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Comparing Sucrose Preference Between Colonies of *Bombus impatiens*

Kevin Corrigan, Becky Hansis-O'Neill, Aimee Dunlap PhD

INTRODUCTION

Bombus impatiens (*B. impatiens*) is a bumblebee native to eastern North America. *B. impatiens* is adaptable to many environments, lives underground, has a very large range, and is an important pollinator species. Studying their sucrose preferences helps us better understand how bees and plants coevolved.

There are published studies listing sucrose preferences for the *Bombus* genus which can be used as a guide. Also, there is evidence that the *Bombus* genus could opt for sucrose rewards with a lower concentration because it is more energy efficient. Thus, there are studies that list measurements for optimal concentration. However, these preferences may differ among colonies. I predict that our bee colonies will show colony level differences in their sucrose preferences and behavior.

In terms of direct preference measurement, one study shows *B. impatiens* prefers between 50-60% sucrose concentration when given a broad range of choices^[3].

Sucrose optimal concentration range is 50-65%^{[1][2][3]}.

As we can see, these direct measurements for sucrose preference line up well with the optimal net energy intake of 50-65%.

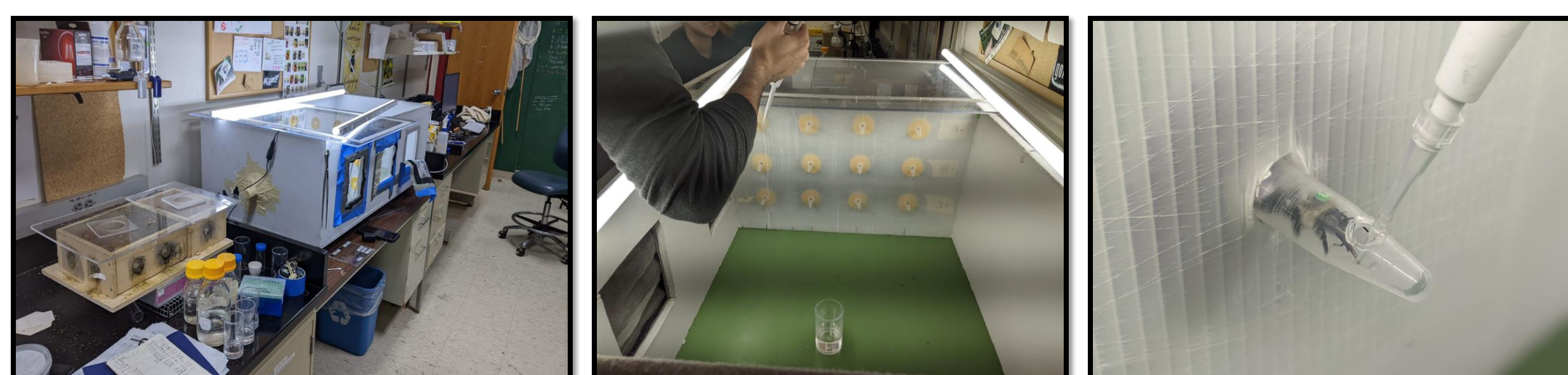


METHODS

Our laboratory setup consisted of a colony box, a foraging arena, and a tube bridge connecting the two. To begin a data run, we would allow a tagged bumblebee to enter the arena and begin foraging on the flower wall. Data was collected for six run types: FR30, FR45, FR60, PR30, PR45, and PR60. The accompanying number refers to the sucrose concentration. Data collection for an individual bee was completed once it finished one of each run. We collected data from two colonies, A6 and B2.

For a FR data run, every time a bee gave a response, meaning it went inside of a flower, it would receive a 5µL sucrose reward.

For a PR data run it's the same except that an increasing response requirement had to be met to receive a reward. Thus, the first reward required one response, the second reward required two responses, the third reward required three responses, and so on.



RESULTS

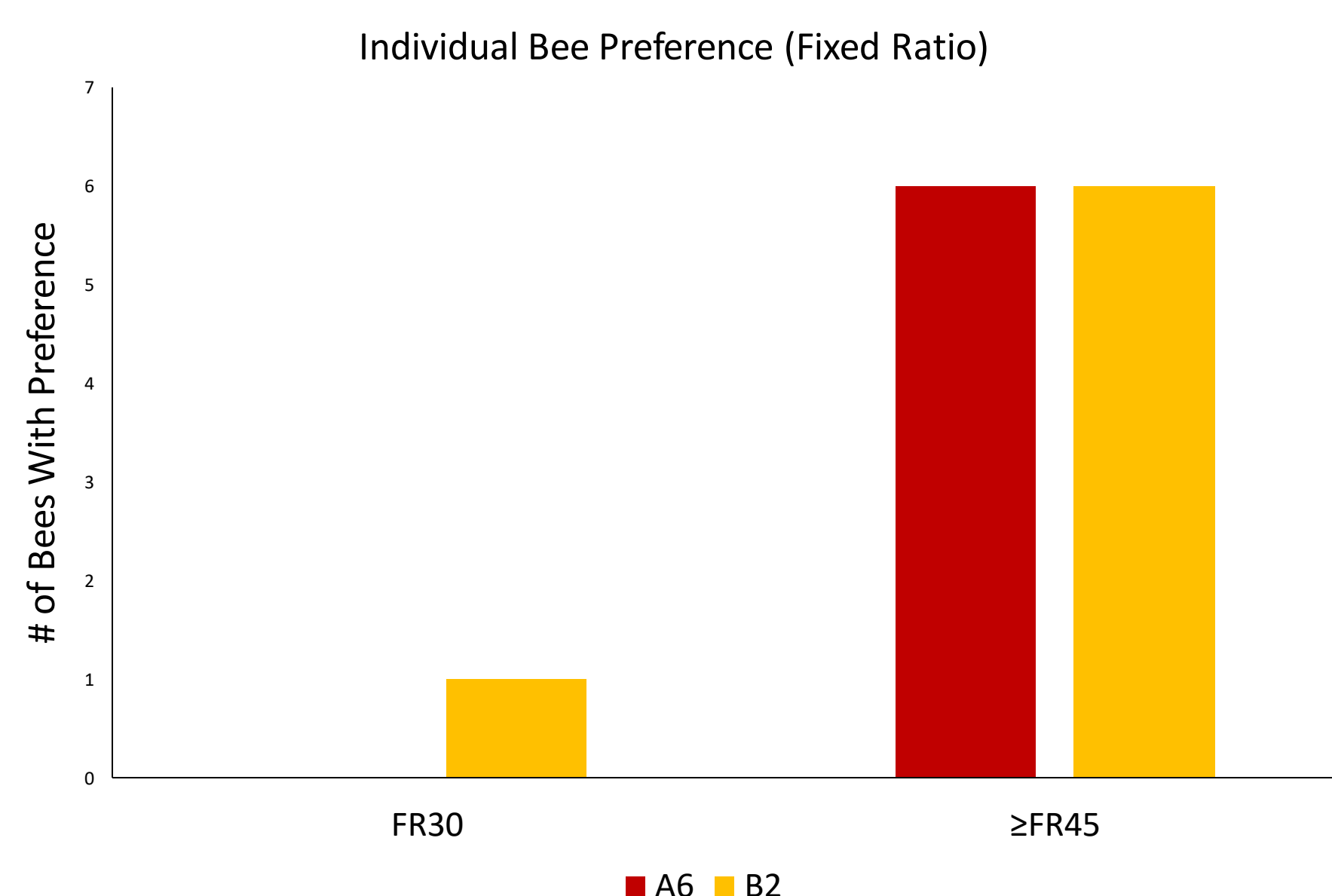


Figure 1. Individual bee preference under fixed ratio conditions (two colonies).

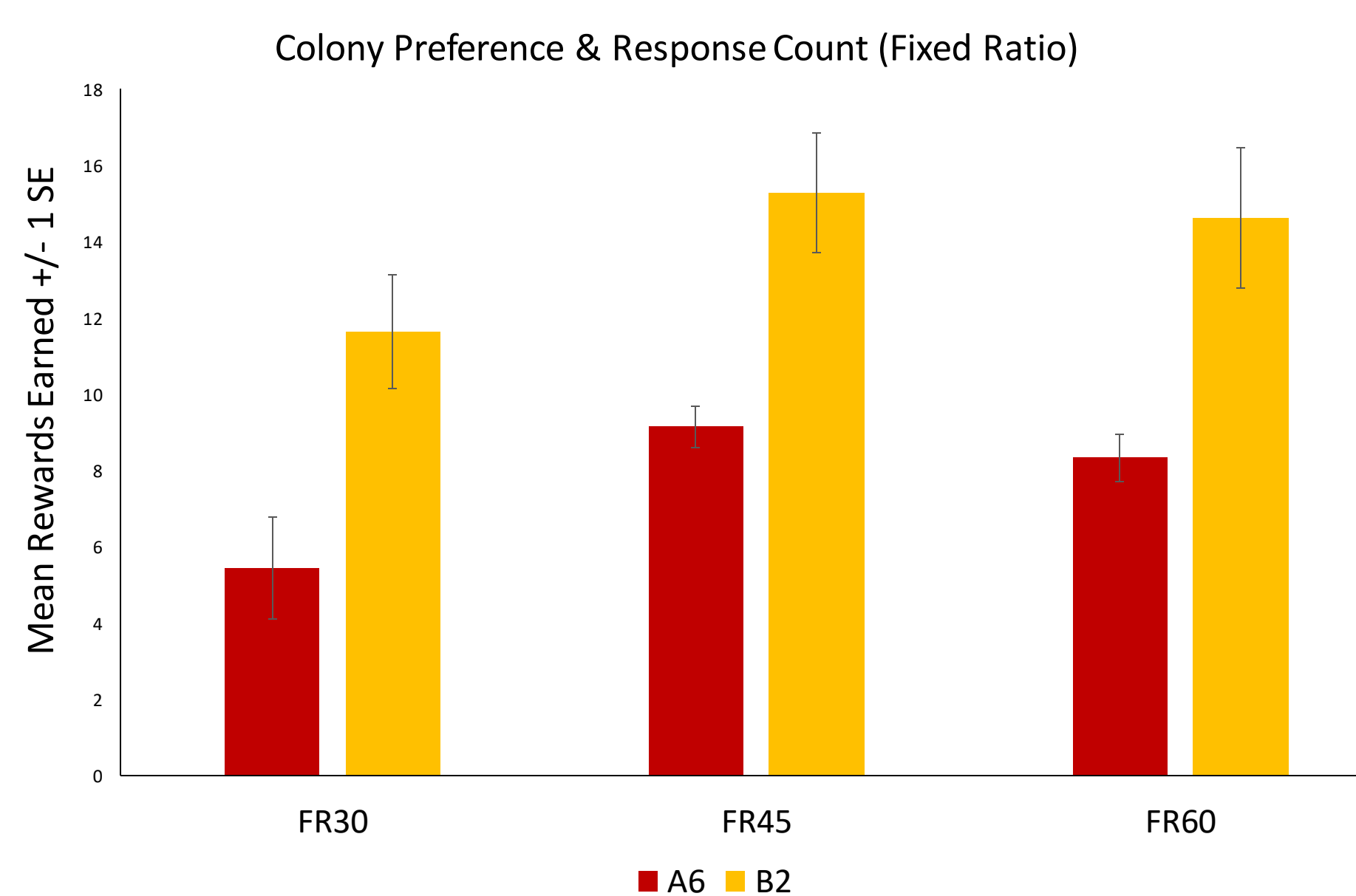


Figure 2. Mean number of responses for each sucrose concentration under fixed ratio conditions for colonies A6 and B2.

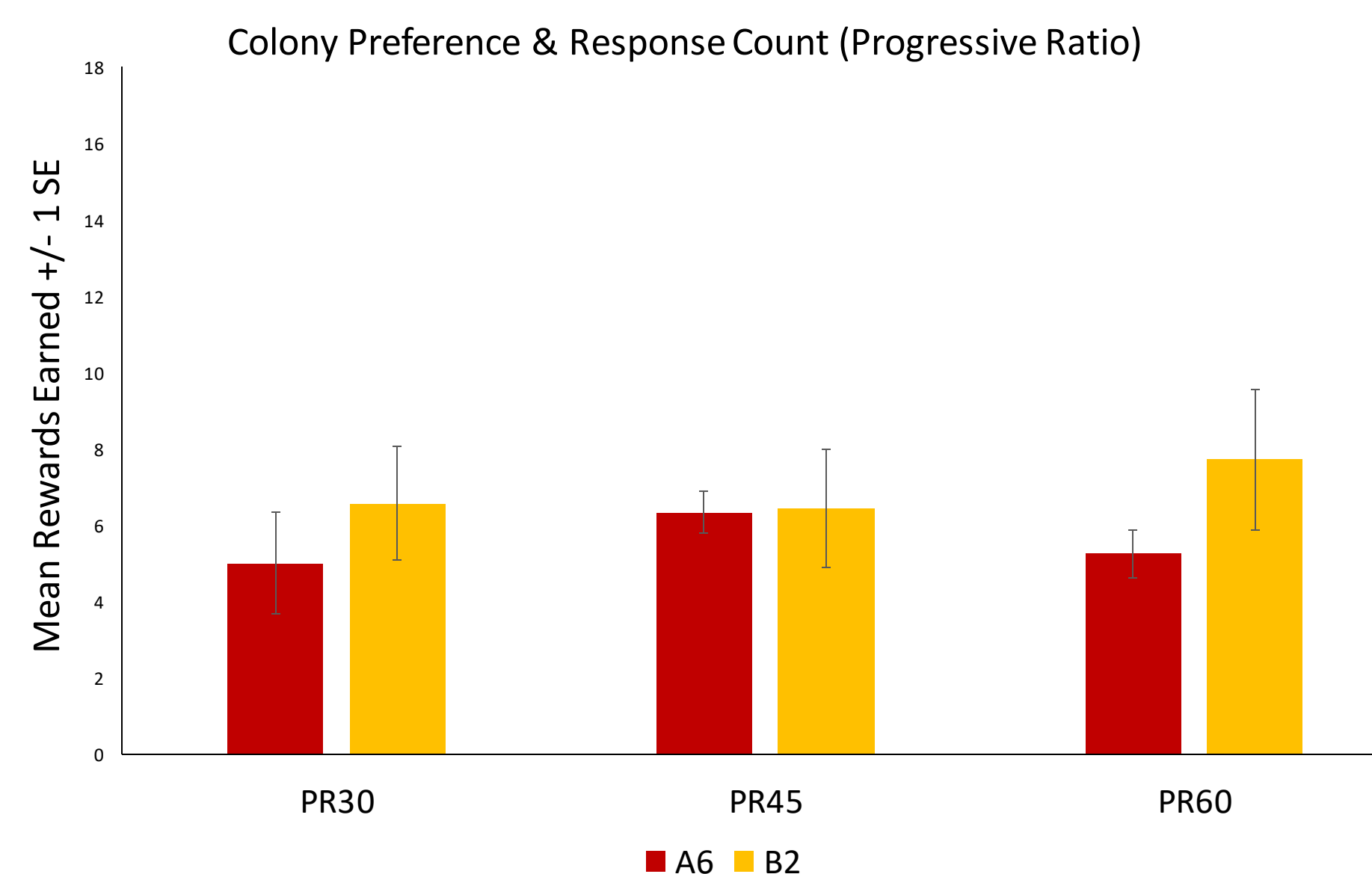


Figure 3. Mean number of responses for each sucrose concentration under progressive ratio conditions (two colonies).

Table 1: Results of GLM looking for interactions among colony and treatments.

Tests of Between-Subjects Effects (General Linear Model)					
Dependent Variable: Rewards Earned					
Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1193.934 ^a	19	62.839	3.399	<.001
Intercept	5530.955	1	5530.955	299.202	<.001
Colony ^b	402.877	2	201.438	10.897	<.001
Reward Schedule	200.501	2	100.250	5.423	.006
Sucrose Concentration	35.177	2	17.588	.951	.389
Colony * Reward	145.124	4	36.281	1.963	.105
Colony * Sucrose	9.404	4	2.351	.127	.972
Reward * Sucrose	12.204	2	6.102	.330	.720
Colony * Reward * Sucrose	9.886	3	3.295	.178	.911
Error	2070.399	112	18.486		
Total	13564.000	132			
Corrected Total	3264.333	131			

a. R Squared = .366 (Adjusted R Squared = .258) b. colony A7 included in analysis, but not on graphs due to low n.

CONCLUSIONS

According to our results showing that, for *both* colonies, individual bees preferred a sucrose concentration of 45% or greater (Fig. 1). Published literature indicates these numbers should be between 50-60% so our findings were close to what was expected.

When comparing average rewards earned between fixed ratio colonies, we found statistically significant results showing that colony B2 earned more rewards overall than colony A6 ($p < .001$, Tukey's HSD) overall.

- Colony-level differences did exist, but disappeared under PR
- Bees in the lab may behave differently than bees in the wild
- If a colony produces more efficient or more motivated foragers, that could bring up the while average

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