

DATA *Nugget*

To bee or not to bee aggressive

Featured scientist: Clare C. Rittschof from the University of Kentucky

Research Background:

Honey bees are highly social creatures that live in large colonies of about 40,000 individuals and one queen. Every member of the hive works together to benefit the colony. Some of the tasks adult bees perform include making honey, nursing young, foraging for food, building honey comb structures, and defending the colony.

From spring through fall, the main task is turning nectar from plants to honey. The honey is stored and eaten over the winter, so it is vital for the colony's survival. Because honey is an energy-rich food source, hives are targets for break-ins from animals, like bears, skunks, and humans that want to steal the honey. Bees even have to fight off bees from other colonies that try to steal honey. Research shows that colonies adjust their defenses to match threats found in their environment. Hives in high risk areas respond by becoming more aggressive, and hives that do not face a lot of threats are able to lower their aggression. This flexibility makes sure they do not waste energy on unnecessary behaviors.

Clare is a scientist studying the behavior of social animals. There is an interesting pattern seen in other social animals, including humans, that Clare wanted to test in honey bees. In these species, the social environment experienced when an individual is young can have lasting effects on their behavior later in life. This may be because this is the time that the brain is developing. She thought this would likely be the case with honey bees for two reasons. First, bees can use social information to help coordinate group defense. Second, young bees rely completely on adult bees to bring them food and incubate them, so there are a lot of social interactions when they are young. After reading the literature and speaking with other honey bee experts, Clare found out that no one had ever tested this before!



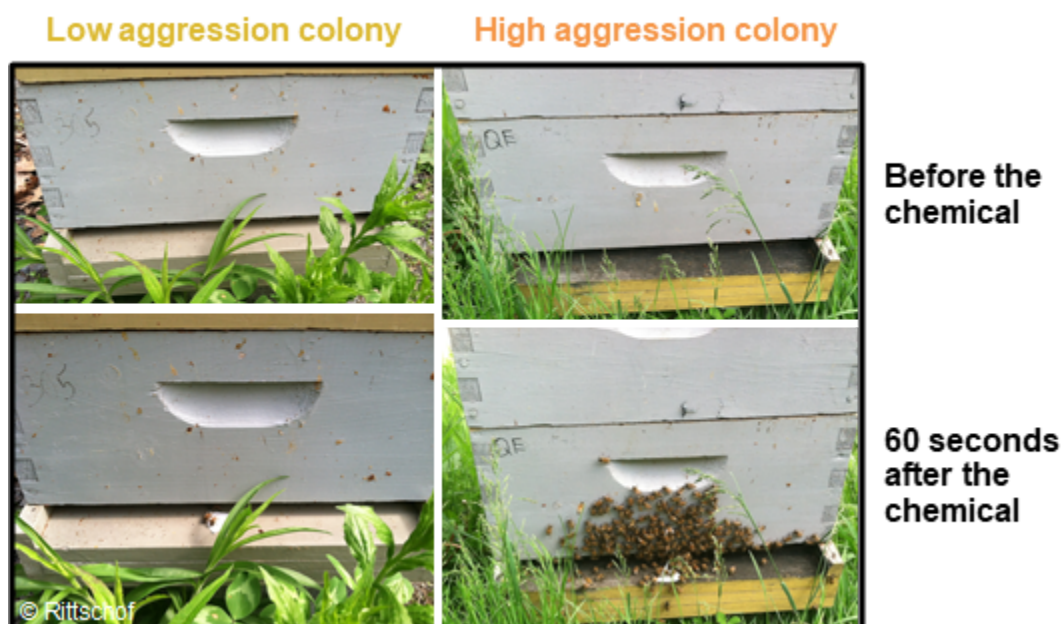
Figure 1: A honey bee (*Apis mellifera*) collecting nectar to bring back to the hive. Photo by Andreas Trepte www.photo-natur.net

Clare chose to look at aggression level as a behavioral trait of individual bees within a colony. She predicted that young honey bees raised in an aggressive colony would be more aggressive as adults, compared to honey bees raised in a less aggressive colony. To test her predictions, Clare used 500 honey bee eggs from 18 different queens. To get these 500 eggs she collected three times in the summer, for two years. Each time she collected, she went to two different locations. Collecting from so many different queens helped Clare make sure her study included eggs with a large genetic diversity.

To test her questions, she used these eggs to set up an experiment. Eggs from each of the 18 queens were split into two groups. Groups were put into one of two types of **foster colonies** – high aggression and low aggression. Clare determined whether each foster colony was considered high or low aggression using a test (Figure 2). Because half of each queen's eggs went into a low aggression foster colony, and the other half in a high aggression foster colony, this represents the experimental treatment.

Clare left the foster colonies alone and waited for the bees to develop in the hives. Eggs hatch and turn into larvae. These larvae mature into pupae and then into adults. Just before the young bees emerged from their pupal stage to adulthood, Clare removed them from the foster colonies and brought them into the lab. This way the bees would spend their whole adult life in the lab together, sharing a common environment.

After a week in the lab, Clare tested the aggressiveness of each individual bee. Her test measured aggressive behaviors used by a bee to defend against a rival bee from another colony. Clare observed and counted a range of behaviors including attempts to sting the rival and bites to the rival's wings and legs. She used these values to calculate



an **offspring aggression score** for each bee.

Figure 2: To measure the aggression of foster colonies in her experiment, Clare first had to perform a test. She put a small amount of a chemical that makes bees aggressive on a piece of paper at the front of the colony entrance. The top two photos show two colony entrances before the chemical. The bottom two photos show the same two colonies 60 seconds after the chemical. The more bees that come out, the more aggressive the colony. You can see from these images that the colony on the right is much more aggressive than the colony on the left. Clare counted the number of bees and used this value to classify the colony as high or low aggression. This became her experimental treatment.

Scientific Question: In what way does social environment experienced when young affect aggressiveness in adult bees?

What is the hypothesis?

- 1) Find the hypothesis in the Research Background and copy/paste it below. *A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.*

Scientific Data:

- 2) Clare collected eggs from 18 queens in the wild. Here we have the data for the average for each queen's offspring in each of the two treatments. What data will you graph to answer the question?

Independent variable: _____

Dependent variable: _____

- 3) [Make a graph](#) using your selected variables, and screenshot it below:
- 4) Identify any changes, trends, or differences you see in your graph. Include your graph and specifically refer to it when describing those changes, trends, or differences.

Interpret the data:

- 5) Make a claim that answers the scientific question.
- 6) What evidence was used to write your claim? Reference specific parts of the table or graph.
- 7) Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about the importance of aggression in bees.
- 8) Did the data support Clare's hypothesis? Use evidence to explain why or why not. If you feel the data were inconclusive, explain why.

Your next steps as a scientist:

- 9) Science is an ongoing process. What new question do you think should be investigated? What future data should be collected to answer your question?

Digital Extension



These questions are a digital extension of the original Data Nuggets activity. The data manipulation and graphing tasks within are best completed here on DataClassroom.

Statistics Extension

- 10) Add the the average Offspring Aggression Score for each group to your graph by [checking the box for *Descriptive stats*](#). **Considering the variation in the data, do you think the difference in the average Offspring Aggression Score is the result of a real difference between the groups or do you think it looks like the result of random chance alone? Explain your thinking as you answer.**
- 11) Scientists use statistics to help evaluate a level of confidence they can place on their conclusions. **Conduct a statistical test to check for a difference in mean Offspring Aggression Score between the two groups of bees (those that were raised in high aggression hives and those that were raised in low aggression hives).** Run a [graph-driven hypothesis test](#) while you have a graph showing Aggression of Foster Colony on X and Offspring Aggression Score on Y.

Paste the output of your test here.

- 12) **Which test did you run? Why did you run this test?**

Hint: Look at the table that appears before you run the Graph Driven Test to see why this test was chosen.

- 13) **Given the result of your statistical test and the data you had to work with, how much confidence do you have in your answer to #10? Explain your thinking.**

Nature or Nurture? Which has the greater impact on a bee?

- 14) Create a graph of Aggression of Foster Colony on x-axis, and Offspring Aggression Score on the y-axis. Select Queen ID# for z-axis. Screenshot the graph below:

15) Consider what this data may be telling us about genetic makeup vs. colony culture. What seems to have more of an impact - the queen the bee came from, or the colony it was raised in? Provide specific evidence for your answer.