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Effect of Caffeine on Bee Behavior: Progressive Ratio Study

Kayle Cohen, Becky Hansis-O'Neill, Aimee Dunlap PhD

Introduction

The study of learning in bees has provided valuable insights into the cognitive and behavioral mechanisms of social insects. One approach to investigating learning in bees is by using behavioral pharmacology methodologies. Our research on bee learning behavior focuses on using caffeinated nectar and altering schedules of reinforcement to better understand nectar preferences.

The schedules included:

- Training
- Fixed ratio (FR) (1 reward/flower visit)
- Progressive ratio (PR) (1 reward/ progressively more flower visits)

Our study utilized the fixed ratio (FR) and progressive ratio (PR) schedule of reinforcement to assess the effects of caffeinated nectar on the bees' ability to learn. The PR schedule is a type of operant conditioning in which the number of responses required for a reward is gradually increased over time.



Methods

We trained two bumblebees to drink nectar from an artificial flower and recorded their responses. This project was meant to evaluate these methodologies on a small number of bees before moving on to a larger study. Caffeinated and non-caffeinated sucrose were pipetted into the artificial flowers, acting as a reward during FR and PR. For the caffeinated reward bees were administered a .0001 M dose of caffeine in 60% sucrose solution w/v (weight by volume).



Results



Figure 1: Comparison of total average rewards earned of subjects 53 and 46 during FR with sucrose, PR with sucrose, and PR with caffeinated nectar.

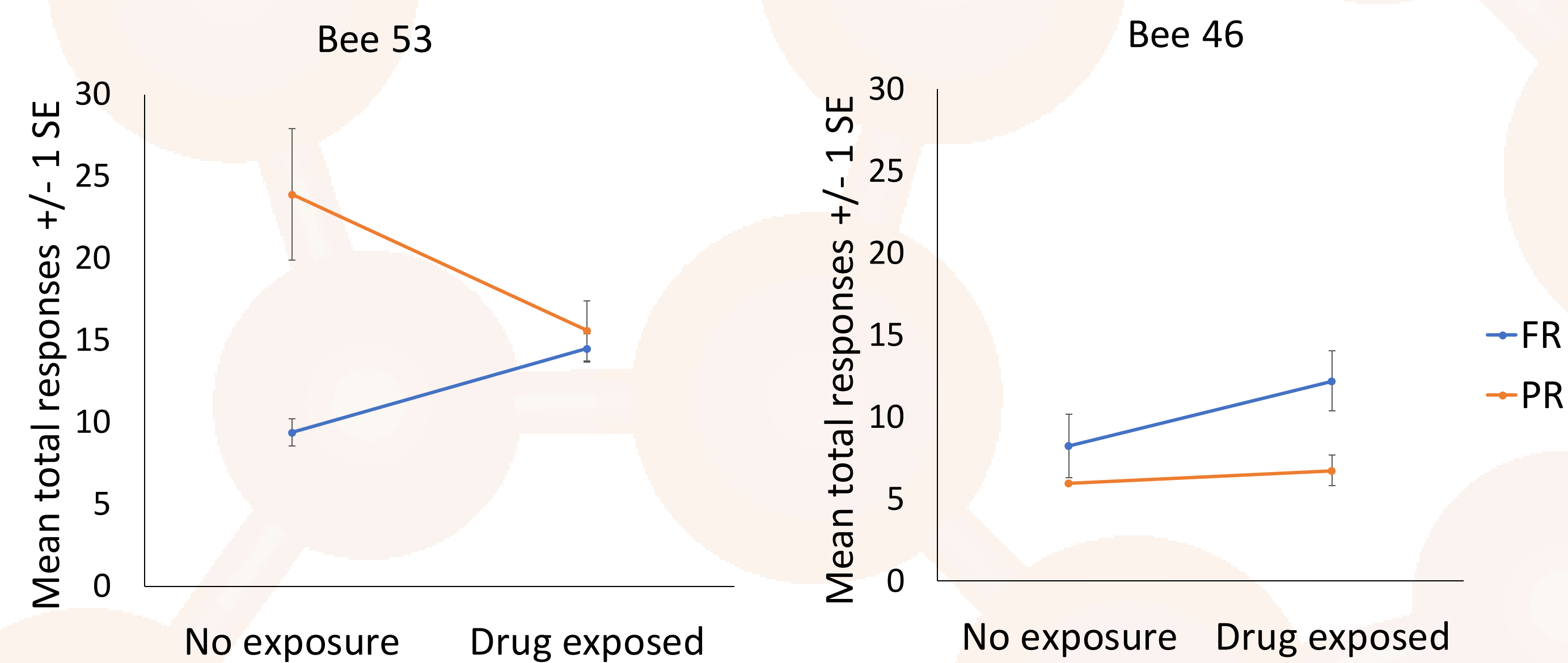


Figure 2: Mean total rate of response comparison for bee 53 and bee 46.

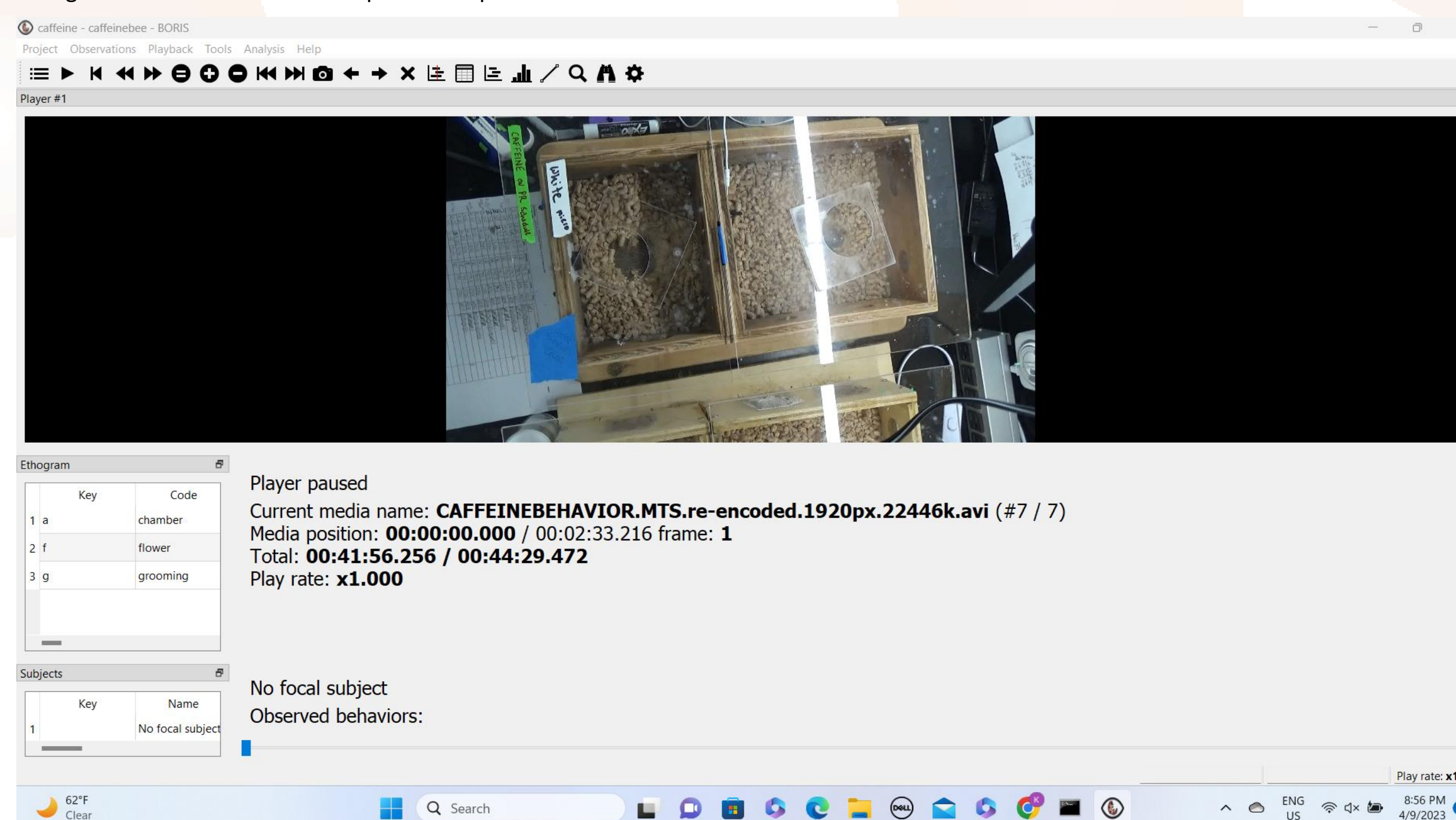


Figure 3: Behavioral Observation Research Interactive Software (BORIS)

Conclusions

Our results from the schedule data shows that bees fed caffeinated nectar were not significantly more likely to earn rewards during the caffeinated progressive ratios than progressive ratios with sucrose nectar.

- This finding suggests that caffeine did not enhance sugar rewards.
- Drug exposed bees earn more rewards, indicating a possible psychotropic effect
- Because the project is ongoing, this result may be attributed to data limitations.
- Researchers are currently working on testing more bees to attain more conclusive results.

Testing the bees is time consuming due to the unpredictable nature of the colonies. There is also a period before the effect of caffeine while the sucrose reward is more instantaneous. In the future researchers may test the effects of the caffeine reward during trials with a higher concentration.

Future Work

Researchers will use Behavioral Observation Research Interactive Software (BORIS) to score videos of trial runs and analyze duration and grooming behaviors.

References

- Julian Leslie. Essential Behaviour Analysis. Routledge; 2002. Accessed January 16, 2022. <https://search.ebscohost.com.ezproxy.umsl.edu/login.aspx?direct=true&db=nlebk&AN=104458&site=ehost-live&scope=site>
- Hassanpour-Ezatti, M. (2013). Comparison of acute effects of heroin and Kerack on sensory and motor activity of honey bees (*Apis mellifera*). *Journal of Apicultural Research*, 52(2), 63-70. doi: 10.3896/IBRA.1.52.2.01
- Mustard, J. A. (2014). The buzz on caffeine in invertebrates: effects on behavior and molecular mechanisms. *Invertebrate Neuroscience*, 14(1), 1-10. doi: 10.1007/s10158-013-0169-2.
- Thomson, J. D., Draguleasa, M. A., & Tan, M. G. (2015). Flowers with caffeinated nectar receive more pollination. *Arthropod-Plant Interactions*, 9(2), 131-138.

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