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The Oaβ1R receptor mediates octopamine signaling at the periphery to promote male aggression

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The Oaβ1R receptor mediates octopamine signaling at the periphery to promote male aggression

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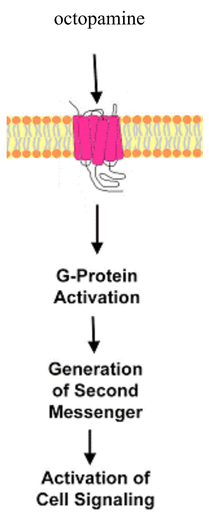
1- Octopamine is required for male social behavior

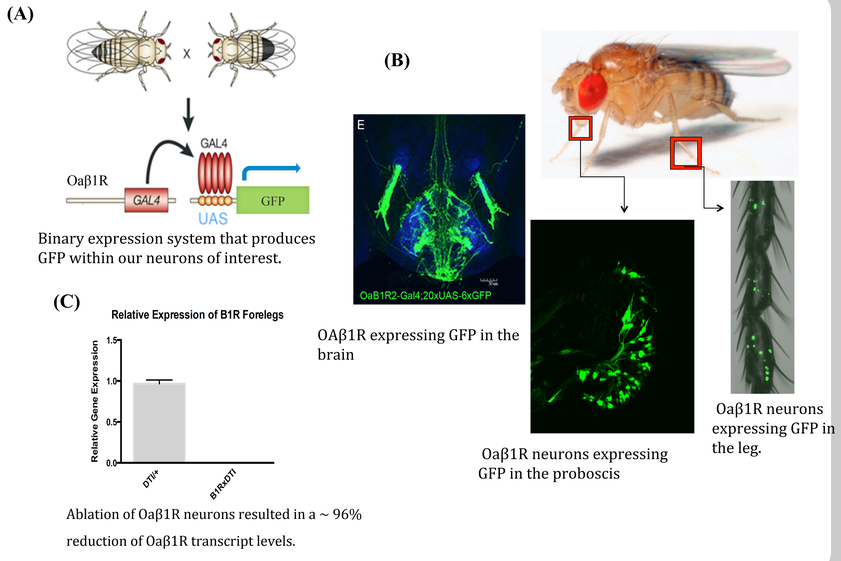
In order to survive, an organism needs to be able to interpret their surroundings and rapidly make decisions that lead to an appropriate behavioral response. By examining individual or small groups of neurons, we can ask how specific neurons contribute to behavior and what decision-making processes lead to that behavior. *Drosophila melanogaster* provides an excellent opportunity to study behavior. In addition to being thoroughly studied and easily genetically manipulated, they also exhibit quantifiable and consistent patterns of behavior in both aggression and courtship settings.

Experiments from our lab and others have demonstrated that octopamine (OA), an invertebrate norepinephrine analog, is responsible for promoting aggression and limiting courtship between *Drosophila* males**. Of four known octopamine receptors, Oaβ1R is expressed in sensory neurons in the periphery that receive environmental signal that should promote social behavior.**

We found that males with ablated Oaβ1R-expressing neurons and males without the Oaβ1R receptor displayed significant changes in aggression and courtship behavior. Ongoing experiments are determining which subset of Oaβ1R-expressing neurons are important for these different behaviors.

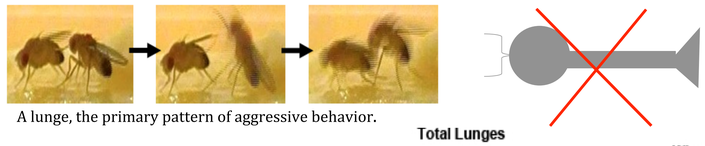


2- Oaβ1R is expressed in peripheral neurons.

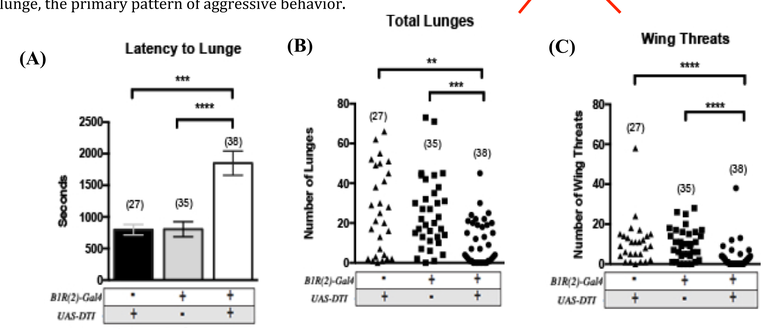


3-*Drosophila* males without OAβ1R neurons display less aggression

Experimental Procedure:
Use *Oaβ1R(2)-Gal4* ; *UAS-DTI* to ablate the neurons and examine aggression patterns



A lunge, the primary pattern of aggressive behavior.

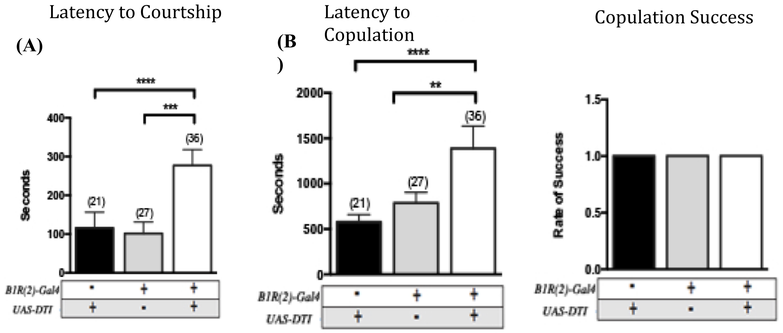


Oaβ1R deficient males displayed latency-related aggression deficits

(A) The loss of Oaβ1R-expressing cells increases time until the first lunge.
(B) The loss of Oaβ1R-expressing cells decreases the amount of lunges.
(C) The loss of Oaβ1R-expressing cells decreases number of wing threats.
(D) The loss of Oaβ1R-expressing cells may retreat less often.

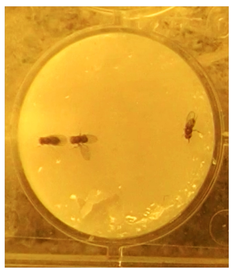
These results show that OAβ1R neurons are required for male aggression regulation

4- Males without OAβ1R neurons take longer to court and to copulate



Oaβ1R deficient males display latency-related courtship deficits

(A) Increased latency to onset of courtship
(B) Increased latency to copulate
(C) No significant changes in copulation success
No significant changes in patterns of singing/wing extension



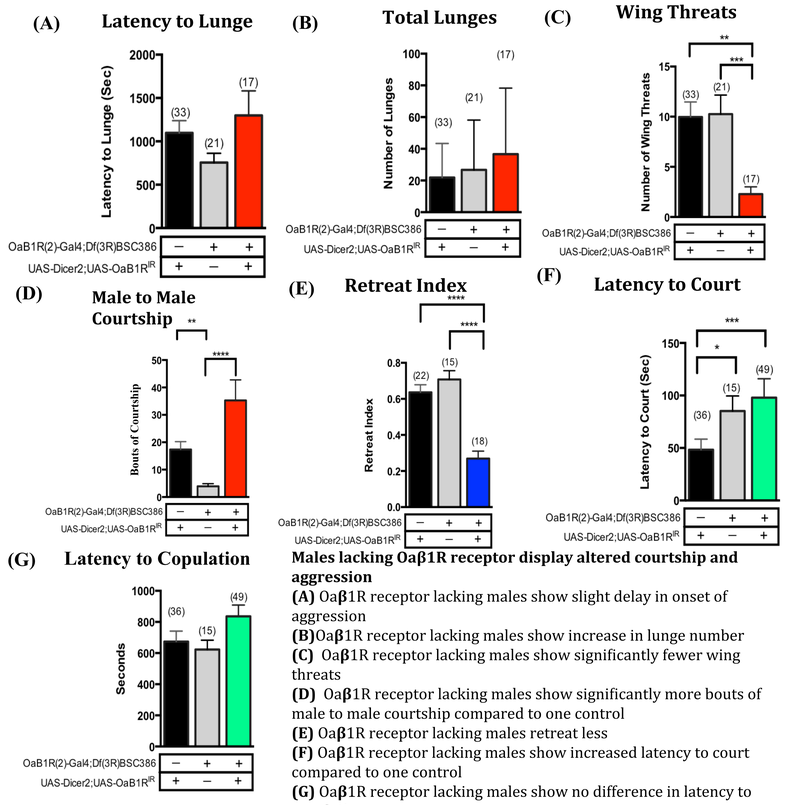
Wing Extension

Reproductive behavior:
- Singing (wing extension)
- Tapping
- Licking
- Attempted copulation

These changes suggest that Oaβ1R-expressing neurons promote courtship behavior but do not appear to alter rates of wing extension or the target of courtship.

5- Males lacking Oaβ1R receptor show altered aggression patterns and take longer to initiate courtship

Experimental Procedure: Use *Oaβ1R(2)-Gal 4* ; *Df(3R)BSC386* to get rid of OAβ1R receptor and observe



Males lacking Oaβ1R receptor display altered courtship and aggression

(A) Oaβ1R receptor lacking males show slight delay in onset of aggression
(B) Oaβ1R receptor lacking males show increase in lunge number
(C) Oaβ1R receptor lacking males show significantly fewer wing threats
(D) Oaβ1R receptor lacking males show significantly more bouts of male to male courtship compared to one control
(E) Oaβ1R receptor lacking males retreat less
(F) Oaβ1R receptor lacking males show increased latency to court compared to one control
(G) Oaβ1R receptor lacking males show no difference in latency to copulation

6-Conclusions

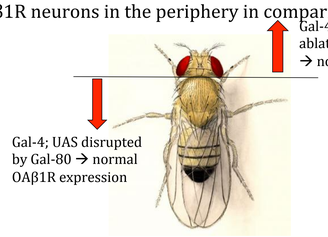
- OAβ1R neurons in *Drosophila* males promote engagement in aggressive encounters
- OAβ1R neurons may play a role in decision making when retreating from an aggressor
- OAβ1R neurons are required for appropriate and timely interaction with a female
- The OAβ1R receptor is necessary for aggression control
- The OAβ1R receptor is responsible for decision making when choosing whether to retreat from an aggressor
- The OAβ1R receptor influences earlier onset of courtship

7-Future Directions

- As some of these figures represent preliminary results, I will continue performing and analyzing behavioral experiments
- We will use *UAS-TNT* ; *tsh-Gal80* to eliminate OAβ1R neurons in the brain and proboscis but retain

  \+ *β1R(2)-Gal4*

  function in the peripheral OAβ1R neurons. This will allow us to more clearly define function of OAβ1R neurons in the periphery in comparison to OAβ1R neurons in the head.



The t-shirt Gal 80 system will allow us to isolate specific OAβ1R neurons.

Acknowledgements:
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