Effect of Caloric Value of Nuts on Food Preferences of Corvus brachyrhynchos

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Abstract:

The nut preferences of Corvus brachyrhynchos, or commonly known as the American crow, were observed to determine if caloric value was the main driving force for preferred consumption for common urban birds. Birds tend to prefer protein and energy-rich nuts compared to cheese and crackers, according to a 2017 study (Støstad et al, 2017). Our null hypothesis is that if the birds are more driven towards high-calorie foods, then more of the pecans would be consumed. To determine if this preference extends to the entire nut family, a 2-week long experiment was performed to collect data on how many almonds, peanuts, pecans and walnuts the birds would eat daily. The data was then statistically analyzed with the Kruskal-Wallis test, which produced a p-value of 0.9953. Since the p-value > 0.05, we fail to reject the null hypothesis and conclude that there was no significant difference in nut preference due to caloric differences in Corvus brachyrhynchos.

Introduction:

All living organisms in nature look for the most efficient way to obtain high-quality food sources, with urban birds tending to seek and favour the most energy and protein-rich foods (Støstad et al, 2017). This is because in nature, food is often scarce so organisms must look for the most efficient way to sustain themselves, in case they do not get to eat again for a while. If the birds are more driven towards high-calorie foods, then more of the pecans would be consumed, since pecans have the highest caloric value compared to other common nuts (Ros, 2010). The theory of optimized foraging also supports pecans being the nuts that would be eaten the most (Pecor et. al, 2015). This theory notes that in the absence of predation risk, organisms would tend to forage for food that is nearby and food that provides an adequate reward for the amount of handling time spent. In this case, the reward would be high-calorie nuts, and the location of the nuts and type of nut (shelled or de-shelled) is held constant. By monitoring the crows for 2 weeks to determine if they have a preference for pecans, we can better understand if crows prioritize high-calorie foods over other food values, such as nutritional value.

Methods:

4 white ceramic bowls were set outside on the grass in the front yard. Each bowl was placed 20 cm apart from each other, measured with a ruler, in a square formation. One bowl contained 10 pieces of de-shelled roasted almonds, one with 10 pieces of de-shelled roasted pecans, one with 10 pieces of de-shelled roasted walnuts and one contained 10 pieces of de-shelled roasted peanuts. This set-up is illustrated in Fig 1. All nuts came from Walmart's bulk section. The bowls of nuts were then monitored every day for 2 weeks, from March 13, 2021 to March 27, 2021. The nuts were replaced every 12 hours, once in the morning at 8 am, and once in the evening at 8 pm. A check-in was performed while the nuts were being replaced to count how many nuts were eaten, or carried away to be eaten at a later time. While the nuts are being replaced, take note of the weather during that time, as well as if there are any birds in the vicinity. Once the data was collected, we removed the days where there were not any nuts eaten, as we were only interested in days where nuts were eaten. Then, we performed a Kruskal-Wallis test on it to determine if the mean amount of nuts eaten significantly differed from each other. A multiple comparisons test and descriptive statistic test were also performed to further extract more information from the data obtained.

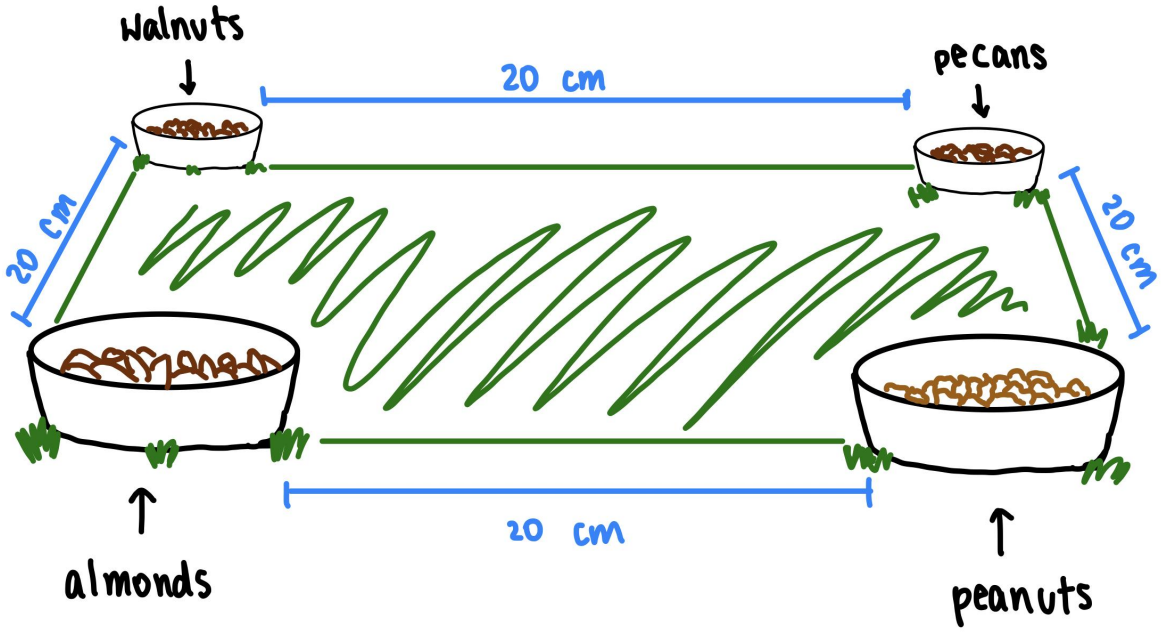

Fig 1. 4 ceramic white bowls containing the 4 different types of nuts are placed on the lawn in a square formation, 20 cm apart from each other.

Results:

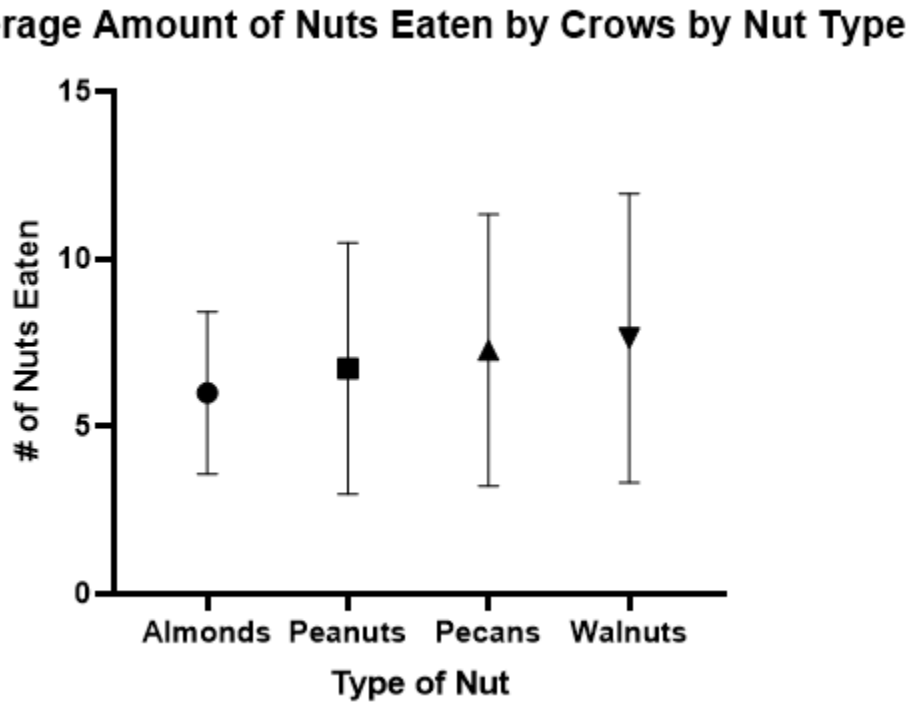

Fig 2. The 4 nuts and their respective amount eaten showed no significant difference according to the Kruskal-Wallis test (p-value > 0.05). Mean amount of nuts eaten (+95% C.I.) of n=304 nuts.

Figure 2 shows the mean amount of nuts eaten along with their 95% confidence interval. An average of 6 almonds were eaten per day, with a confidence interval between 3.6 and 8.4 nuts. Peanuts had an average of 6.7 eaten per day with a confidence interval between 3 and 10.5. The mean amount of nuts eaten per day for pecans was 7.3 with a confidence interval between 3.2 and 11.3 and walnuts had a mean of 7.6 nuts eaten per day with a confidence interval between 3.3 and 11.9. Overall, all 4 nuts had approximately the same mean number of nuts eaten, with almonds being the least eaten nut and walnuts being the most eaten nut. Walnuts had the largest confidence interval range, so the amount of nuts eaten varied more compared to the other 3 nuts. Almonds had the smallest confidence interval range, so the variance of nuts eaten from day to day was less volatile. Since the raw data was not normally distributed, we performed the Kruskal-Wallis test instead of the one-way ANOVA test. The p-value was 0.9953 according to the Kruskal-Wallis test. Further analysis with a multiple comparisons test revealed that there was no significant difference in mean between each individual nut group compared to each other, all with a p-value > 0.999.

Discussion:

In this experiment, we fail to reject the null hypothesis. The results indicate that there is not a significant difference between the mean values of nuts eaten between the 4 nuts. From the Kruskal-Wallis test, we obtained a p-value of 0.9953, which is larger than 0.05, meaning that the mean amount of nuts eaten did not significantly differ between the 4 nut groups. The Kruskal-Wallis test was performed over the one-way ANOVA test because the raw data was not normally distributed. Attempts at transforming it and removing the days where no nuts were

eaten at all did not change the normality of the data. In addition, we are 95% certain that the true mean of the nuts eaten lie between 3.6 and 8.4 for almonds, 3 and 10.5 for peanuts, 3.2 and 11.9 for pecans and 3.3 and 11.9 for walnuts. Almonds have a smaller confidence interval range compared to the pecans, peanuts and walnuts, because they had less variation in terms of how many almonds were eaten.

The results could be explained by the fact that in addition to caloric value, handling time, nutritional value and location are also important factors in determining if an organism will expend effort and energy into obtaining the food source (Schoener, 1971). Since handling time and location were kept constant among all 4 nut types, it is possible that the nutritional value of the nuts were what the crows valued. Compared to common foods, nuts have high nutritional value and the 4 nuts themselves had similar nutritional values in terms of how much calcium, magnesium, sodium and potassium they contained (Ros, 2010). Another factor that could have influenced the results was that birds prefer sheltered areas to eat their food (Pecor, 2015). Since less birds would have frequented the open yard, and due to the colder weather, a smaller sample size was obtained. A small sample size indicates that we can not extrapolate the data to say all crows do not have a preference for nuts with a higher caloric value.

Some possible sources of error would be that because the bowls were not constantly monitored and left on the ground, other animals such as racoons could easily acquire the nuts as well. Another error is that the sample size was small and the location the experiment was performed at was not ideal. Crows do not usually frequent residential areas meaning it was likely the same couple of crows coming to eat the nuts every day. The weather and season also did not

aid the situation, as fewer birds can be seen during the rainy winter-spring season. Since the sample size was small, we can not extrapolate the data to say all crows do not have a preference for a particular nut. In future experiments, these problems could be solved by installing a video camera to observe the bowls on the ground, removing any data points that have another animal eating the nuts and moving the experiment location to a more crow-inhabited area during the warmer weather.

Conclusion:

There was no significant difference between almonds, peanuts, pecans and walnuts in terms of how many of them were eaten by crows according to the Kruskal-Wallis test. Therefore, we fail to reject the null hypothesis and conclude that the caloric value of nuts have no influence on what nuts crows prefer to eat.

Acknowledgements:

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Appendix:

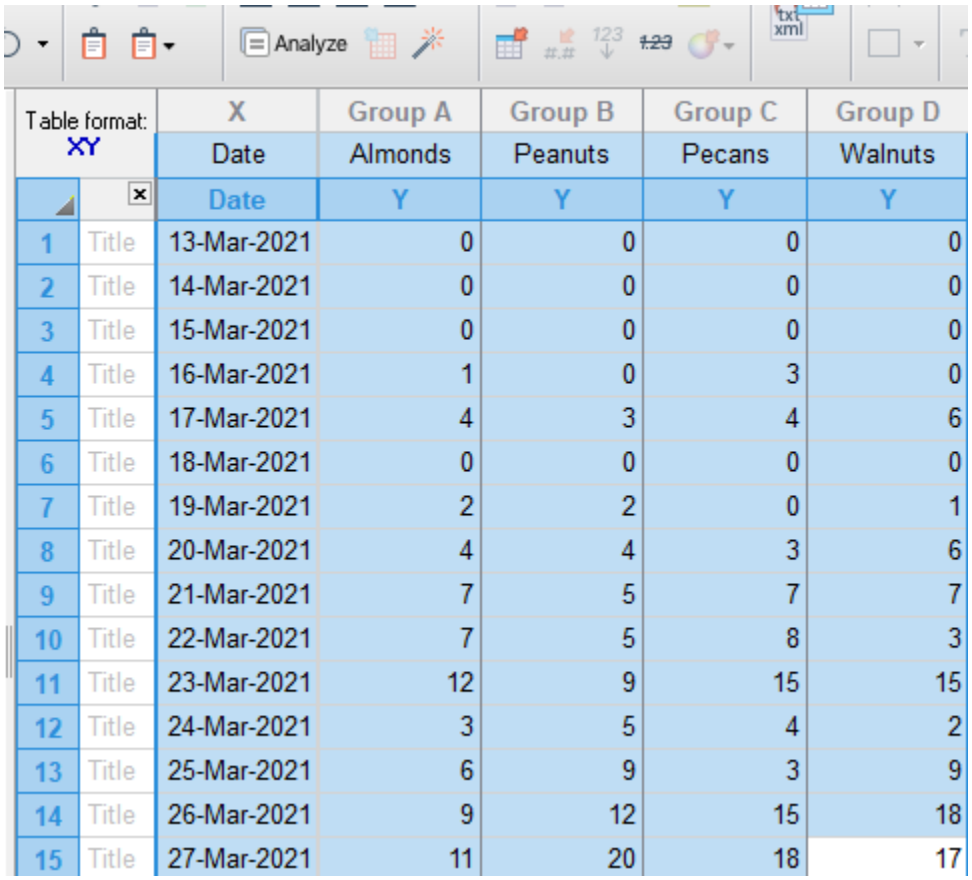
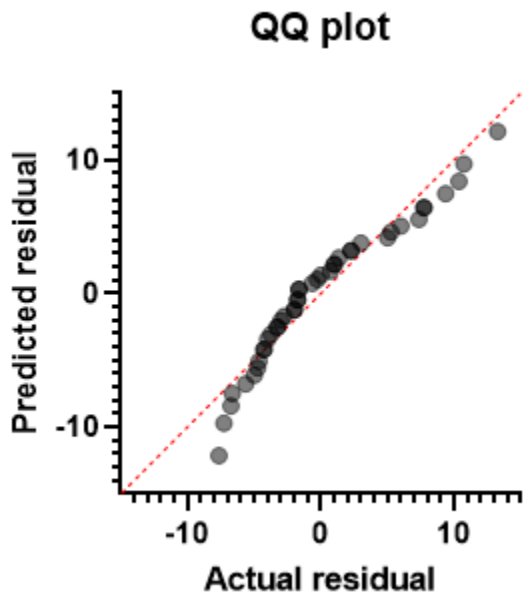


Table format: XY	X	Group A	Group B	Group C	Group D
	Date	Almonds	Peanuts	Pecans	Walnuts
	Date	Y	Y	Y	Y
1	Title	13-Mar-2021	0	0	0	0
2	Title	14-Mar-2021	0	0	0	0
3	Title	15-Mar-2021	0	0	0	0
4	Title	16-Mar-2021	1	0	3	0
5	Title	17-Mar-2021	4	3	4	6
6	Title	18-Mar-2021	0	0	0	0
7	Title	19-Mar-2021	2	2	0	1
8	Title	20-Mar-2021	4	4	3	6
9	Title	21-Mar-2021	7	5	7	7
10	Title	22-Mar-2021	7	5	8	3
11	Title	23-Mar-2021	12	9	15	15
12	Title	24-Mar-2021	3	5	4	2
13	Title	25-Mar-2021	6	9	3	9
14	Title	26-Mar-2021	9	12	15	18
15	Title	27-Mar-2021	11	20	18	17

Table format: XY	X	Group A	Group B	Group C	Group D
	Date	Almonds	Peanuts	Pecans	Walnuts
	Date	Y	Y	Y	Y
1	Title	16-Mar-2021	1	0	3	0
2	Title	17-Mar-2021	4	3	4	6
3	Title	19-Mar-2021	2	2	0	1
4	Title	20-Mar-2021	4	4	3	6
5	Title	21-Mar-2021	7	5	7	7
6	Title	22-Mar-2021	7	5	8	3
7	Title	23-Mar-2021	12	9	15	15
8	Title	24-Mar-2021	3	5	4	2
9	Title	25-Mar-2021	6	9	3	9
10	Title	26-Mar-2021	9	12	15	18
11	Title	27-Mar-2021	11	20	18	17



Kruskal-Wallis test	
Table Analyzed	Data 1
Kruskal-Wallis test	
P value	0.9953
Exact or approximate P value?	Approximate
P value summary	ns
Do the medians vary signif. (P < 0.05)?	No
Number of groups	4
Kruskal-Wallis statistic	0.06852
Data summary	
Number of treatments (columns)	4
Number of values (total)	44

ANOVA results | Multiple comparisons | **Descriptive statistics**

Kruskal-Wallis test Descriptive statistics	A Almonds	B Peanuts	C Pecans	D Walnuts
Number of values	11	11	11	11
Minimum	1.000	0.000	0.000	0.000
25% Percentile	3.000	3.000	3.000	2.000
Median	6.000	5.000	4.000	6.000
75% Percentile	9.000	9.000	15.00	15.00
Maximum	12.00	20.00	18.00	18.00
Mean	6.000	6.727	7.273	7.636
Std. Deviation	3.606	5.587	6.035	6.423
Std. Error of Mear	1.087	1.685	1.820	1.937
Lower 95% CI	3.578	2.974	3.219	3.321
Upper 95% CI	8.422	10.48	11.33	11.95
Mean ranks	21.82	22.36	22.59	23.23

ANOVA results | Multiple comparisons | Descriptive statistics

Kruskal-Wallis test
Multiple comparisons

1	Number of families	1					
2	Number of comparisons per family	6					
3	Alpha	0.05					
4							
5	**Dunn's multiple comparisons test**	**Mean rank diff.**	**Significant?**	**Summary**	**Adjusted P Value**		
6	Almonds vs. Peanuts	-0.5455	No	ns	>0.9999	A-B	
7	Almonds vs. Pecans	-0.7727	No	ns	>0.9999	A-C	
8	Almonds vs. Walnuts	-1.409	No	ns	>0.9999	A-D	
9	Peanuts vs. Pecans	-0.2273	No	ns	>0.9999	B-C	
10	Peanuts vs. Walnuts	-0.8636	No	ns	>0.9999	B-D	
11	Pecans vs. Walnuts	-0.6364	No	ns	>0.9999	C-D	
12							
13	**Test details**	**Mean rank 1**	**Mean rank 2**	**Mean rank diff.**	**n1**	**n2**	**Z**
14	Almonds vs. Peanuts	21.82	22.36	-0.5455	11	11	0.09993
15	Almonds vs. Pecans	21.82	22.59	-0.7727	11	11	0.1416
16	Almonds vs. Walnuts	21.82	23.23	-1.409	11	11	0.2582
17	Peanuts vs. Pecans	22.36	22.59	-0.2273	11	11	0.04164
18	Peanuts vs. Walnuts	22.36	23.23	-0.8636	11	11	0.1582
19	Pecans vs. Walnuts	22.59	23.23	-0.6364	11	11	0.1166
20							