IOWA STATE UNIVERSITY

MCNAIR PROGRAM

HONEY BEE BEHAVIORS & VIRUSES

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BACKGROUND

- Over 80% of plants are pollinated by insects and bees are obligate flower visitors.
- Honey bees are extremely important for the pollination of agricultural crops and ecological settings.

Relying on Bees

Some of the most valuable fruits, vegetables, nuts and field crops depend on insect pollinators, particularly honeybees.

	Crop value *in billions 2006*	Percentage pollinated by honeybees	Percentage of crop pollinated by …
			HONEYBEES / OTHER INSECTS / OTHER
Soybeans	$19.7	5%	
Cotton	5.2	16	
Grapes	3.2	1	
Almonds	2.2	100	
Apples	2.1	90	
Oranges	1.8	27	
Strawberries	1.5	2	
Peanuts	0.6	2	
Peaches	0.5	48	
Blueberries *cultivated*	0.5	90	

Besides insects, other means of pollination include birds, wind and rainwater.

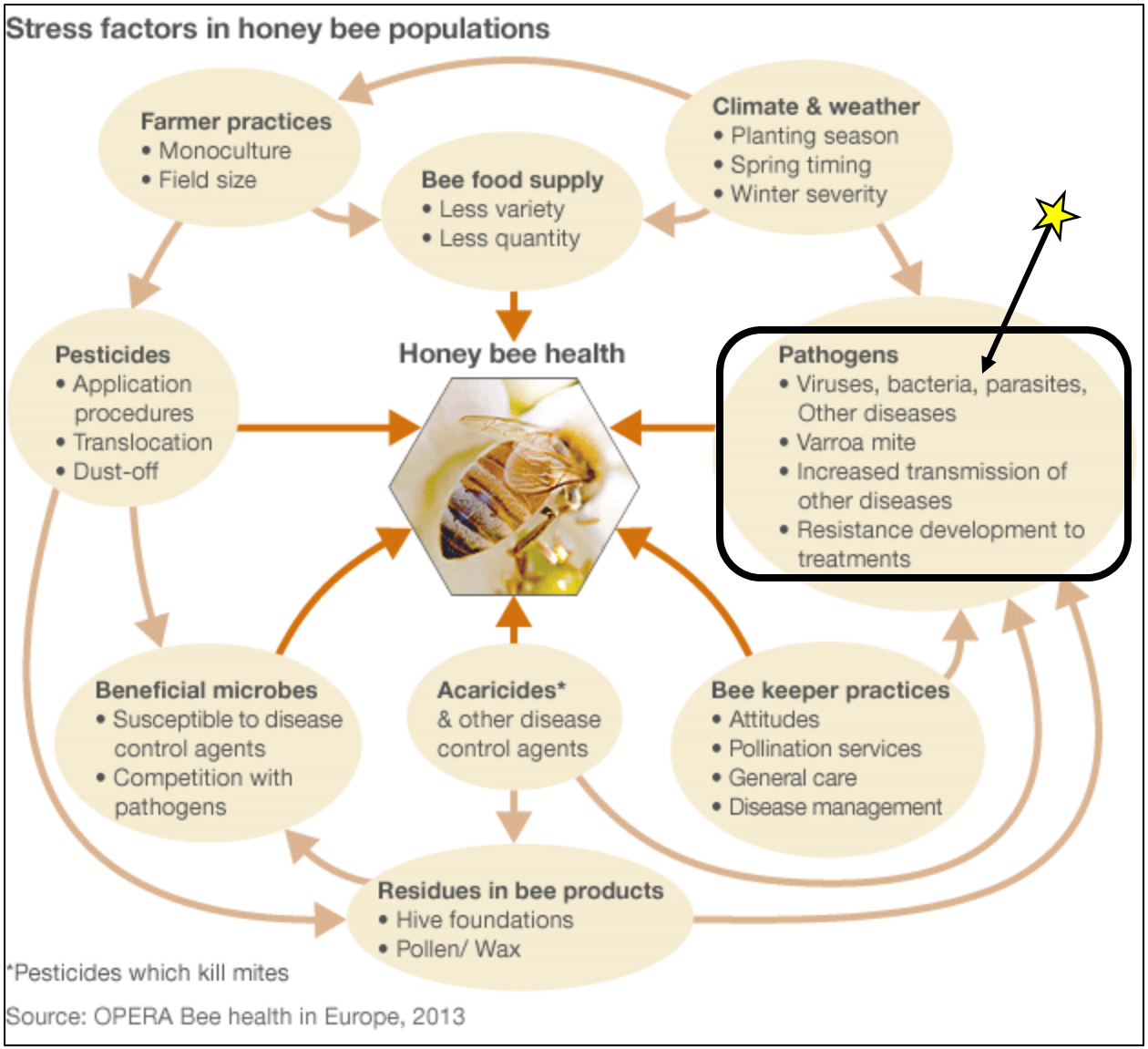
Sources: United States Department of Agriculture; Roger A. Morse and Nicholas W. Calderone, Cornell University

The New York Times

THE PROBLEM

- Honey bee populations have been declining intensely in the United States.

- It is important to recognize possible contributing factors to aid in recovering the problem.


Stress factors in honey bee populations
Farmer practices
• Monoculture
• Field size
Climate & weather
• Planting season
• Spring timing
• Winter severity
Bee food supply
• Less variety
• Less quantity
Honey bee health
Pesticides
• Application procedures
• Translocation
• Dust-off
Pathogens
• Viruses, bacteria, parasites, Other diseases
• Varroa mite
• Increased transmission of other diseases
• Resistance development to treatments
Beneficial microbes
• Susceptible to disease control agents
• Competition with pathogens
Acaricides*
& other disease control agents
Bee keeper practices
• Attitudes
• Pollination services
• General care
• Disease management
Residues in bee products
• Hive foundations
• Pollen/ Wax
*Pesticides which kill mites
Source: OPERA Bee health in Europe, 2013

HONEY BEE VIRUSES

- Israeli Acute Paralysis Virus (IAPV)
  - Affects all developmental stages of honey bees. Causes both death and severe colony lost.
- Black Queen Cell Virus (BQCV)
  - Causes the larvae of the queen to turn black and die.
- Deformed Wing Virus (DWV)
  - Causes wing deformities and other body malformations.
- Sacbrood Virus (SBV)
  - Causes the affected larvae to change from white to black, then die right before pupation.

Deformed Wing Virus
(DWV)

Black Queen Cell Virus
(BQCV)

Sacbrood Virus
(SBV)

NATURAL HONEY BEE BEHAVIORS







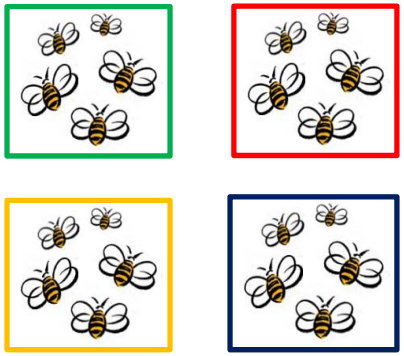




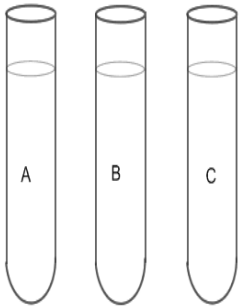
HYPOTHESIS

- We predicted that…
  - Viral stress would cause the virus fed bees to change their behaviors to spread the virus quickly and efficiently to other individuals.
  - Food sharing behavior would appear most in the virus infected bees than in any other treatment group.

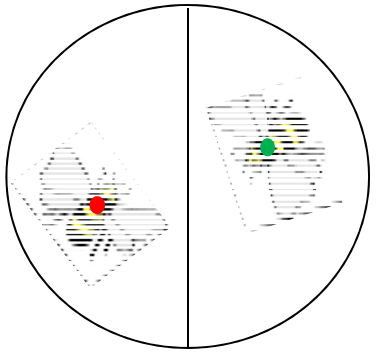
METHODS



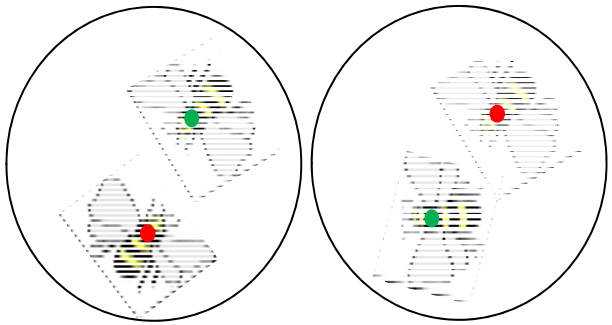
Each group of bees were marked with a dot of paint on their backs and separated by color into containers.



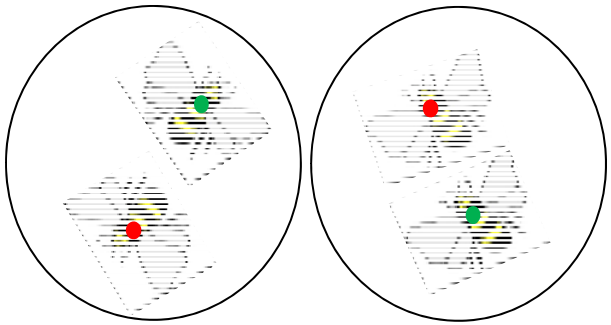
The bees were then fed either a **virus mixture**, **heat inactivated virus or sugar water** and was kept in an incubator.



Each trial consisted of a variable bee with a partner bee. They were separated by a cardboard barrier. The acclimation period was 5 min.



The cardboard barrier was removed and the bees were then able to interact.



Behaviors were recorded with a score of 0 or 1. Two sets of bees were observed for 2 minutes at a time.

After use, the bees were humanely placed in a freezer, then disposed of in a hazardous bag.

An example of a previous experiment that was being conducted. This photo was taken during an acclimation period.

METHODS: Behaviors Scored

- Antennating (A)
- Trophallaxis (T)
- Begging (BG)

- Auto-grooming (AG)
- Allo-grooming (G)

- Mandible Opening (M)
- Wing Flickering (WF)
- Biting (B)

- Walking upside down (WU)
- Standing still (S)
- Walking (W)

RESULTS

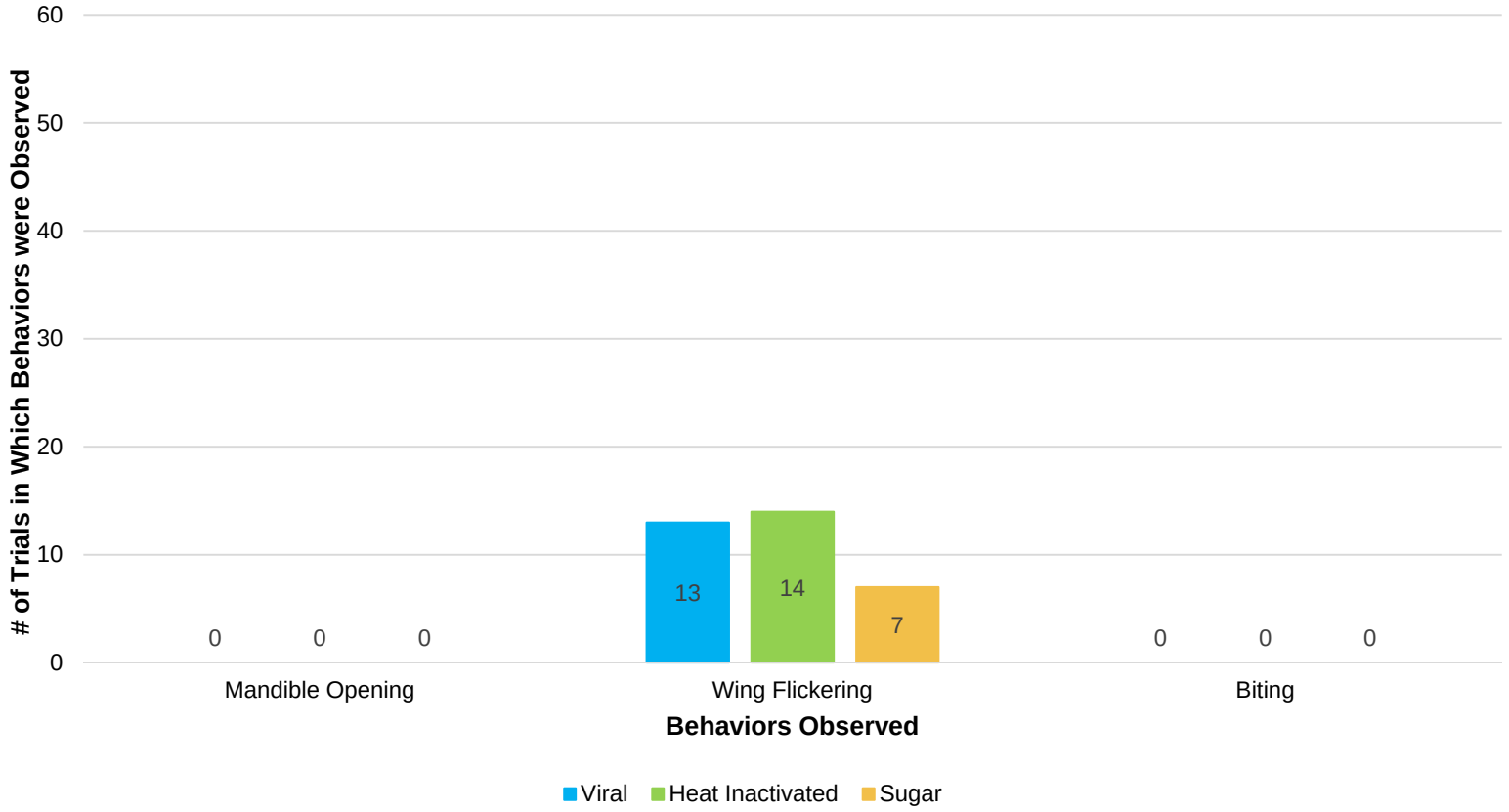


Figure 1. A comparison of social behaviors associated with aggression and aggravation that were displayed per treatment type.

RESULTS

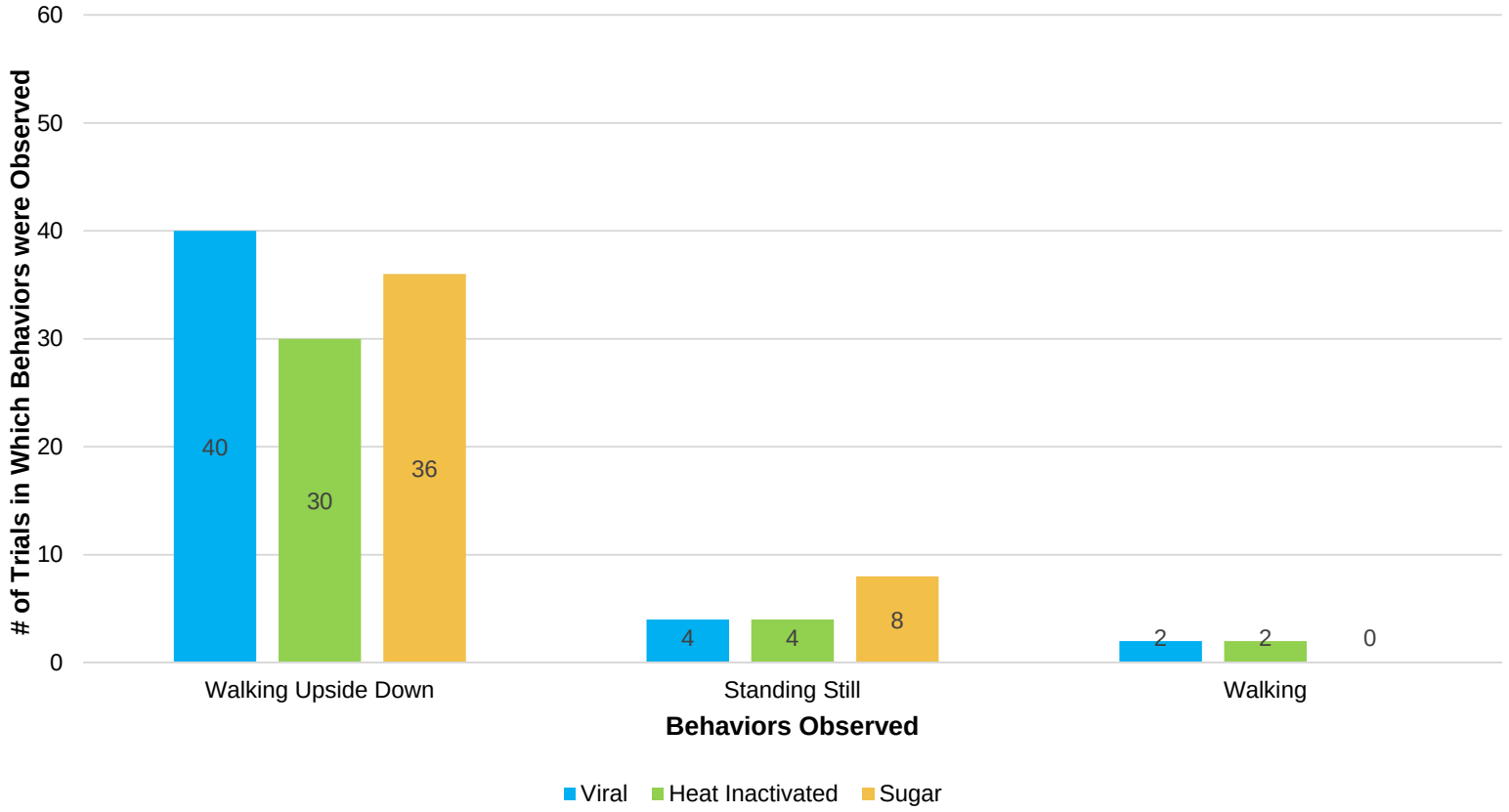


Figure 2. A comparison of locomotive behaviors that were displayed per treatment type.

RESULTS

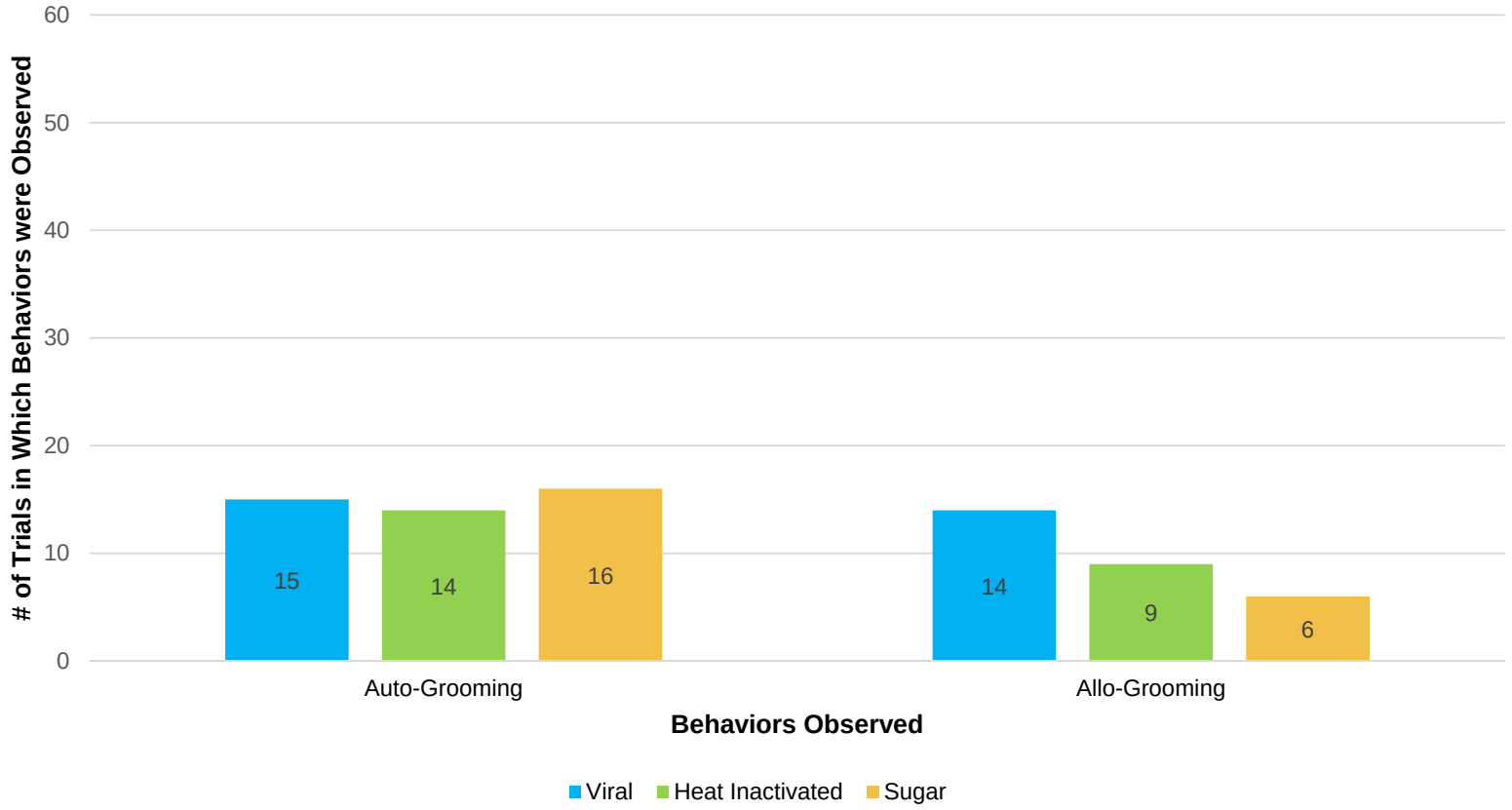


Figure 3. A comparison of social behaviors associated with grooming that were displayed per treatment type. A chi-squared test was used for statistical data. The p-value of allo-grooming for virus vs. sugar was 0.170904. The p-value of allo-grooming for virus vs. heat-inactivated was 0.375435. Neither were significant.

RESULTS

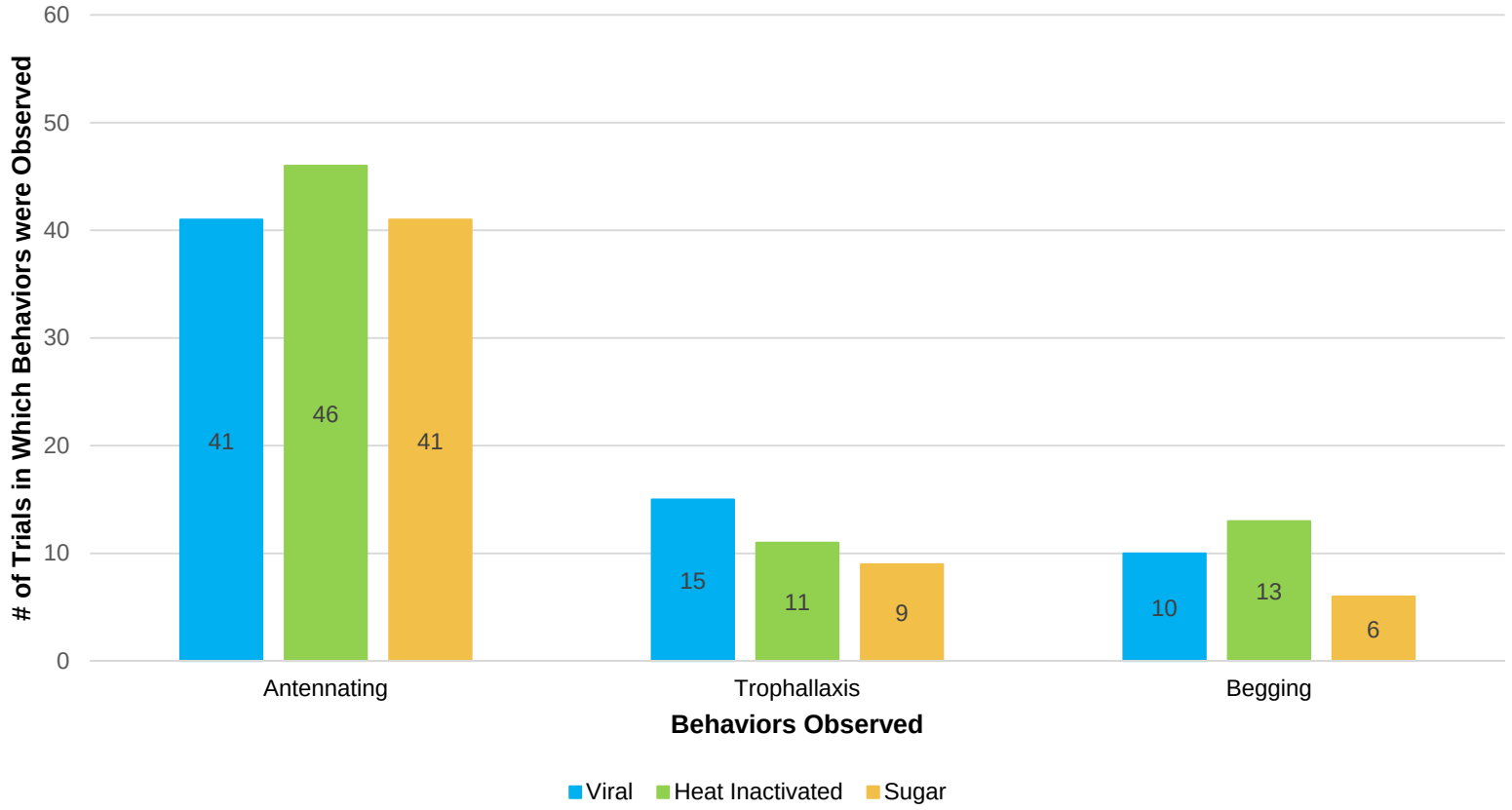


Figure 10. A comparison of social behaviors associated with eating that were displayed per treatment type. A chi-squared test was used for statistical data. The p-value of trophallaxis for virus vs. sugar was 0.050044. The p-value of trophallaxis for virus vs. heat-inactivated was 0.246209. Neither were significant.

RESULTS

- The viral infection did appear to have some effect on honey bee behavior.
- The virus fed bees as predicted did display more food sharing behavior than the other treatment groups.
- The virus fed bees also displayed more social behaviors such as grooming than the other treatment groups.
- None of the behaviors per treatment group were significantly different but looked very promising.

INTERPRETATIONS

- It’s very possible that the infected bees (hosts) were being manipulated by the virus (pathogen) by interacting more with other bees to spread the virus to the next individual.

- Honey bee viruses are very persistent, and although there may not be any direct signs of disease, it can intensely affect honey bee behavior, health and shorten the lives of infected bees.

SUMMARY

- Investigated the role of viral pathogens affecting honey bee behavior.

- Closely observed the differences in behavior between **virus fed bees**, **heat inactivated virus fed bees**, and **sugar solution fed bees**.

FUTURE STUDIES

- Determine whether or not the partner bee was infected by the virus fed bee.
- Revamp study observing a real hive in comparison to bees in a research setting.
- Observe whether or not change in seasons affect the relationship between the virus and behavior of the bees.
- Use of a video camera for closer observation of behaviors.

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QUESTIONS?