The Effect of Color and Lighting on the Feeding Habits of Birds

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Abstract

Each year billions of animals are affected by various changes being introduced into the environment such as deforestation and urbanization. This experiment was based off of a previous experiment determining whether granivorous birds in their natural wild habitat show a preference in one color over others. To further extend on this idea and to solidify the results, the research was moved to a controlled environment eliminating all external factors such as weather, lighting, temperature and risk factors. This was done by having four cages. First, random colors were set in each cage. Then it was noticed that some feeders were getting more light than others, so then, for the next trial of data collection, the feeders were placed in random order from left to right and changed location every two days which is the frequency the data was collected. After 7 day trials of each data set, full spectrum lights were set on top of the cages. Birds can see in ultraviolet which is something humans cannot so I wanted to determine if the lighting affects their color preference as well. Results showed that they do not show a preference in color.

Introduction

Each year billions of animals are affected by various changes being introduced into the environment such as deforestation and urbanization. As the boundary between nature and civilization is blurring as construction pushes outward, it is crucial to recognize how the introduction of risk factors we introduce into the environment affects the feeding habits of wild animals. Due to the co-dependent nature of animals in the ecosystem, if just one species is removed or forced out of the ecosystem, then it will result in instability in the ecosystem as a whole. Deforestation is occurring in places that are typically left undisturbed. It can be estimated that about 1,150,000,000 trees were cut down in just 2008 alone in the Amazon, depriving approximately 250 different bird species of their habitat (Biol, 2008). As humans continue to modify bird habitats and displace them through deforestation, it is crucial to find ways to help attract them to new areas to feed to reduce ecosystem disruption as much as possible. It was observed in previous research that when taste, nutrition, and accessibility to food sources are equal, birds often exhibit color preferences when feeding. At certain times of the year, individuals of the tit family can lose up to 10% of their body weight just overnight if not fed properly (Rothery et al., 2017). In many cases, supplementary feeding is necessary for the survival of these animals. Not only can finding color preferences in birds help keep the birds in the local ecosystem as well as keep them alive, it can help with the sale of feeders due to the sellers being able to potentially tailor make the feeders according to the preference of birds as well. Previous research has shown that in North America as well as other countries, 20% to 40% of people regularly provide wild birds with additional food. (Rothery et al., 2017). According to the Wild Bird Feeding Industry, in just 2014 alone, about 42.1% of households in the US purchase bird feeders. This means that about 52.5 million households in the US spend money on bird feeders and this number is on the consistent increase. By determining which color is most preferred by birds, the bird feeder industry can produce and sell more of the preferred colors resulting in more birds coming to feed at the feeder. According to an article published on the preferences in bird feeding, the reason people feed birds is because it gives them a sense of personal wellbeing (Rothery et al., 2017). One study examining

fruit-eating birds found that many seemed to prefer yellow fruits while red and black fruits were less preferred. (Willson et al., 1990). Sometimes the preferences in certain colors over others in frugivorous birds are because the preference may actually be for the nutritional value, ripeness, and size (Rothery et al., 2017). There are many studies done determining different preferences in color for birds, however, experimental studies on feeders do not show a consistent preference for any particular color (Rothery et al., 2017). The purpose of a previous project was to determine whether granivorous birds, that feed on seeds, near homes, show a color preference on the feeder itself. The results of this experiment showed that birds show a preference in the color red as opposed to clear, brown and green. These results were further analyzed by a chi-square analysis to test the statistical randomness of the data. The results showed that red feeder finished first and this was a reiterating pattern throughout the experiment. However, research in the UK on garden birds showed some different results. This experiment which was conducted showed that silver was much more preferred by the birds than the red because the birds made more frequent visits to the silver feeder. Even in this experiment, the colors which were interpreted in human color space rather than avian color space. This has an impact on the data set because birds see at a different visual spectrum than humans and are capable of seeing UV. (Toomey et al., 2016). These experiments were done on wild birds of varying species in a non-controlled environment. Therefore, an experiment in a controlled environment would cancel out all of the external factors that may affect the data such as weather, temperature, and light. By controlling these factors, a more concrete data set would help prove the color preference in birds if they had any.

Methodology

The type of birds used in this experiment were Zebra Finches. In order to determine whether or not birds showed a color preference under controlled conditions, four cages were set up side by side numbered 3,7,11 and 14. The colors of feeders chosen for this experiment- red, green, clear and brown- were based off of a previous experiment done to determine the color preference in wild granivorous birds. These same colors were used to determine if this preference in color was present in all species of birds or just wild birds consisting of many different species. Also, the same colors were used in this experiment to see if the colors were still preferred in a controlled environment or just wild birds with many external factors. Before any data was collected, the different color feeders were set up in the cages to get the birds used to the change from their initial cage set up. Although there were 4 colors being experimented on, only two colors were put into each cage. The color of the two chosen feeders was chosen at random and located equidistant from each other in the cage. After a week of the birds growing accustomed to the new feeders, data collection was initiated. On every alternate day, the feeders were refreshed with new bird

food and then two other colors were randomly selected again to go in a new cage. To determine which color was preferred, the mass of the feeders before they were put in the cages was measured in grams. After exactly two days, the feeders were taken out of the cage for the mass to be measured again. The difference in the mass on the two day interval portrayed how much food was eaten by the bird. It was observed that sometimes the bird would visit the feeder and not eat but this would not affect the data because even though the bird did not feed, it still visited the feeder which means it preferred that color. The birds were under these conditions over a period of 14 days and every other day, the feeder's mass would be measured. It was then observed that although all of the cages are under the same conditions, since the cages were lined up, side by side, the corner cages are receiving light from three sides of the cage while the middle cages were only receiving light from two sides. In order to cancel out this factor, another trial of data was collected, except this time, the feeders' order from left to right was randomized using a random number generator. Every time the data was collected, the feeders' location, as well as which color feeder was in the cage was randomly selected. The birds were under these conditions over a period of 14 days and every other day, the feeder's mass would be measured. The final factor that was being put into account was the type of lighting. For the first 28 days, the birds were set up under fluorescent lighting. This lighting's wavelength however is limited to around 480 nm to about 570 nm but birds can see into the ultraviolet spectrum. Therefore, full spectrum lights were set up for the next trial of data collection. After all data was collected under different conditions, the data was analyzed using a type three sum of squares analysis was done to see if each factor, the color of feeder, location, and lighting had a statistical significance. Then a two-way ANOVA analysis was done to compare the mean difference between groups that have been split on two independent variables.

Day	Cage number	Moved cages?	Type of light	Color of feeder	Before weight (g)	After weight (g)	Amount eaten or discarded (g)
14	3	yes(3,7,11, 14,)	tube light	clear	80.3	51.2	29.1
14	3	yes	tube light	brown	63.6	52.1	11.5
14	7	yes	tube light	red	56.3	54.9	1.4
14	7	yes	tube light	green	64.5	51.1	13.4
15	3	no	Full spectrum	clear	74.9	64.9	10
15	3	no	Full spectrum	green	56.8	49.6	7.2

15	7	no	Full spectrum	brown	64.3	59.3	5
15	7	no	Full spectrum	red	49.2	44.2	5

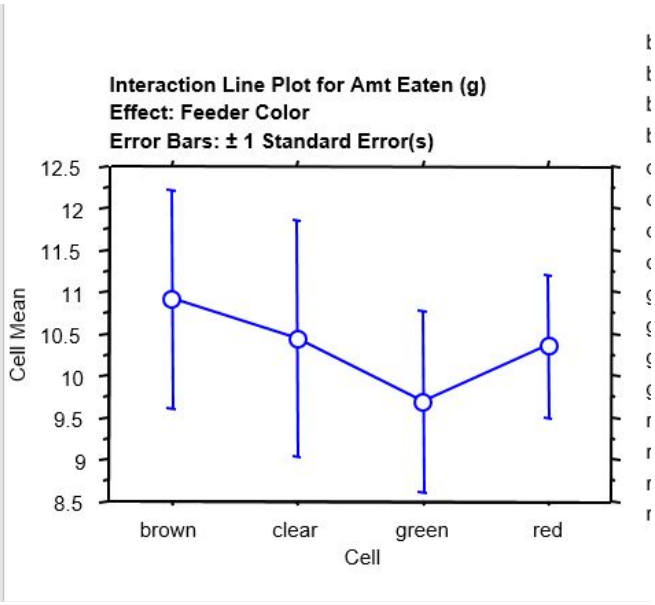
[1] Figure 1

Results

After testing the experiment with three trials under different conditions, the results showed that although some birds showed a preference in one color over the others, every bird showed a different preference. The bird in cage 3 preferred clear significantly over the other colors while the bird in cage had a preference for green. After performing the statistical analysis of the data, it was found that lighting had no effect on the data, therefore, that was not included in the analysis. Cage number 3 bird is significantly different as seen in Figure 2, meaning that this bird ate significantly more from the clear feeder than any other colored feeder. Since the average amount eaten from each colored feeder was not significantly different, it can be concluded that the birds did not consistently pick one color over another as a group.

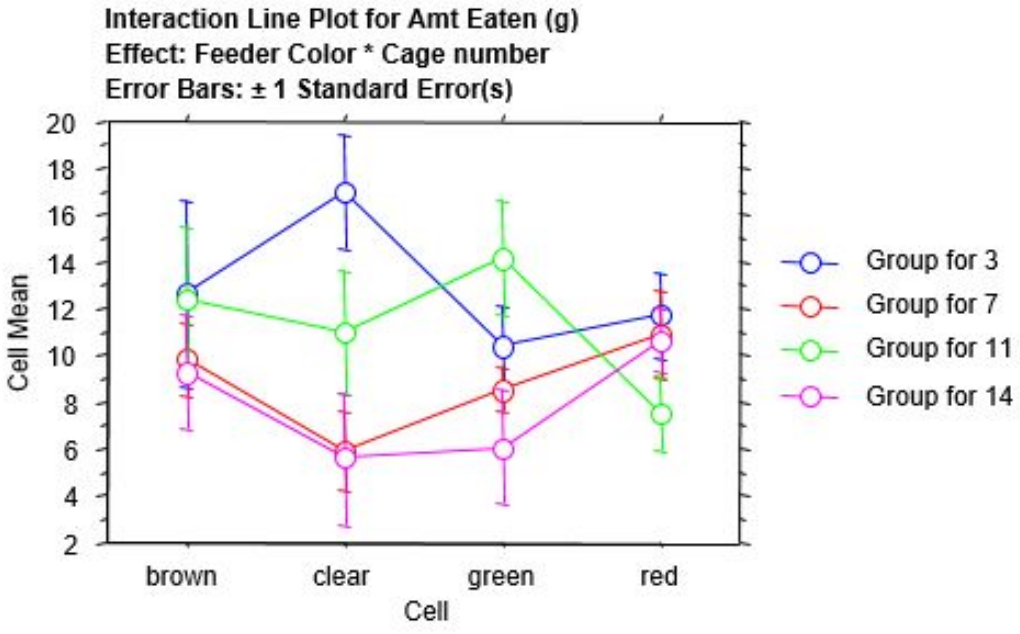
Means Table for Amt Eaten (g)
Effect: Feeder Color * Cage number

	Count	Mean	Std. Dev.	Std. Err.
brown, Group for 3	7	12.586	10.592	4.003
brown, Group for 7	11	9.827	5.149	1.553
brown, Group for 11	9	12.411	9.356	3.119
brown, Group for 14	8	9.300	6.940	2.454
clear, Group for 3	10	16.940	7.776	2.459
clear, Group for 7	8	5.938	4.691	1.658
clear, Group for 11	10	10.970	8.200	2.593
clear, Group for 14	7	5.614	7.434	2.810
green, Group for 3	10	10.320	5.598	1.770
green, Group for 7	8	8.562	2.752	.973
green, Group for 11	8	14.188	7.002	2.476
green, Group for 14	9	6.044	7.283	2.428
red, Group for 3	9	11.689	5.420	1.807
red, Group for 7	9	10.856	5.501	1.834
red, Group for 11	7	7.500	4.450	1.682
red, Group for 14	10	10.680	4.333	1.370



[2] Figure 2

[1] Figure 1 shows how each data collection was taken and each day the feeders were randomly assigned a different color based on the randomizer.
[2] Figure 2 shows the average amount of food the birds ate for each cage group and as seen in the graph, the deviation is significantly large resulting in there being no statistical significance.



[3]Figure 3

Discussion

It is evident that collectively the birds did not show a firm color preference. This may be because of the birds being raised in captivity in a controlled environment so it is known to them that they will receive food no matter what color the feeder is. Since these birds do not show a color preference, it may be needed to further research what birds prefer to keep them in their original location after environmental disruptencies. I hypothesized that the birds would show the same preference as they did in the wild natural environment, which was the color red. My hypothesis was proven incorrect because the birds showed no preference to any color. The limitations to this experiment would be the lack of sample size.

[3] Figure 3 shows the preferred color of each cage.

Only four birds were experimented on and also the amount of data collected. The birds were put under these different conditions for only 42 days and data were collected for only 21 of those days. Future research can be conducted by using a much larger sample size and using birds that were originally in an uncontrolled environment, then placing them into a controlled environment to see if they would react the same as birds that were in captivity all their lives. By doing this further research, a more solid set of data can be collected determining whether birds show a preference to one color over others.

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