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### Assessing the Cognitive and Social Behaviors of *Apis mellifera* in Finding Food

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# ASSESSING THE COGNITIVE AND SOCIAL BEHAVIORS OF *Apis mellifera* IN FINDING FOOD

Office of Sustainability

Sophia Jones and Claire Dorner

## Abstract

*Apis mellifera*, or more commonly named, honeybees, are known for their keen ability to navigate the natural world in search of an unpredictable food source; nectar. Honeybees have a trichromatic visual spectrum which allows them to find flowers through vision, but their spectra is based on ultraviolet, blue and green (Riddle, 2016). They also have a circadian rhythm that allows them to know the optimal times to leave the hive in search of food (Moore et al. 1989). The social behaviors of honeybees also closely mirror our own and has caused numerous scientists to investigate whether they have the capacity to hold memories and learn. This experiment was split up into three segments and set out to determine whether honeybees could be trained to fly to a designated spot in order to get food, and whether they could differentiate between two similar food sources.

## Hypothesis

- Honeybees can be classically conditioned to fly to a designated food source that is slowly moved 100 meters from their hive
- Honeybees will be able to differentiate between the original food source and a newly presented one

## Methods

Week 1 (five days)

- Position yellow colored table outside the two hives
- Fill 96 well plate with a 1:1 solution of sugar water
- Set up video camera to record how many bees fly to the feeder

Week 2 (five days)

- Move yellow table with the feeder a few meters every 5 minutes until the table is 100 m from the two hives on the first day
- Leave there for the next two weeks and count the bees coming to the feeder

Week 3 (five days)

- Set up blue colored table 3 ft from yellow table
- Place 96 well plate of water on the yellow table and place the 96 well plate with the sucrose solution on the blue table

## Conclusions and Future Work

I expected that the bees had learned to come to the yellow table after two weeks of being presented with food, but it is unknown whether the honeybees came to the table due to the color or the food. Although I could not come to any conclusions as to whether the bees associated the yellow color with the presence of food, I can say that the bees were still able to find food, regardless of the table's color. If this experiment were to be repeated, there are several factors that would need to be altered. These include, introducing the honeybees to the tables without food first to determine if they prefer a certain color, using or designing technology to accurately count the number of bees interacting with the feeders, and getting a video camera that had a higher resolution so that I could more accurately see the individual bees.

## References



## Acknowledgements

Thank you to the Office of Sustainability for providing me this opportunity to work as a beekeeper all summer. Also thank you to Professor Henning Schneider for all of the advice.

## Results

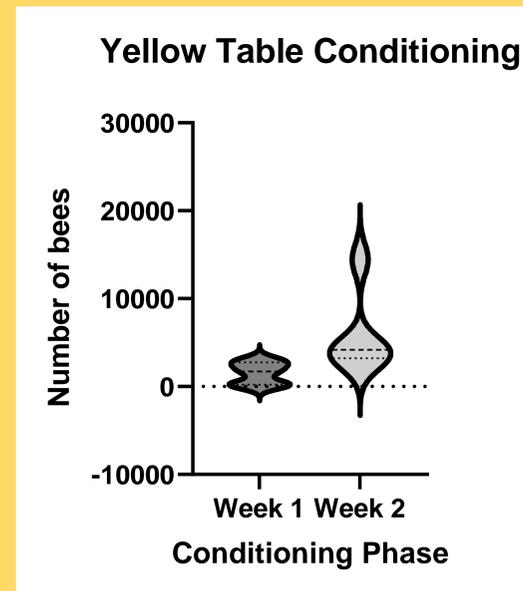


Figure 1: Number of bees visiting the feeder on the yellow table

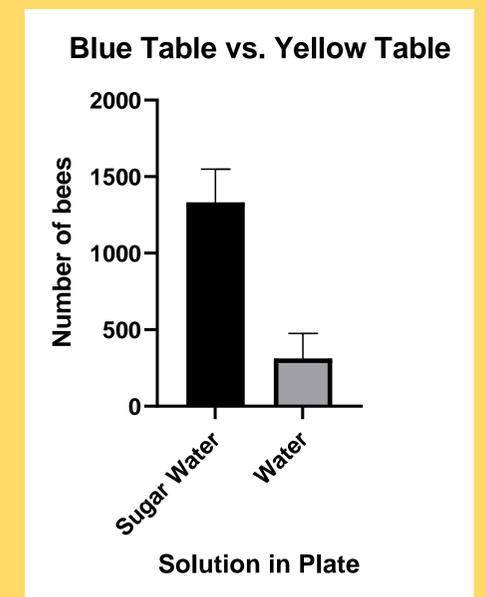


Figure 2: Number of bees visiting the blue and yellow tables

## Discussion

Each day the equipment was set up at 10:00 am and was recorded until 1:00 pm. For counting the bees, I sampled the data by counting the number of bees at the feeder at each minute interval in the videos then used this to compile the data for the two graphs presented.

Figure 1 displays the number of bees visiting the yellow feeder during the conditioning phase. Week one represents the bees that came to the feeder when it was right outside the two hives whereas Week two shows how many bees came to the feeder when it was moved 100 m from the hive. The purpose of moving it that distance is that forager honeybees will demonstrate a waggle dance within the hive in order to communicate to the rest of the hive where a food source is (Nest & Moore, 2018). The most bees observed was on day 6 with approximately 14,500 bees. This was the day that I moved the table back 100 m. Figure 1 shows the number of bees counted with standard deviation.

Figure 2 represents the last experimental portion where I wanted to determine if the honeybees would still fly to the yellow table even when I replaced the 1:1 sugar water solution with plain water to test whether the bees had truly been conditioned to the yellow table to find food. I set up the blue table approximately 3 ft from the yellow table and placed the 1:1 sugar water solution on this table to test if the honeybees would recognize that the food was now in a new location. Honeybees have color preferences because flowers exhibit uv patterns that attract insects like honeybees (Museum Of Earth). Yellow and Blue are at very different wavelengths on the color spectrum so I expected that the honeybees would be able to differentiate between the two colors. Even though I expected that the honeybees would fly to the yellow table initially, they went to the blue table very quickly, indicating that they were able to sense or smell the food on the blue table. As the videos continued, less bees congregated at the yellow table's feeder. Unfortunately, due to human error, I lost the last two days worth data, so the second graph is concerned with the first three days with the blue and yellow tables. Yet even if I were to have that data, I doubt that the graph would drastically change because by the second day, I saw a substantial difference between the bees going to the blue table versus the yellow.