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Aditya A. Mehta

University of Louisville, aditya.mehta@louisville.edu

Jeeva H. Rathnaweera

University of Louisville, jeeva.patabendigerathnaweera@louisville.edu

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Do eastern gray squirrels (*Sciurus carolinensis*) use human-provided cues to increase foraging success in urban landscapes?

Aditya Mehta and Jeeva Rathnaweera

Dr. Perri Eason, PhD

Department of Biology, University of Louisville

Introduction

The coexistence of humans with other animals in populated areas has given rise to a spectrum of agonistic and beneficial interactions. Animals thriving in urban settings are known to exhibit superior foraging and food extraction abilities compared to their wild conspecifics. For decades, researchers have been trying to find answers to the question whether non-human animals can form and maintain a similar “theory of mind” to humans based on the actions they observe in their environments (Schloegl, Kotrschal & Bugnyar, 2007).

Previous studies have been done on how domesticated and wild animals use human cues to explore hidden food items (Pongrácz, Szapu & Faragó, 2019; Shepherd & Platt, 2007). In this project, we tested the response of urban mammals to human-provided cues using an eastern gray squirrel (*Sciurus carolinensis*) model. In this study, we presented squirrels with a foraging opportunity coupled with commonly used cues (click & gaze) for domestic animals. We were interested in the response of squirrels in different age-gender categories to the human-provided cues.

Methodology

This study was conducted on the University of Louisville’s Belknap Campus on free-ranging eastern gray squirrels. The trials were done on weekends during the morning (0800h-1000h) and evening (1600h-1800h) to minimize disturbances. Size of the body and tail, fur coloration, and visibility of reproductive structures were used to categorize squirrels into age-gender classes. All trials (n=30) were targeted to squirrels residing on the ground approximately 1-3 meters away from the nearest tree. Each trial was 10 minutes long and we used all occurrence sampling to record the behaviors of the test subjects. For each trial, five peanuts were placed inside a clear plastic container.

The placement of the container on the ground was coupled with click, gaze, or control cues. The container was shaken gently to attract the squirrel’s attention. Click cues were defined by three sharp clicks and gaze cues were defined by looking at the target squirrel for 5s. After placing the container, we moved 10 meters away from the squirrel. To minimize observer errors and cue variability, data was always recorded by one observer while the other set up the trial. Viper (10X42) binoculars were used for all observations. We recorded the initial time, time lag between each nut acquisition, and the squirrel’s age and gender.

Results

There was a wide variety of responses to the human cues between the four age-gender categories: adult males (AM), adult females (AF), juvenile males (JM), and juvenile females (JF). The cues coupled with the foraging opportunity seemed to increase the response time. Adult squirrels had a higher response rate compared to juveniles. The highest response was for the click cue and lowest response was for the control (no cue) trials. Overall, adult females had the highest response rate.

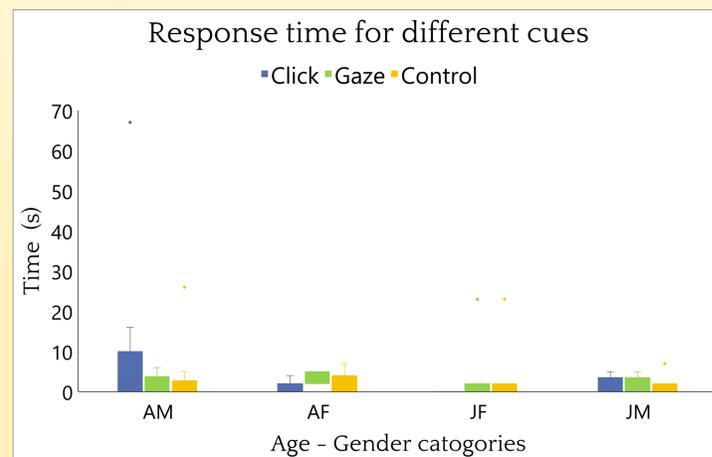


Figure 1. Bar graph showing the time squirrels took to approach the container. Only the trials resulting in a positive response were used to create the graph. Adult males took longer to respond to click cues, while adult females took longer to respond to gaze cues. Female juvenile squirrels were less cautious and did not take very long to respond, while juvenile males took longer to respond to click and gaze cues.

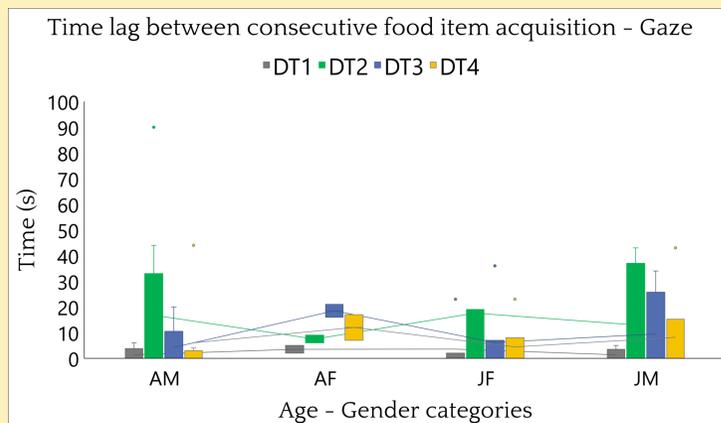


Figure 3. Bar graph showing the time delay (DT) for the squirrel categories between acquisition of each food item after gaze cues. This graph follows the general pattern seen in Figures 2 and 4. However, juvenile male squirrels actually had the longest time lag to acquire the second peanut overall. Adult female squirrels also had a longer DT3 compared to their other time delays. Attainment of the last peanut (5th) was disregarded.

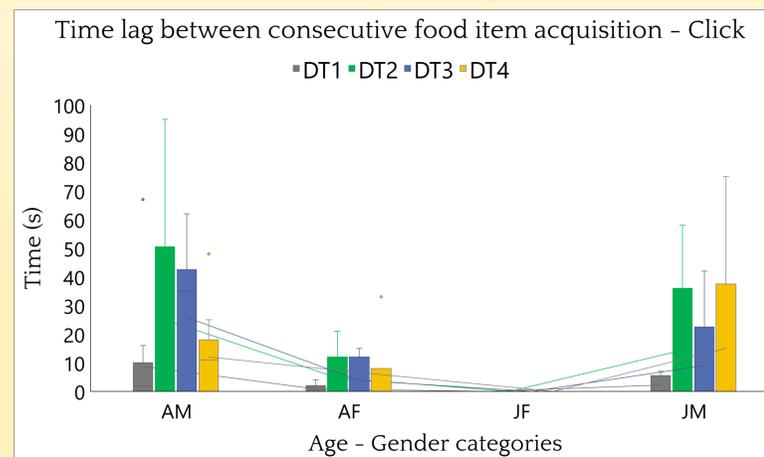


Figure 2. Bar graph showing the time delay (DT) for the squirrel categories between acquisition of each food item after click cues. This graph follows a general pattern (seen in Figures 3 and 4) of less waiting time for the first item, but longer intervals to acquire the consecutive food items. There wasn't sufficient data to quantify juvenile female responses to clicks. Attainment of the last peanut (5th) was disregarded.

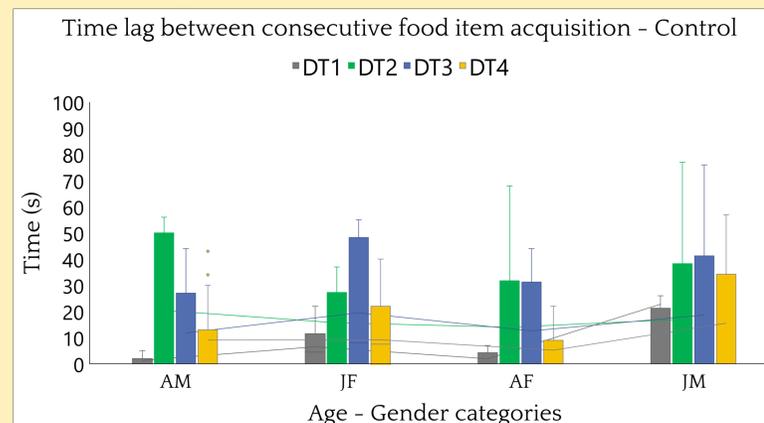


Figure 4. Bar graph showing the time delay (DT) for the squirrel categories between acquisition of each food item after control trials (no cues). All squirrels took less time to acquire the first food item, but they took comparatively longer times to acquire consecutive food items (see Figures 2 and 3). Juvenile female squirrels showed the longest time lag for acquiring the third food item out of all categories. Juvenile males maintained high time lags for finding the last peanuts in the container (DT2, DT3, DT4). Attainment of the last peanut (5th) was disregarded.

Conclusion

The results of the study indicate that squirrels of different age-gender categories have different responses to human provided cues. This may be a result of biological energy requirements, prior experience in acquiring anthropogenic food, boldness, or the curiosity of the animal. Overall, human-provided cues increased the response rate of the squirrels of all age-gender classes compared to the control. Additionally, higher response times for a cue increased the rate of successful response.

It is possible that the increased observation times increased the sense of safety and resulted in successful foraging attempts. It is interesting to see the pattern in time lags between consecutive food item acquisition. It may be a result of higher intraspecific competition or the unlikely occurrence of clumped resources in a natural setting.

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