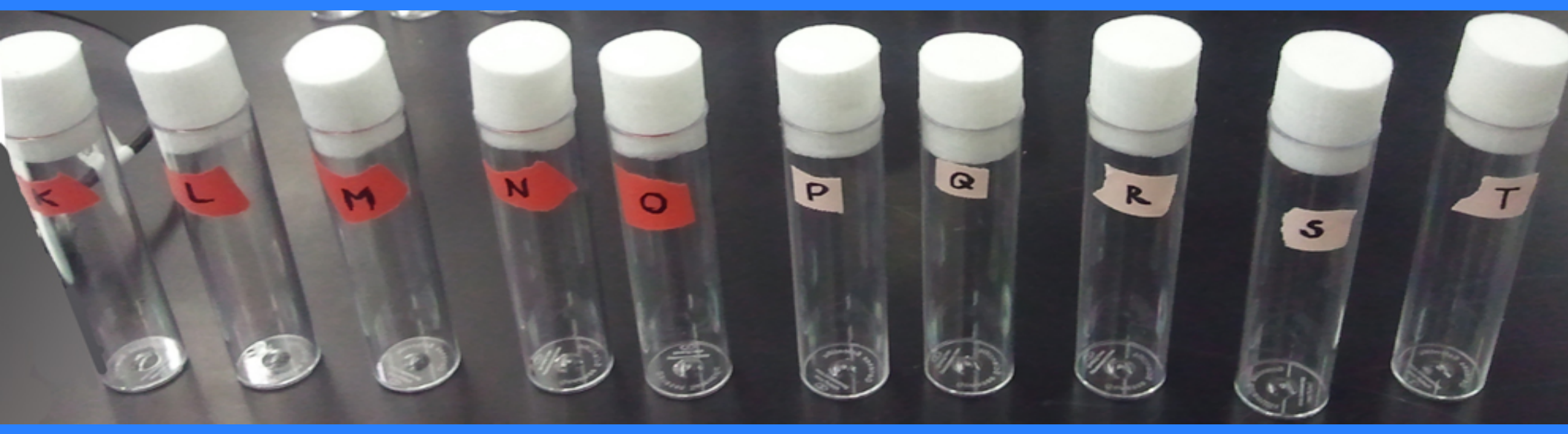


Figure 2. Flies were kept at 0ºC for 90 minutes and then their latency to recover (return to all 6 legs and move) was measured. Shown above is the chill coma recovery times of F1 generations of the cold resistant and cold sensitive strains and parental generation. The F1 generation of the cold sensitive strain was significantly less than that of the parental generation ($P>0.009$.) The F1 of the cold resistant strain showed no significant difference from the parental generation.



Conclusions:

Cold-sensitivity is more heritable than cold-resilience in *D. melanogaster*.

Future Directions:

- **Test heritability of thermo-resilience in other species besides fruit flies.**
- **Investigate heat thermo-resilience in *D. melanogaster* by testing their response to hot temperatures.**
- **Test the heritability of thermo-resilience in conjunction with a hotter or colder environment for generations of *D. melanogaster*.**
- **Investigate the interaction of inbreeding and environment in *D. melanogaster thermo-resilience.***

References:

(1) Morgan TJ, Mackay TFC (2006) Quantitative trait loci for thermo-tolerance phenotypes in *drosophila melanogaster*. Heredity 96: 232-242.

(2) Colinet H, Hoffmann AA (2011) Comparing phenotypic effects and molecular correlates of developmental, gradual and rapid cold acclimation responses in Drosophila melanogaster. Functional Ecology 26: 84-93.

(3) Hosler JS, Burns JE, Esch HE (2000) Flight muscle resting potential and species specific differences in chill coma. J Insect Physiol 46: 621–627.

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