Determining how structures in the bee brain influence memory reversal tasks

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Background:

- Foraging is an important set of behaviours that allows animals to find nutrients to survive [1]
- Honey bees forage and tend to return to the same food source until it is depleted [2]
- To forage effectively they need to determine a food source is no longer viable and search elsewhere. This process is called memory reversal
- Two regions of the brain, the central complex and the mushroom bodies, are involved in learning and memory but how they relate to memory reversal tasks is unknown [3]

Objective:

Examine the role of the central complex and mushroom bodies in honey bee memory reversal tasks by inactivating these regions using procaine

Hypothesis:

The central complex and mushroom bodies have different roles involving memory reversal

Predictions:

1. There will be a reduction in ability to accomplish memory reversal tasks when central complex or mushroom bodies are inactivated
2. There will be a different behavioural response between individuals with central complex and mushroom bodies inactivated

Treatments:

1. Unaltered (no treatment)
2. Inactivated central complex
3. Inactivated mushroom bodies
4. Saline injected control (no procaine)

Three Stages:

Preliminary trials:

- A y-maze (Fig. 1) will be used to train bees to associate different colours with a tainted food source, a food reward, or water.
- Trials will be deemed a:
  - Success: if the bee moves towards the correct food source
  - Failure: it moves towards the wrong well

Treatment:

- Brain surgically accessed using forceps
- Procaine or saline injected into either central complex or mushroom bodies using a Narashigi pressure injector [4]

Separate post surgery trials will:

- Retest associations with colours
- Train reverse associations with colours for each well
- Test bees' ability to form the reversed associations for each of the treatments

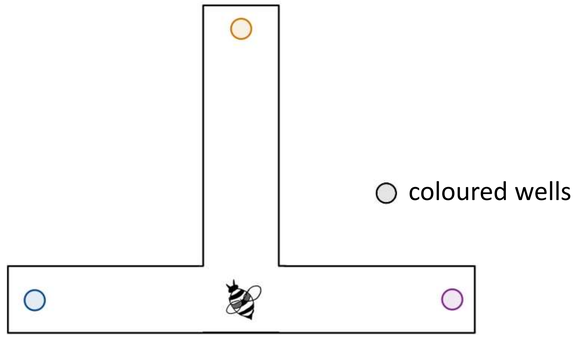

Fig. 1 Y-maze to be used to train bees. Bees will be tested on their ability to locate the food reward found in one of the three wells.

Statistical Analysis:

- Proportion of successes vs failures will be analyzed with a Chi-square test
- Trial length times will be analyzed using Kruskal-Wallis one-way analysis of variance as data will not be normally distributed

Expected Results

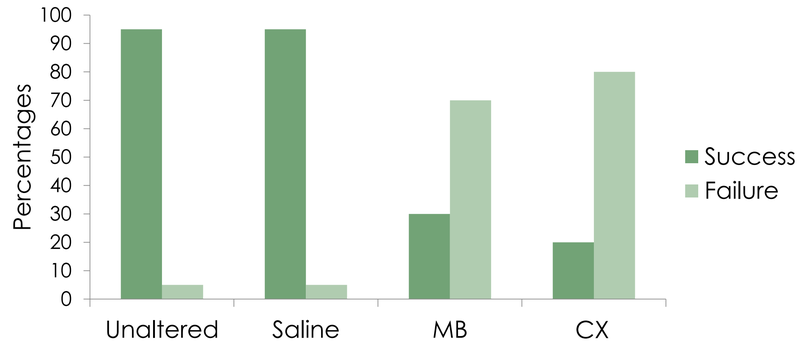

Fig. 2 Proportion of successes vs failures for all 4 treatments: unaltered, saline injected, inactivated mushroom bodies (**MB**), and inactivated central complex (**CX**)

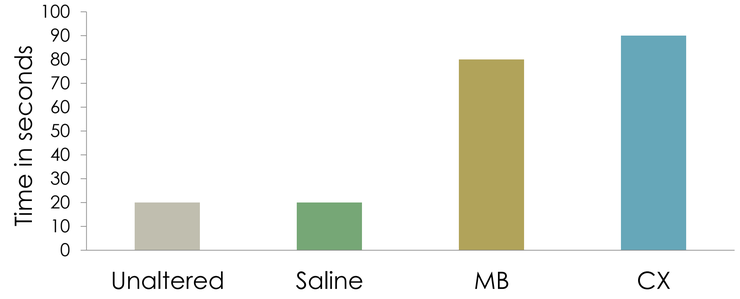

Fig. 3 Length of time to complete trials for all 4 treatments: unaltered, saline injected, inactivated mushroom bodies (**MB**), and inactivated central complex (**CX**)

Importance:

- This project can provide insight into how the mushroom bodies and the central complex function in memory reversal tasks in other insects as well as how the se two structures work together
- Information on the functioning of insects brains can assist in improving upon systems of machine learning

References:

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3. Sitnik,N.A., et al. 2003. Neurosci. Behav. Physiol. **33**.
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