

# Synaptic output of dopaminergic neurons controls contextual learning by promoting antagonistic behaviors

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## Background

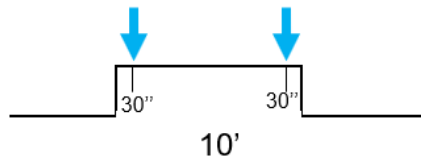
Accumulated evidence supports that dopaminergic neurons (DANs) by modulating the synaptic output of mushroom body neurons control the behavior in associative learning in *Drosophila*. However, self-motivated contextual learning might depend on distinct molecular and cellular mechanisms.

## Objective

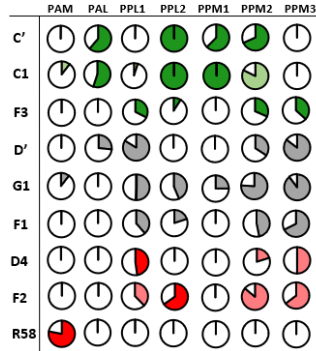
- Examine the role of dopaminergic neurons in contextual learning in freely behaving flies.

## Methods

- Animals: *Drosophila*, adults male, 2-6 days.
- Several GAL4 lines (e.g. TH-C'-GAL4) were used to drive the expression of the thermosensitive allele *Shi<sup>ts1</sup>* or *TrpA1* to different DANs subsets (Liu et al 2012a,b).
- In parallel experiments, habituation was tested at 23 °C and 30 °C (N=12).
- Protocol for testing habituation:



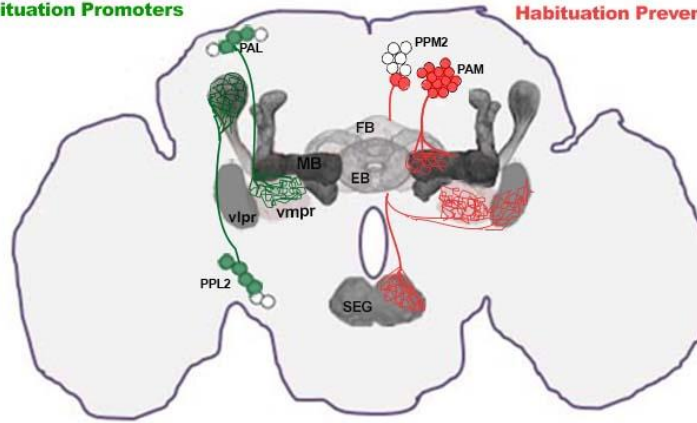
## Results



**Figure 1.** Pie Chart indicating the proportion of DANs affected by each GAL4 line (e.g. TH-C'-GAL4) within each cluster (indicated at the top). Red and green, indicates neurons preventing or promoting habituation, respectively. Gray indicates neurons without effect on behavior.

**Figure 2.** Schematic representation of the role of DANs in the control of behavior during contextual learning and memory.

**Habituation Promoters** **Habituation Preventers**



## Conclusions

- This study shows that DANs control contextual learning in freely behaving flies.
- The results support both three neurons from the PAL cluster and four PPL2 neurons contributed to promote habituation. Furthermore, possibly just a neuron from PPL2 is enough to see this effect.
- Habituation is prevented by two different clusters of DANs: neurons from the PAM and the PPM2 clusters. Moreover, only one neuron from PPM2 seems to be enough to prevent habituation.
- Taken together, habituation of a motivated behavior is under positive and negative control of DANs.**

## References

- Boto et al 2019    Liu Qili et al 2017    White et al 2010  
 Galili et al 2014    Mann et al 2013    Xie et al 2018  
 Mao et al 2009    Marella et al 2012  
 Liu Qili et al 2012a    Nassel et al 2008  
 Liu et al 2012b    Tanaka et al 2008