Simon Says…Jump! The neural manipulation of crickets by their parasites

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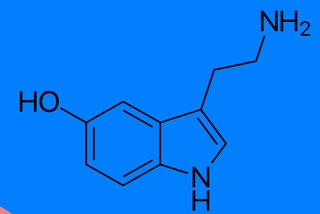
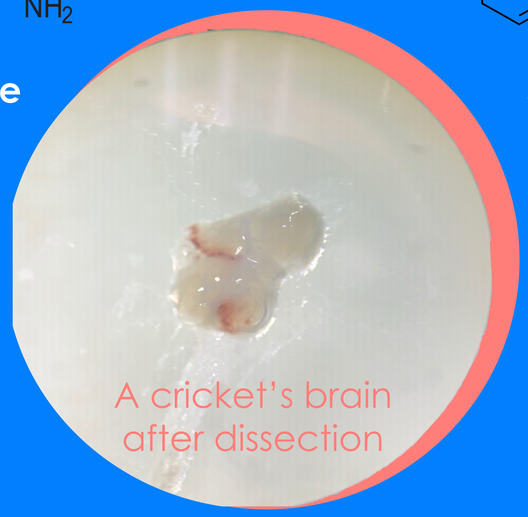
Background

- Parasites significantly change the behavior of their hosts to benefit their own survival.
- Juvenile parasites often <u>inhibit</u> host behaviors that attract predators (locomotion or making noise) or lead to injury/death (aggression)
- Adult parasites often <u>increase</u> host behaviors that will help the parasite emerge in the prime habitat (e.g. locomotion or aggression)
- Neuroamines, such as OA and 5-HT, have conserved functions that modulate host behaviors beneficial to parasites.

Octopamine
(OA)



Serotonin
(5-HT)



A cricket's brain after dissection

<u>Higher OA results in hosts with:</u>
- Increased immune investment
- Increased dispersal via flight
- Increased aggression during fights
- Increased locomotion

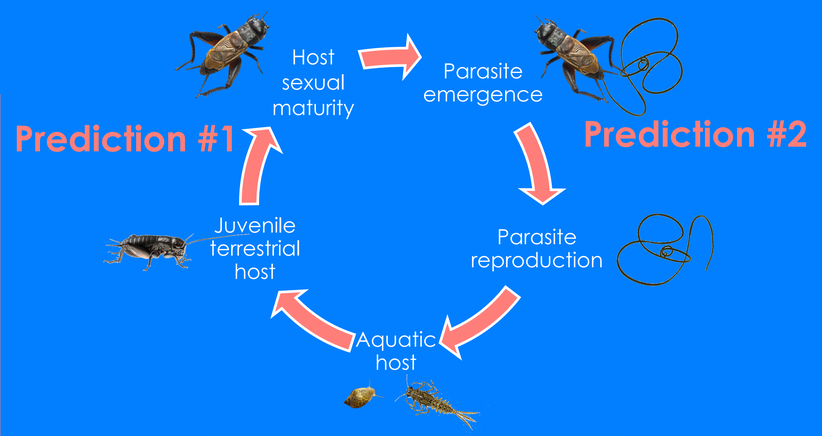
<u>Higher 5-HT results in hosts with:</u>
- Decreased aggression
- Decreased feeding behaviors
- Decreased escape reactions
- Decreased circadian

Predictions

If OA and 5-HT mediate the behavioral shifts in crickets infected with the horsehair worm parasite, then we predict:

#1 <u>*Upon host sexual maturity*</u>, infected crickets will have lower levels of OA and higher levels of 5-HT relative to healthy crickets to decrease host locomotion, aggression, and calling behaviors.

#2 <u>*Upon parasite emergence*</u>, infected crickets will have higher levels of OA and lower levels of 5-HT compared to healthy crickets to increase locomotion, aggression, and escape behaviors.



Research Questions

1) Are the levels of octopamine (OA) and serotonin (5-HT) in the brains of parasite-infected crickets different than of healthy, non-parasitized crickets?

2) If so, do the modifications of OA and 5-HT align with the specific timepoints when the critical behavioral shifts in the host-parasite relationship occur, specifically at host sexual maturity and parasite emergence?

Methods

- Rear juvenile sand field crickets (*Gryllus firmus*)
- Sort 7th instar individuals and fast for 3 days
- Randomly assign crickets to eat either:
  1) a parasite-encysted snail
  2) a healthy control snail
- Rear crickets then dissect crickets' brains at:
  1) sexual maturity
  2) parasite emergence
- Store brain tissue in -80 °C freezer
- Use HPLC to quantify the octopamine and serotonin

Horsehair worms inside an infected cricket

Future Work

- Finish collecting brain tissue to reach a N = 20 for each treatment x time group.
- Perform behavioral assays on healthy and infected crickets to provide a baseline measurement of activity.
- Manipulate the OA and 5-HT levels in a healthy cricket's brain by injecting agonists and antagonists to replicate the behavioral effect of parasitic infection.