BLUE JAYS ARE MORE LIKELY TO SPEND TIME FEEDING IN COVERED AREAS

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ABSTRACT

In response to urbanization, many animals have evolved certain behavioral syndromes to cope. The most common behavioral traits that maximize fitness and survival, in terms of optimal foraging theory, is boldness vs foraging in covered sites. To study this, we observed blue jays foraging on peanuts in covered and open areas. We found that blue jays, on average forage, for a longer period of time in covered areas than in exposed areas. Therefore, our data backs the idea that certain behavioral syndromes in animals towards urbanization can greatly increase their chances of efficiency in foraging, compared to others. Furthermore, our results are important to guide future research on foraging behavior in human-dominated landscapes to encourage better policies on ecological management.

Keywords: Behavior, biological fitness, blue jays, covered and exposed areas, optimal foraging, urbanization

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INTRODUCTION

Optimal foraging theory was developed to explain how certain species hunt or scavenge for food sources in accordance with their environment (Sih and Christensen 2001). Many factors that play a role in an animal's foraging patterns include, but are not limited to, the type of food source, the availability of it, the geography of its foraging areas, the scavenger's physical limitations, predator abundance, and competitor abundance (even among its own species). For example, some animals, especially those that are easy prey, like rodents, are concerned with the balance of risk and reward during their foraging activities. By considering the factors mentioned, particularly the type of location they forage in, the animals are able to recognize if the reward outweighs the risk (Sih and Christensen 2001).

Unfortunately, outside intervention can drastically distort a species' optimal foraging in regards to location, food preference and availability. The most common disruption is human urbanization: Replacing natural habitats with human landscapes such as buildings, roads, and houses (Belinsky et al. 2019). While urbanization is a recreational way of improving human life, as many population densities increased, so did the exploitation of many natural resources, including water, trees, plants, and fertile lands for crops. This leads to rapid and dramatic reductions in abundance and diversity of wildlife, with them either dying or pushed out of their natural environments (Tryjanowski et al. 2016). However, some species of animals have evolved certain behavioral syndromes that allow them to cope with urban environments, especially when their foraging grounds are within them (Tryjanowski et al. 2016).

Despite urban environments being superabundant in various food sources, human presence can serve as a predation risk for some animals. Certain animals cope with this through boldness [neophilia] or avoidance against something novel [neophobia] (Tryjanowski et al. 2016). The greater the frequency of exposure, the greater the boldness. Also, regarding predation as a risk, some animals compensate for this by feeding in areas that offer protective cover. In other scenarios, many prefer to forage in areas closer to where they live (Sih and Christensen 2001). Unfortunately, across many groups of animals, not all of their members share one coping mechanism to urbanization. On the other hand, the group may evolve a behavioral mechanism that would risk the safety and stability of the group. Therefore, optimal foraging theory is not always recognized among groups due to unresolved dissent or intraspecific competition (Jones et al. 2019). For example, if there is decreased diversity of food resources in urban environments, the foraging patterns would become more predictable, making them easier to track. These patterns include group size, foraging duration, and distribution of the foraging events (Jones et al. 2019). Furthermore, if some members within a group are more risk-prone and neophilic compared to the rest, this may incur a fight for dominance to influence the overall group social structure and behavior (Jones et al. 2019).

The most common animals used to observe optimal foraging theory are birds, given that they are numerous in various habitats, including urban, and that they have faster response times to disruptions thanks to flight (Belinsky et al. 2019). In this case, optimal foraging theory assumes that the most fit bird would be the most efficient feeder, if they can overcome the risk of predation. Therefore, natural selection would favor that individual over all the others because they cannot adopt those same behaviors (Werner and Mittelbach 1981). We observed how often blue jays (*Cyanocitta cristata*) visited the food source and how long they stayed at the food source. Furthermore, we hypothesized that blue jays were more likely to visit and stay longer at a covered feeder rather than a feeder in an exposed area.

METHODS

We used one makeshift bird feeder made out of cardboard. The food source we decided on was 50 peanuts (*Arachis hypogaea*). Two sites were set up in the front yard of a house. The exposed site was in the center while the covered site was in a bush. Also, the ground of the covered site was filled with leaves that had fallen from trees. For the exposed site, two trials were recorded, showing every blue jay's appearance and duration at the feeder. For the covered site, two trials were recorded for the same data. After every trial, we refilled the feeder up to 50 peanuts.

For each trial, we recorded the length of time every individual blue jay spent each time it visited the feeder. We used this data to calculate the average number of seconds, per visit for every feeder. We then calculated the standard deviation and standard error for each trial. Lastly, we combined the data for both covered trials and exposed trials in order to evaluate the differences in average-visit-duration and total number of visits.

RESULTS

Our results show that blue jays tend to spend more time feeding in covered locations than exposed locations (Fig. 1). We found that in the two trials using covered feeders, blue jays spent on average 13.24 seconds each time they came to the feeder. In the uncovered trials, jays spent only 9.36 seconds at each visit. This distinction can be seen across all four trials. Trial 3 had the highest visit duration of both covered trials, and was still 1.29 seconds below Trial 4, which was the lowest duration in covered trials (Fig. 2). This difference is not due to less visits being made to covered feeders. We recorded a total of 96 visits to covered feeders, representing 56.1% of total visits recorded (Fig. 3). We also recorded the distribution of times blue jays spent feeding. The majority of results are clustered under the 15 second mark (Fig. 4). Since blue jays did not seem to spend time at the feeder together, more research to determine if this timing is an effect of competition of optimal foraging theory is needed.

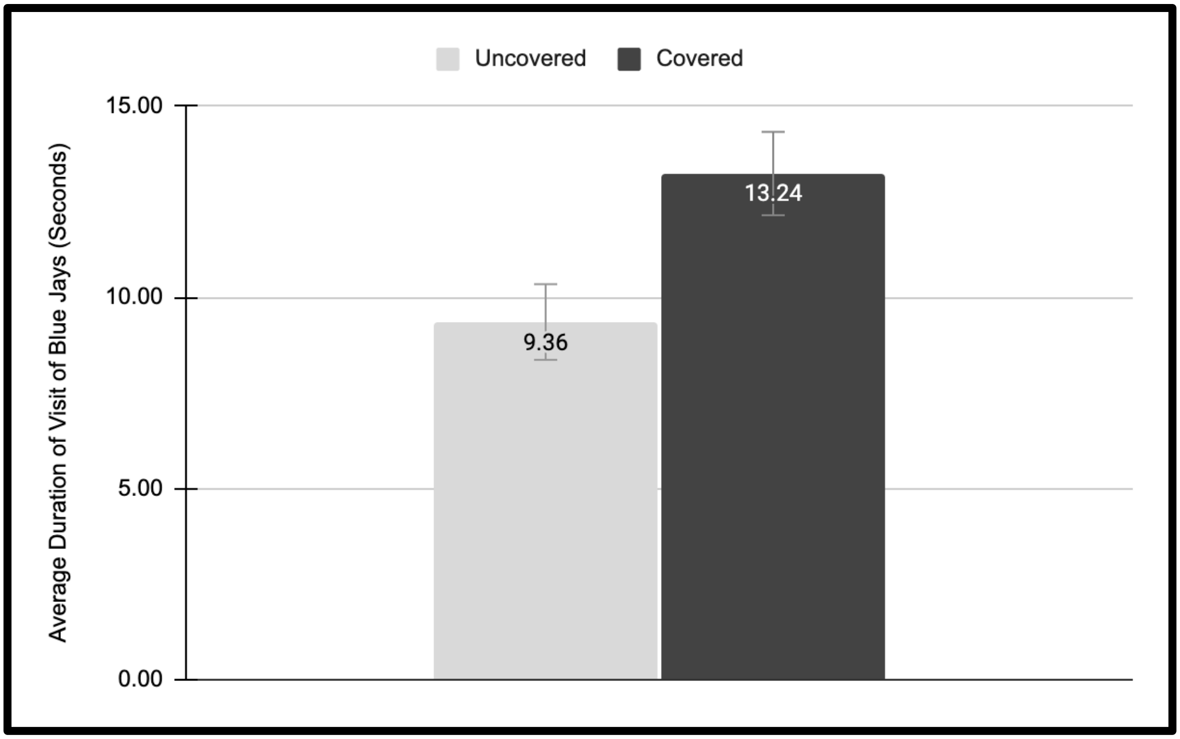

Figure 1. Blue Jays tend to stay for longer at the covered feeders then the feeders left in the open. Error bars represent standard error.

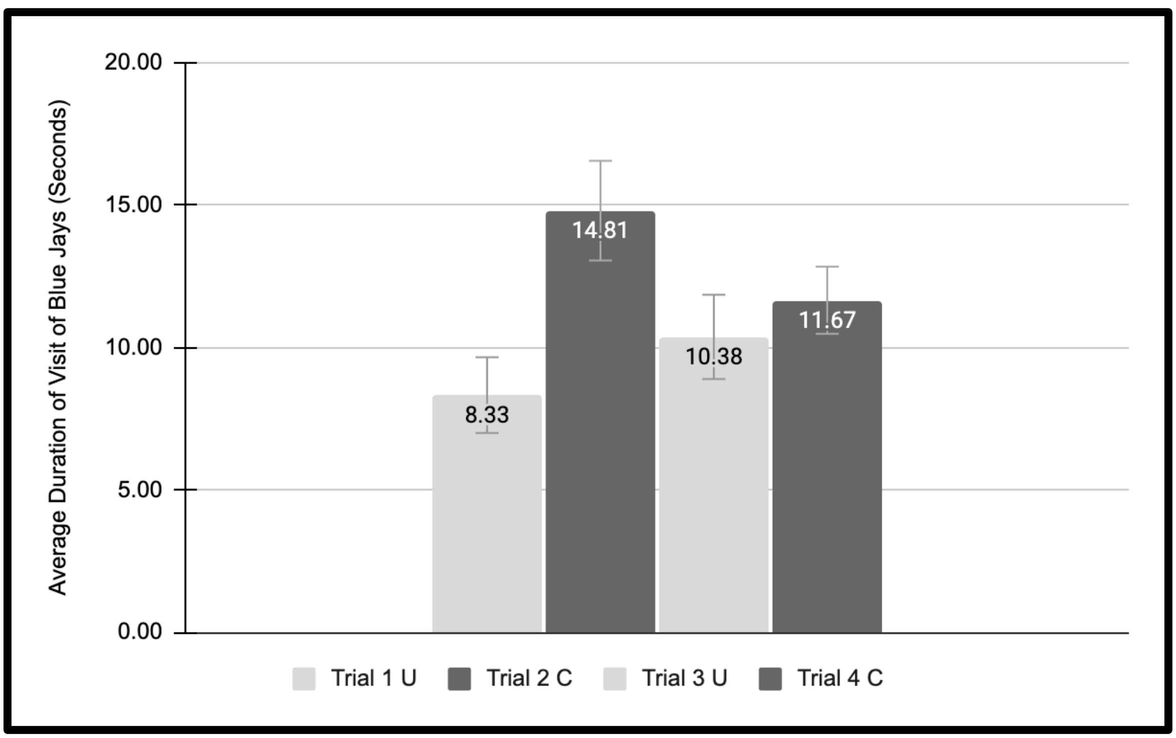

Figure 2. The average visit duration from all four trials. The trials with the highest average duration (Trial 2 and Trial 4) were both performed with a covered feeder. Error bars represent standard error.

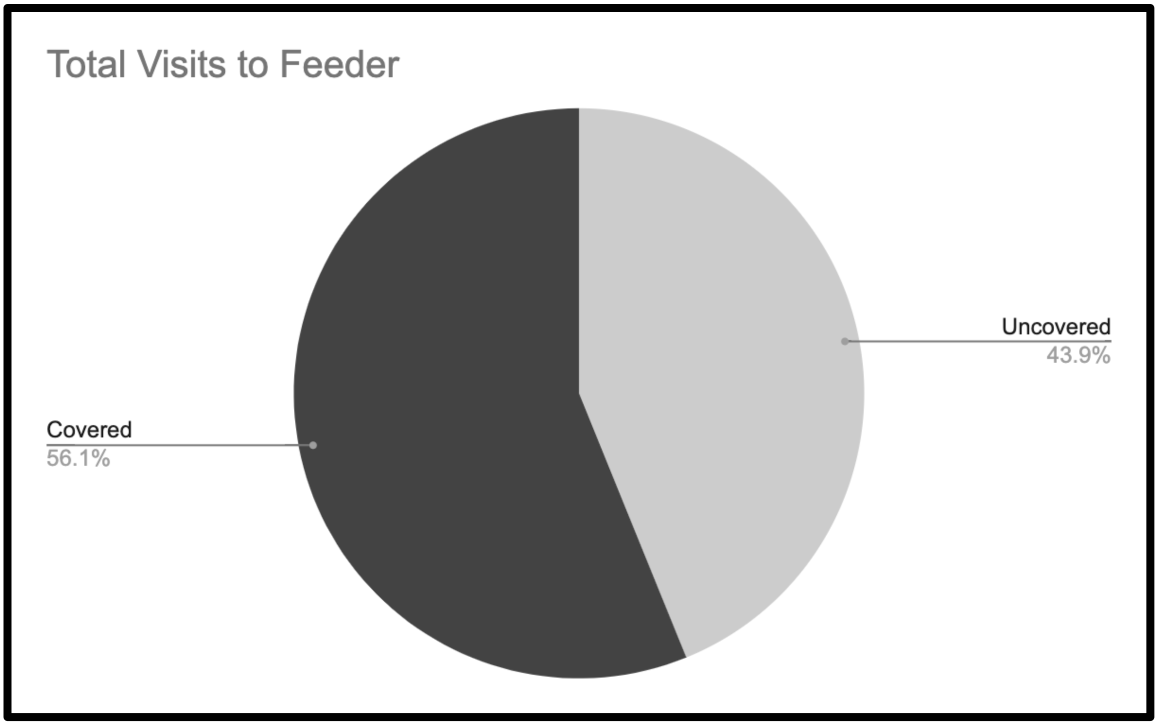

Figure 3. When all results were recorded, we saw more total visits to the covered feeders then to the uncovered feeders.

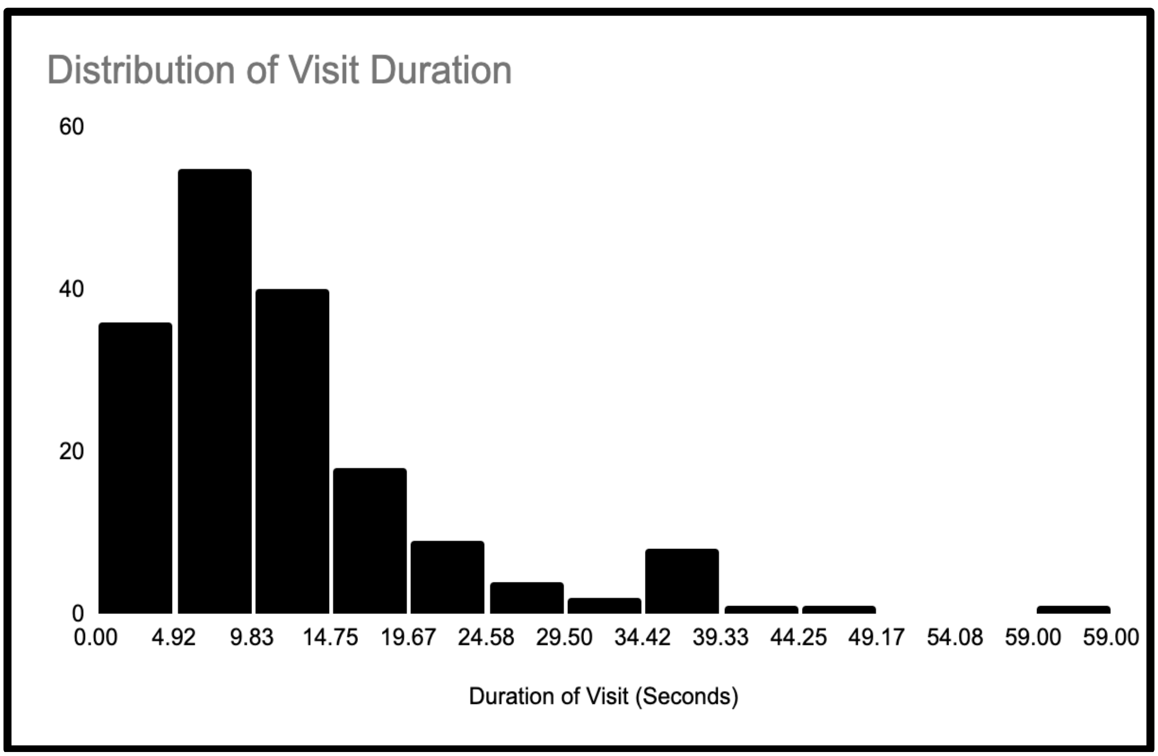

Figure 4. The distribution of the duration of time spent at the feeder per visit.

DISCUSSION

Our results are consistent with our hypothesis that blue jays were more likely to visit and remain for longer at a feeder with cover, rather than a feeder in an exposed area. Our analysis shows that on average, blue jays stayed for longer in the covered feeders than the uncovered feeders by 3.88 seconds. Additionally, the covered feeders were visited by blue jays 96 times compared to 75 visits to the uncovered feeders. This is consistent with optimal foraging theory, which posits that organisms will cease to forage at a patch when the benefit of foraging is equal to the combined metabolic cost and perceived risk of predation (Martin 1985, Pyke 1978). Some of these determinants are the energy densities of food sources, the abundance of those food sources, the geography of the area they forage, carrying limitations, predators and competition with others all play into optimal foraging theory (Wilson 1976). Since the rate of searching, along with the type and density of the food sources are all equal, we can determine that the perceived risk of predation is the reason for any variance in foraging behavior.

These results are consistent with existing research on optimal foraging theory. Analysis of the giving up density in birds in the greater Phoenix area found that birds will cease going to a patch significantly sooner in open areas, noting that this disparity was lesser in the urban area than the surrounding desert (Schochat et al. 2004). Further research is needed to determine if this urbanization difference is maintained in other habitat types. This difference has also been found when multiple artificial patches were presented at once, as an analysis of white-throated sparrows (*Zonotrichia albicollis*) shows that the birds will nearly deplete a site located closer to cover before moving away (Schneider 1984). Thus, the optimal foraging site for is the intersection between density of food and distance from cover. Schneider (1984) found a key interaction between optimal foraging theory and dominance: That subordinate birds will be forced to feed farther from cover in order to acquire enough food. This matches up with our qualitative observations that blue jays appeared to be chasing other jays away from the covered feeder.

Our analysis of optimal foraging theory in blue jays does not answer how the birds perceive risk and reward. The original optimal foraging theory assumed animals that were perfectly knowledgeable of their environment, and based predictions off of this. Research has shown that this is not the best predictor for foraging behavior. Recent studies have shown that animals incrementally update their decision making based on recent experiences (Marshall et al. 2013). More research is needed on this to determine the weight animals place on experiences at foraging patches. This is especially critical in a world where human influences can alter environments drastically in a short period of time. Studies have already shown that current models cannot perfectly predict foraging behavior (Killeen et al. 1996). Further research into this topic would improve our understanding of how animals interact with their environment, which is critical to protecting biodiversity.

When foraging, animals may repeatedly return to areas they foraged in. In the instance of a feeder, it seems like the birds feeding from it are repeat customers to the spot rather than them all being different birds (Jones et al. 2019). Further testing could be done by tracking the animals that come to the feeder to see if they have a pattern of going back and forth: To an area where they know there is food versus aimlessly searching for food in an unknown area. Further research could be done to examine the changes to foraging patterns when birds are breeding because it was discovered that they are stricter in their food selection when raising young (Sauter et al. 2006). Offering a variety of food choices could also result in changes in behavior. Blue jays are known to prefer certain types of nuts and seeds, and this preference could be enough to overcome the risk of exposed feeders (Moore and Swihart 2006).

There are several improvements we would consider for our study. During data collection, if we were to increase the sample size by taking longer videos or more videos, that would result in a more accurate model. Another way to increase sample size would be to have more locations under surveillance, such as four covered areas and four uncovered to see the effects across a broader geographic range. To take this even further, tests could have been done during each season, as was done in a study by Lewis (1982), where he had three time periods encompassing all the seasons. Studies have shown that animals have differing methods of foraging depending on shifts in their environment conditions, such as change in season (Kuwae et al. 2010). Another improvement would be to have cameras placed at more angles around the feeder, to clearly determine the length of time a blue jay was in close proximity to the feeder.

CONCLUSION

The way animals forage has been greatly affected due to human intervention. So much space is now dominated by human activities and infrastructure, that many animals now live within the sphere of human influence. This has resulted in altered foraging behavior, particularly when comparing urban and wild populations (Schochat et al. 2004). An example is that many animals regularly scavenge from human-food waste sources, such as garbage cans (Sauter 2006). With the abundance of animals living in human dominated habitats, studying their behavior can help us understand the impact we have on natural environments and inform ecological guidelines. Further studying can even help us comprehend the reasons behind animals' foraging patterns and contribute to a better understanding of the natural world as a whole.

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AUTHOR CONTRIBUTIONS

Conceptualization - all. Data collection. - RR. Data curation - EB and SJ. Formal analysis - EB and SJ. Methodology - all. Project Submissions - RR. Resources - all. Visualization: Figures - EB. Writing: Intro - RR and SJ. Writing: Methods - RR. Writing: Results - EB. Writing: Discussion - EB and AB. Writing: Conclusion - AB. Writing: Abstract - RR. Writing: Acknowledgements - RR. Writing: Literatures Cited - all. Writing: Reviewing and Editing - EB and RR.

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