

Parasitoids and predators: How *Drosophila* mothers assess and respond to hymenopteran threats

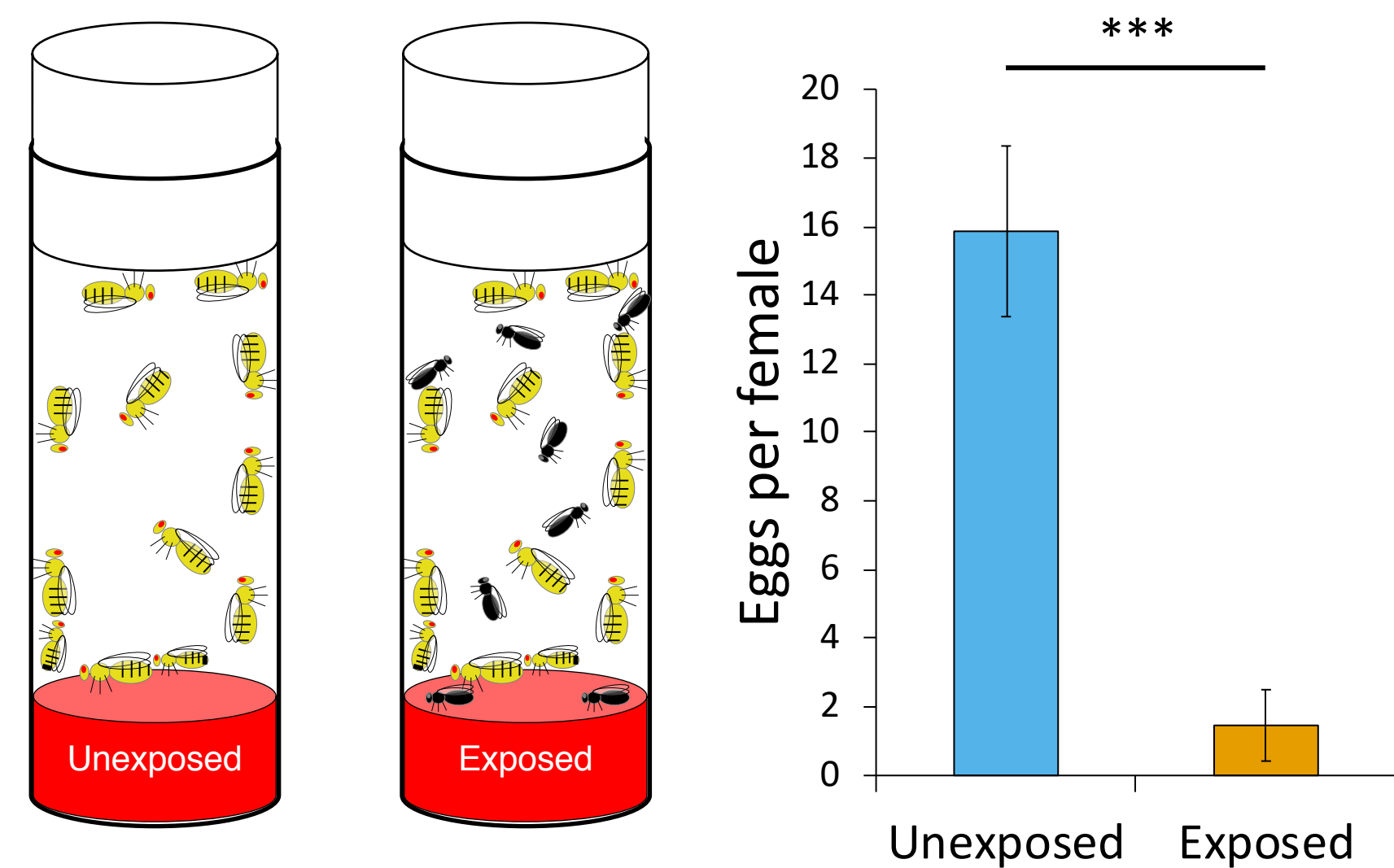
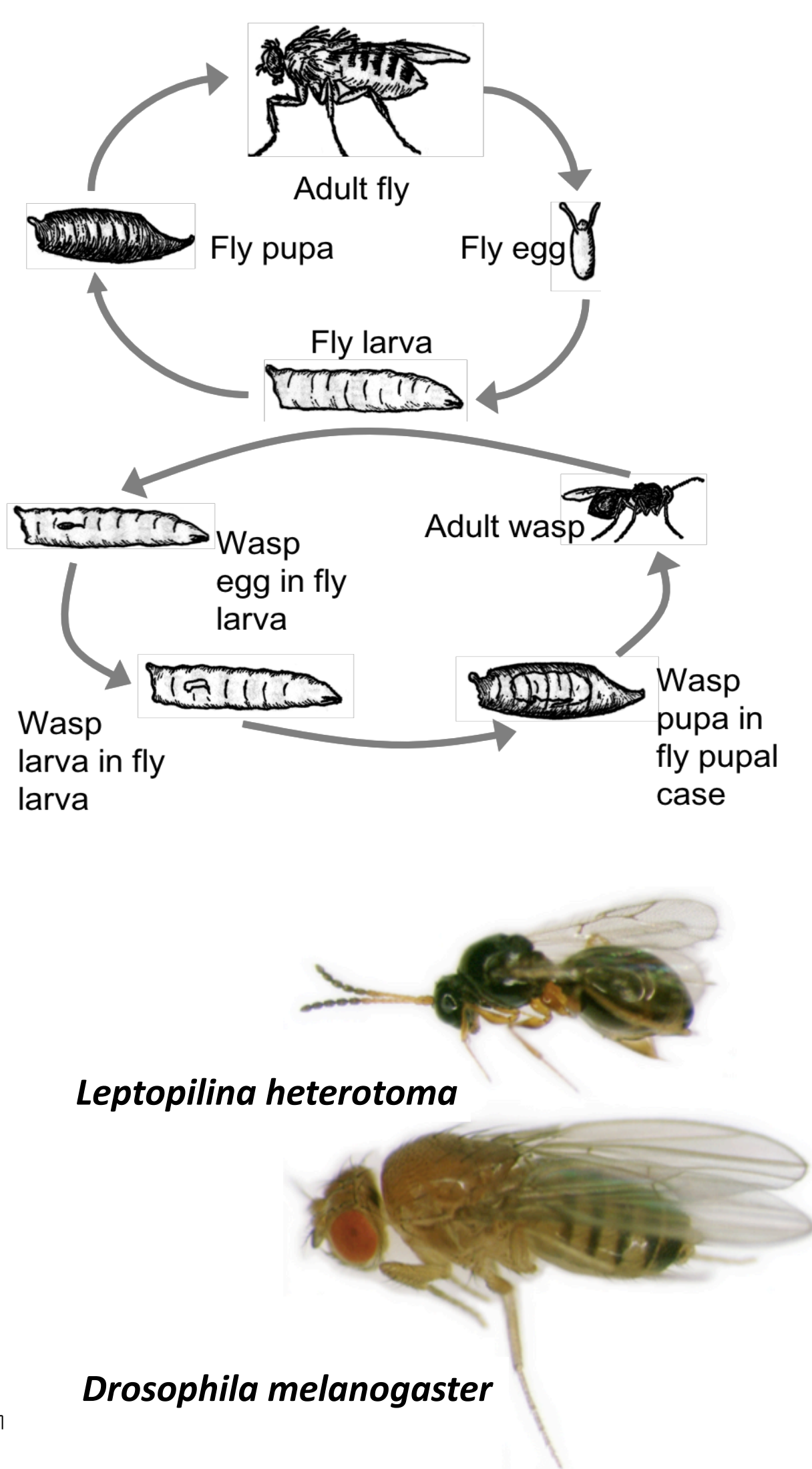
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1. Introduction

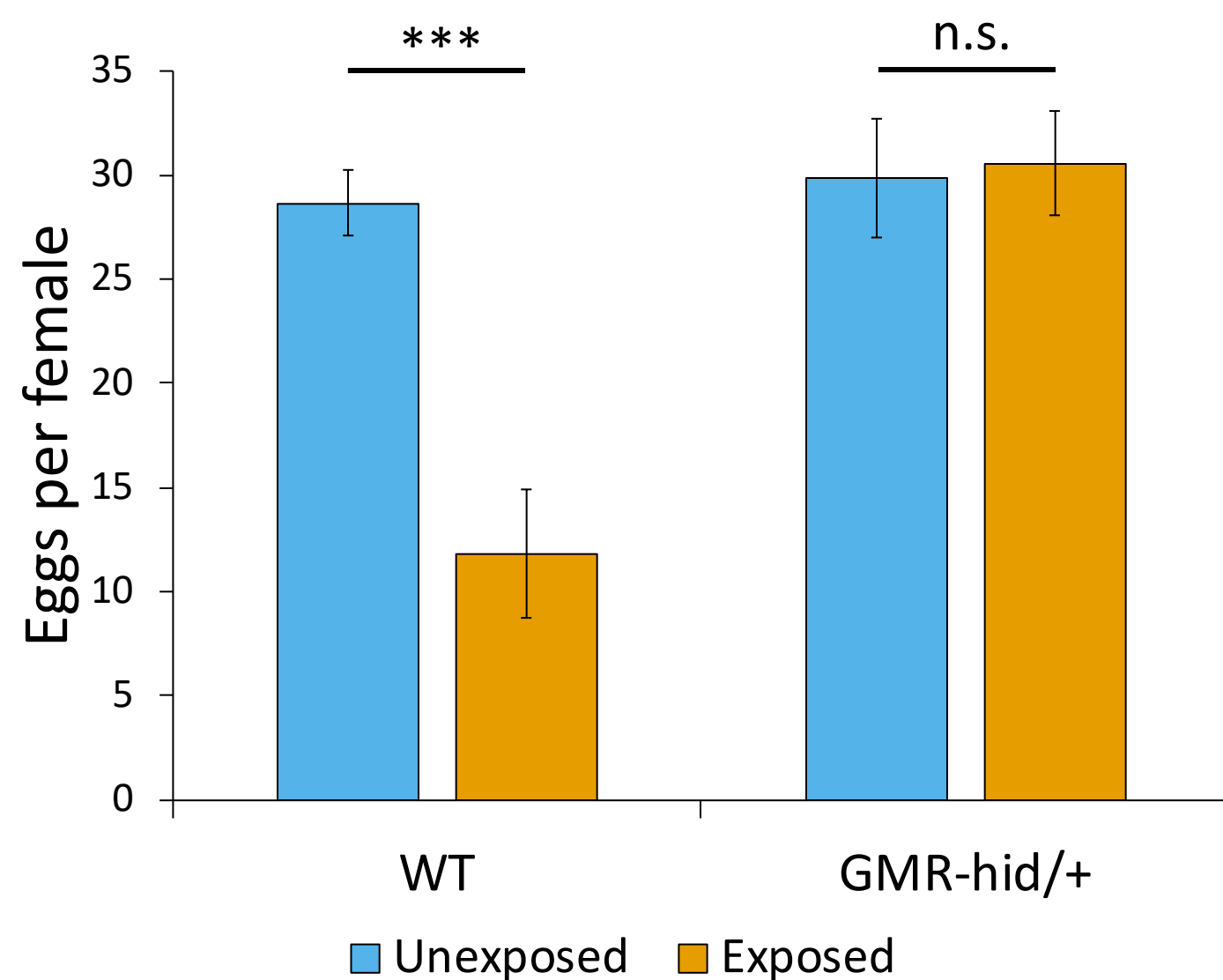
- Correct recognition of environmental threats is essential to an organism's survival
- Flies encounter endoparasitic wasps in the wild (ref. 1). These small dark insects inject their eggs inside the body of fly larvae, which then hatch and eventually consumes the host
- While adult female flies are not attacked by wasps, they reduce oviposition in the presence of wasps
- We study this phenotype in the lab by co-housing groups of flies with wasps (or keeping them unexposed) and counting the number of eggs that were laid over a 24-hour period
- Question: How do flies sense the presence of parasitoid wasps?**



2. Vision is required for wasp detection

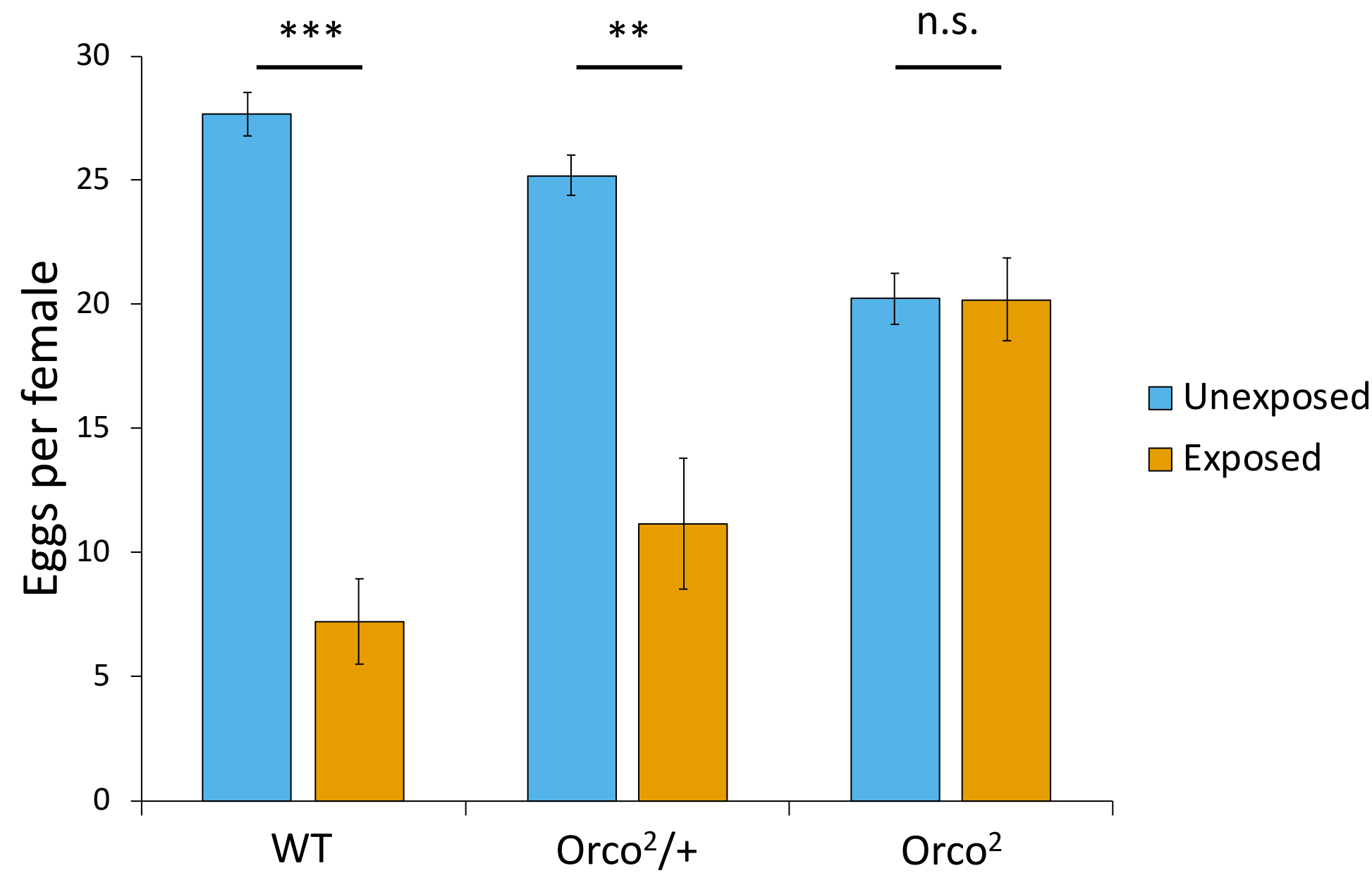


- Wildtype flies responded to the presence of wasps by reducing oviposition
- Blind flies failed to reduce oviposition



3. Olfaction is also required for wasp detection

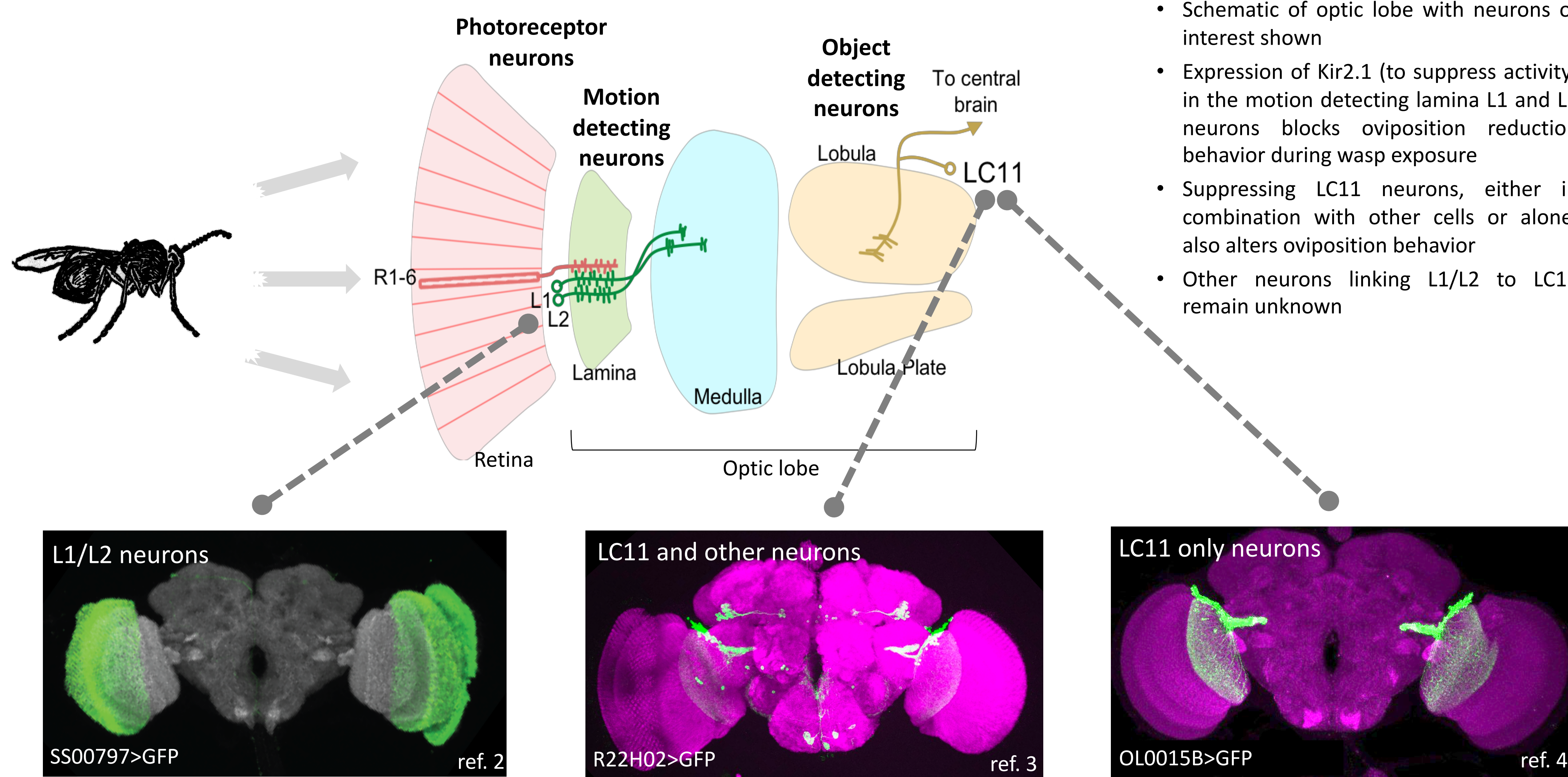
- Mutations in the *Odorant receptor co-receptor (Orco)* renders flies unable to smell
- Control flies responded appropriately to the presence of wasps, but anosmic flies failed to reduce oviposition



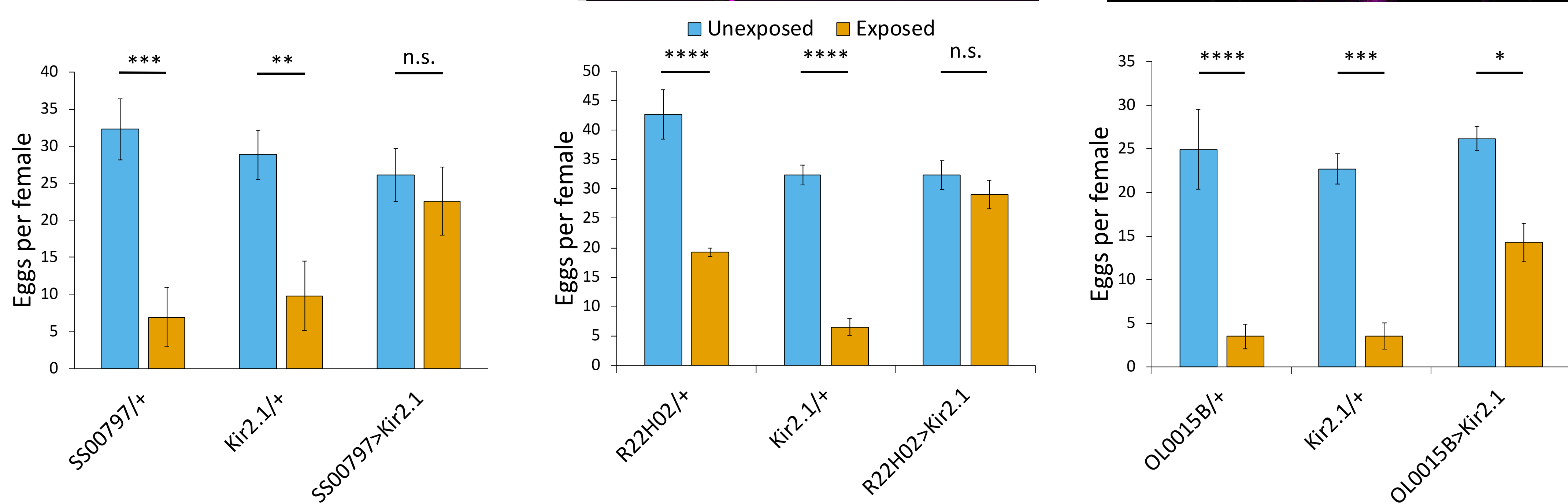
10. References

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4. Visual neurons mediating wasp detection

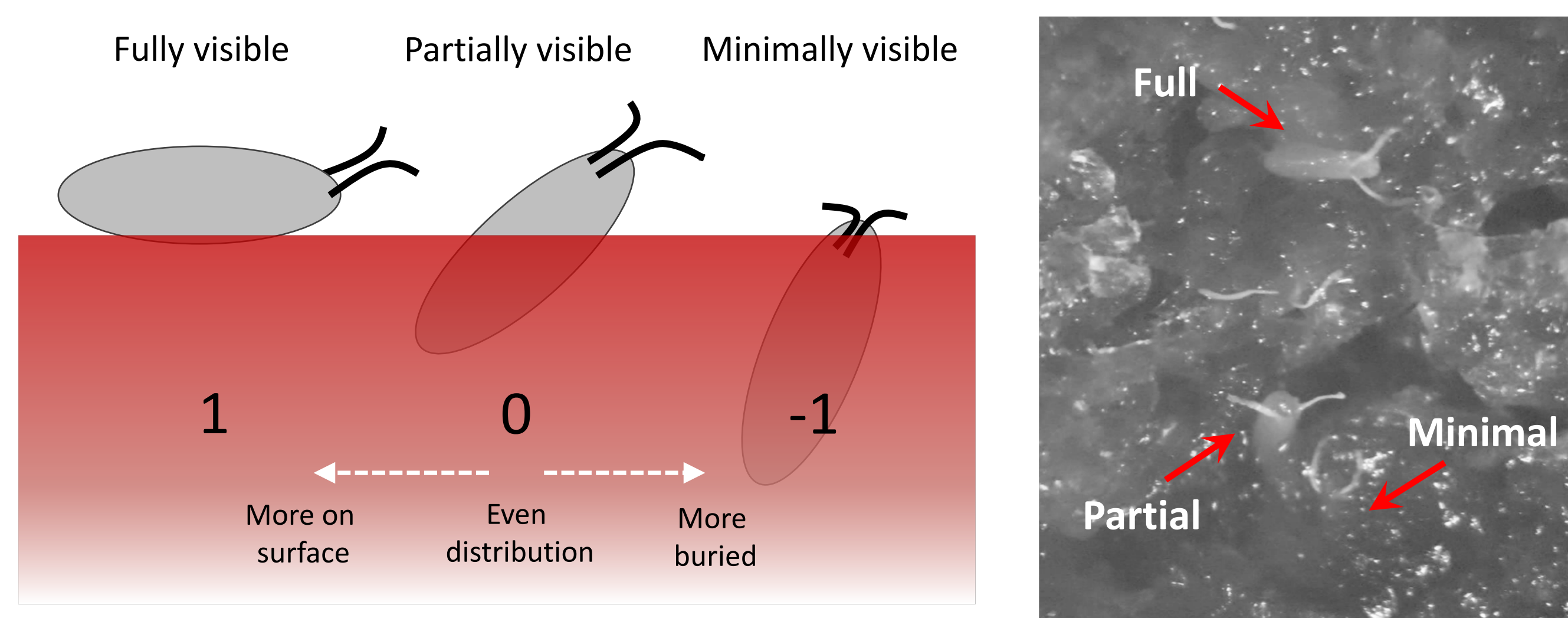


- Schematic of optic lobe with neurons of interest shown
- Expression of Kir2.1 (to suppress activity) in the motion detecting lamina L1 and L2 neurons blocks oviposition reduction behavior during wasp exposure
- Suppressing LC11 neurons, either in combination with other cells or alone, also alters oviposition behavior
- Other neurons linking L1/L2 to LC11 remain unknown

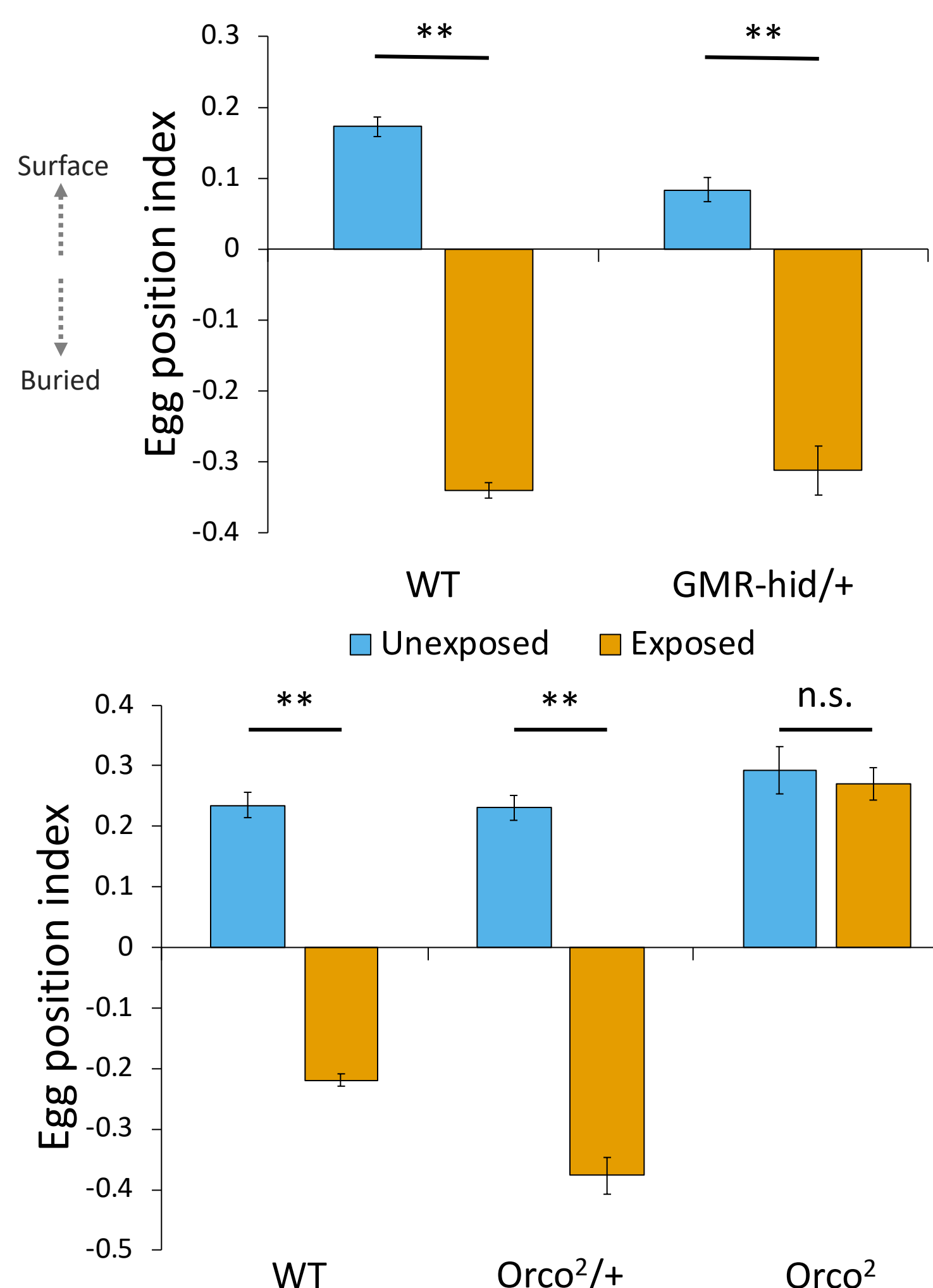


5. Flies alter oviposition depth when exposed to wasps

- Flies alter not only the number of eggs that are laid, but also how deeply they push their eggs into the substrate
- Eggs were classified into one of three categories:
 - fully visible eggs located on the surface of the food substrate
 - Partially visible eggs with at least some portion beneath the surface
 - Minimally visible eggs where the egg is nearly fully submerged
- The egg position index is the sum of all egg scores divided by the total number of eggs. An index of 0 represents an even distribution of eggs in the three categories

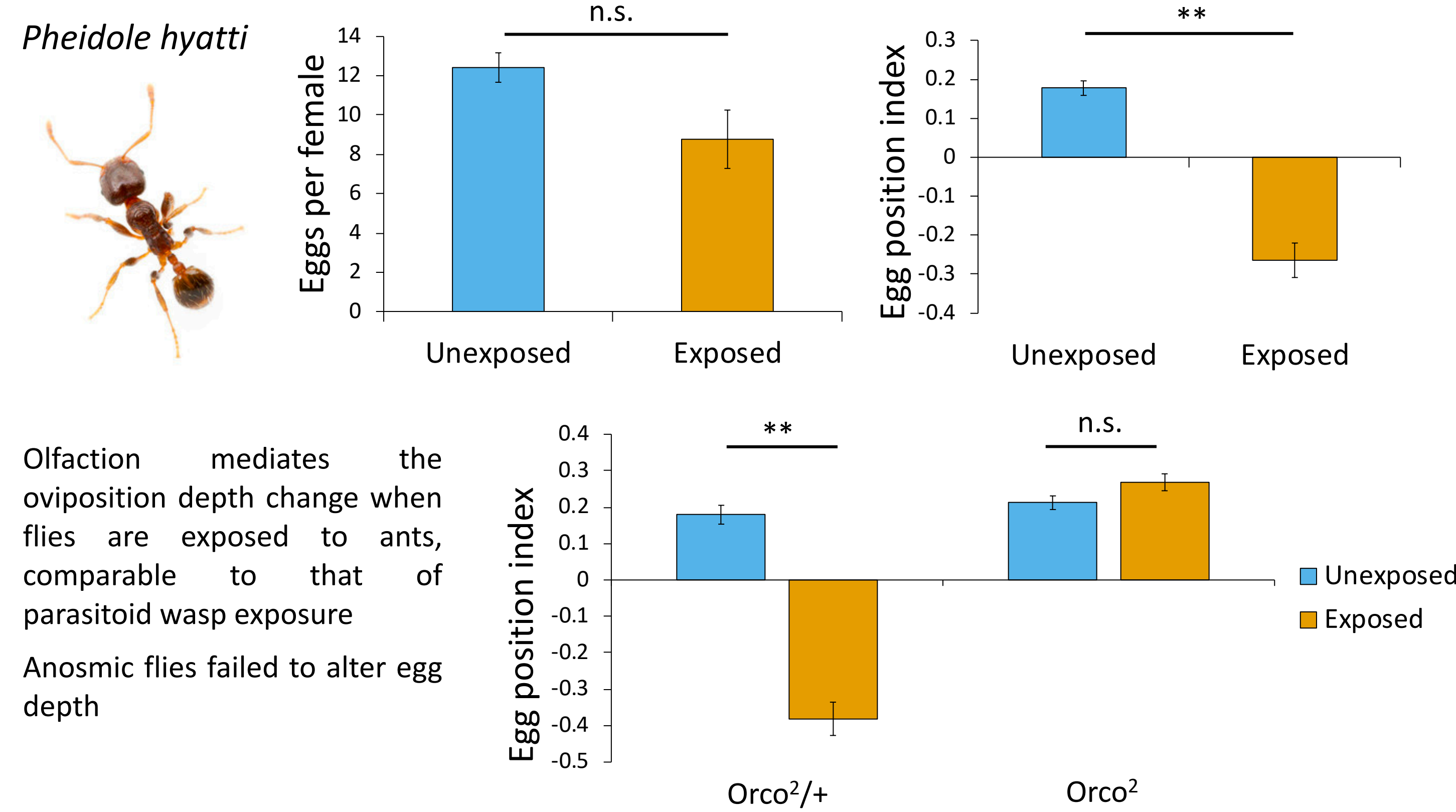


- Oviposition depth is regulated by olfactory stimuli only
 - Blind flies responded appropriately to wasps by depositing eggs deeper in the substrate
 - Anosmic flies failed to alter oviposition depth.



6. Exposure to ants alters oviposition depth

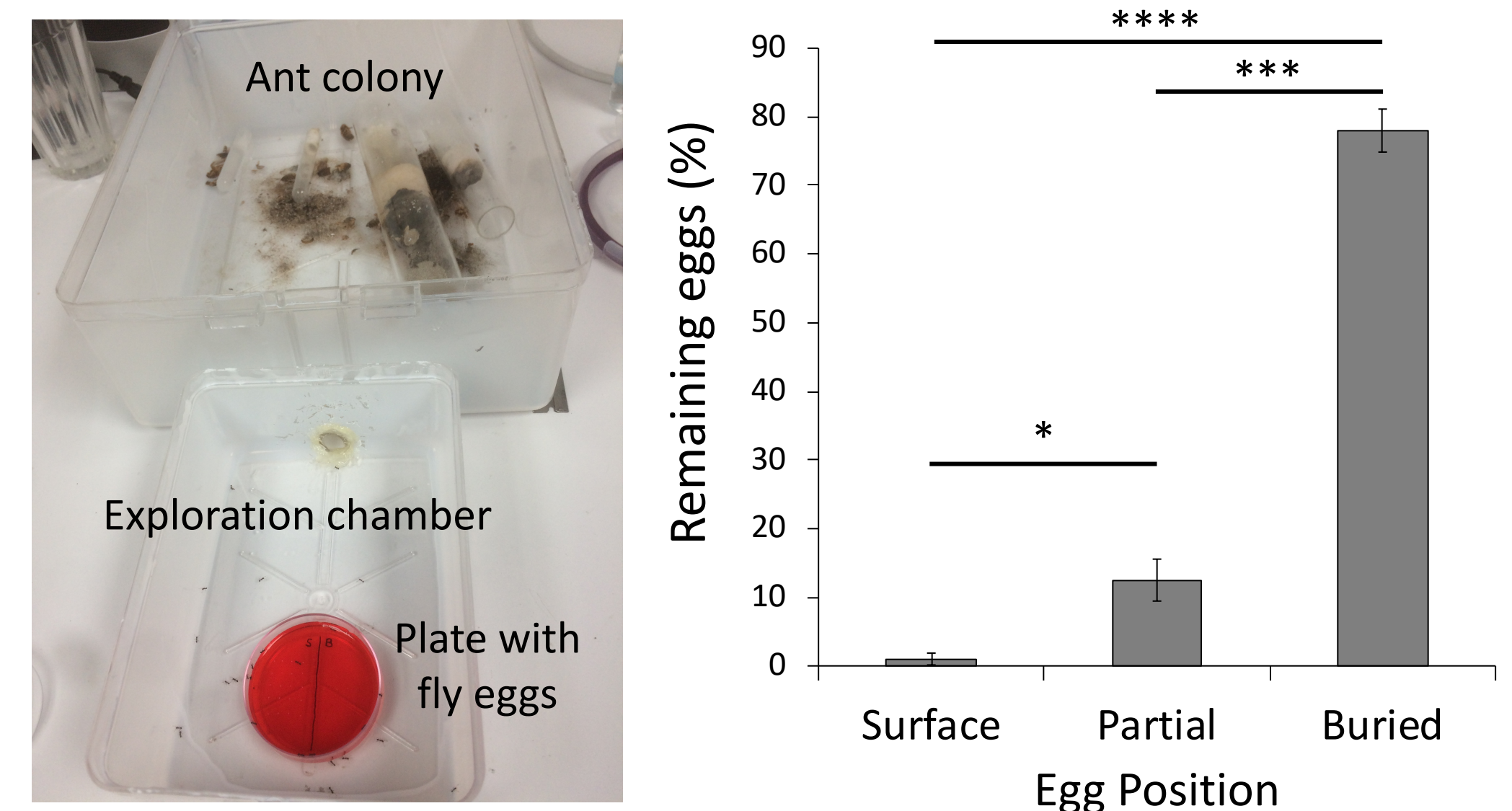
- Other hymenopterans, such as ants with a conserved odorant with wasps, also influence the flies' oviposition depth behavior
- Flies that were exposed to lab-reared *Pheidole hyatti* ants did not alter oviposition numbers, but the depth at which the eggs were laid was changed



- Olfaction mediates the oviposition depth change when flies are exposed to ants, comparable to that of parasitoid wasp exposure
- Anosmic flies failed to alter egg depth

7. Buried eggs are protected from foraging ants

- Fly eggs were positioned at different depths in substrate
- P. hyatti* ants were given 30 minutes to forage
- Buried eggs survived ant exposure at a much higher rate than the other two positions



8. Many ant species alter fly oviposition behavior

- Flies were exposed to odors from wild-caught ants to test for alterations in oviposition depth
- Of five tested species, only one did not alter fly behavior
- B. patagonicus* may prefer carbohydrate over protein food sources

Subfamily	Species	Oviposition depth change?
Dolichoderinae	<i>Forelius mccooki</i>	Yes
	<i>Tapinoma sp.</i>	Yes
Formicinae	<i>Brachymyrmex patagonicus</i>	No
Myrmicinae	<i>Pheidole hyatti</i>	Yes
	<i>Solenopsis xyloni</i>	Yes

9. Model of fly's detection and response to hymenopteran threats

