Foraging Juvenile Wolf Spider Response to Predatory Bird Calls

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Abstract

Adult male spiders midst courtship displays respond to predatory avian cues in one of two ways, they either attempt to escape or freeze. While juvenile spiders are not capable of courtship displays, they may still respond similarly to predatory cues in other contexts, such as foraging. To test if juvenile wolf spiders respond to avian cues during foraging, we collected 3rd – 4th instar spiderlings from the field in October (2019, 2020) and brought them to the lab. In the 1st experiment (2019), we introduced a live cricket into an arena while also playing back avian cues via a substrate-borne vibrational playback system. In the 2nd experiment (2020), we controlled all cues by playing a video of a cricket coupled with its vibrational cues while simultaneously playing avian cues as in the 1st experiment. The results of both experiments yielded no significant affect between predator cues and antipredator behaviors in juvenile wolf spiders, although there were some interesting trends. We plan to improve our experimental approach in future iterations of this research and continue to investigate foraging behavior in juvenile wolf spiders.

Introduction

Forest wolf spiders have an important position within forest ecosystems, they serve as a bridge between lower and higher trophic levels of the food web (Gunnarsson, 2007). Adult Wolf spiders in the genus *Schizocosa* are known to be eaten by avian predators and as such are also known to exhibit antipredator behavior when presented with predatory avian cues. Lohrey *et.al.*, (2009) demonstrated that courting adult males, when exposed to acoustic/vibrational cues of a predatory bird, will freeze in place for a period, but will flee if the cue is a shadow passing overhead. *Schizocosa sp*. wolf spiders are only adults for a short period of time when compared to their time as juveniles. Thus, we hypothesized, juveniles will exhibit similar antipredator behaviors as has been previously reported in adults. To test this hypothesis, we performed a series of vibrational playback experiments (during the past 2 fall seasons) while recording behavioral responses. We predicted that juvenile wolf spiders would elicit antipredator behavior (e.g. stay stationary) when exposed to predatory avian vibrational cues. Given what we currently know about adult wolf spider anti-predator behavior, this experiment could improve our understanding of innate versus learned behaviors in an important genera of forest dwelling wolf spiders.

Methods

Spiders were collected in October (2019 & 2020) from Yellow Creek Park in Daviess County as 3rd instars and brought back to KWC. Spiders were kept in individual containers within the lab with a light/dark cycle of 12/12. They were fed twice weekly with gut-loaded, size appropriate prey of either flightless fruit flies (*Drosophila melanogaster*) or crickets (*Acheta domestica*) and had *ad libitum* access to water.

Cue Playback

Vibrational signals played to spiders were delivered by a linear resonant actuator (Samsung-Mplus-LRA1040) connected to either a PC's or a mobile phone's audio jack. To ensure signal fidelity and appropriate playback volume, vibrational signals were compensated (as in Cocroft *et.al.*, 2014; Gibson & Cocroft 2018). We recorded vibrational signals from each trial using an accelerometer (PCB-352A24, 100mV/g) and signal conditioner (PCB-480C02) plugged into the input of a Nikon D5600 which simultaneously captured video.

2019 Experiment

A single juvenile was placed in an arena (Figure 1) and was given time (~5min) to acclimate before a prey item was introduced. A single, size appropriate prey item (*Acheta domestica*), was introduced while simultaneously one of five treatments (n=5-8/treatment) was played back (white noise, cricket, house finch, Carolina wren, or northern cardinal). The trial was recorded until either the spider captured the prey or five minutes had elapsed. Trails were observed for a variety of behaviors (Table 1) and scored using BORIS (v7.9.8). We exported total duration and total number of events for each behavior for statistical analysis in JMP (Ver 15.2.1).

Table 1: The behaviors used for the ethogram in both 2019 and 2020.

2019	2020
Locomotion	Locomotion
Stationary	Stationary
Prey Introduction	Prey Introduced
Attack	Grooming
Feeding	Leg Raise
Other	Leg Tap
	Other

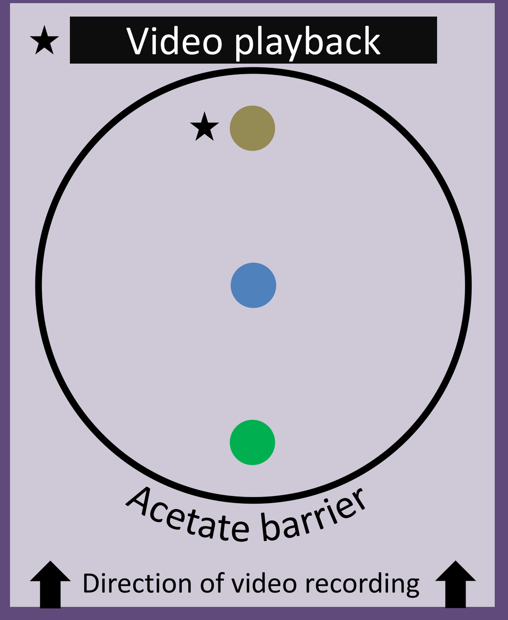


Figure 1: Playback arena with paper-based floor (replaced after each trial), recording and playback devices were attached beneath the arena with wax. ★ Denotes devices used in 2020 only.

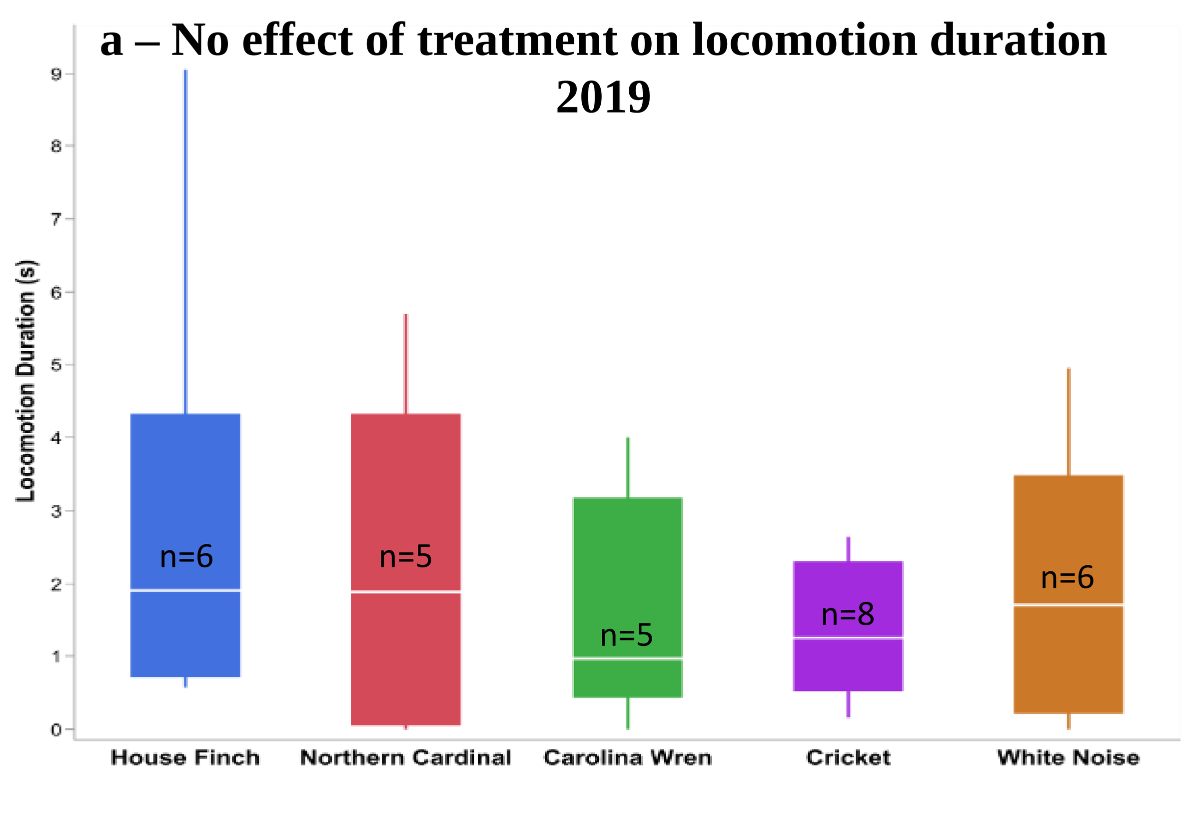
- Accelerometer
- Avian cue playback
- Cricket cue playback

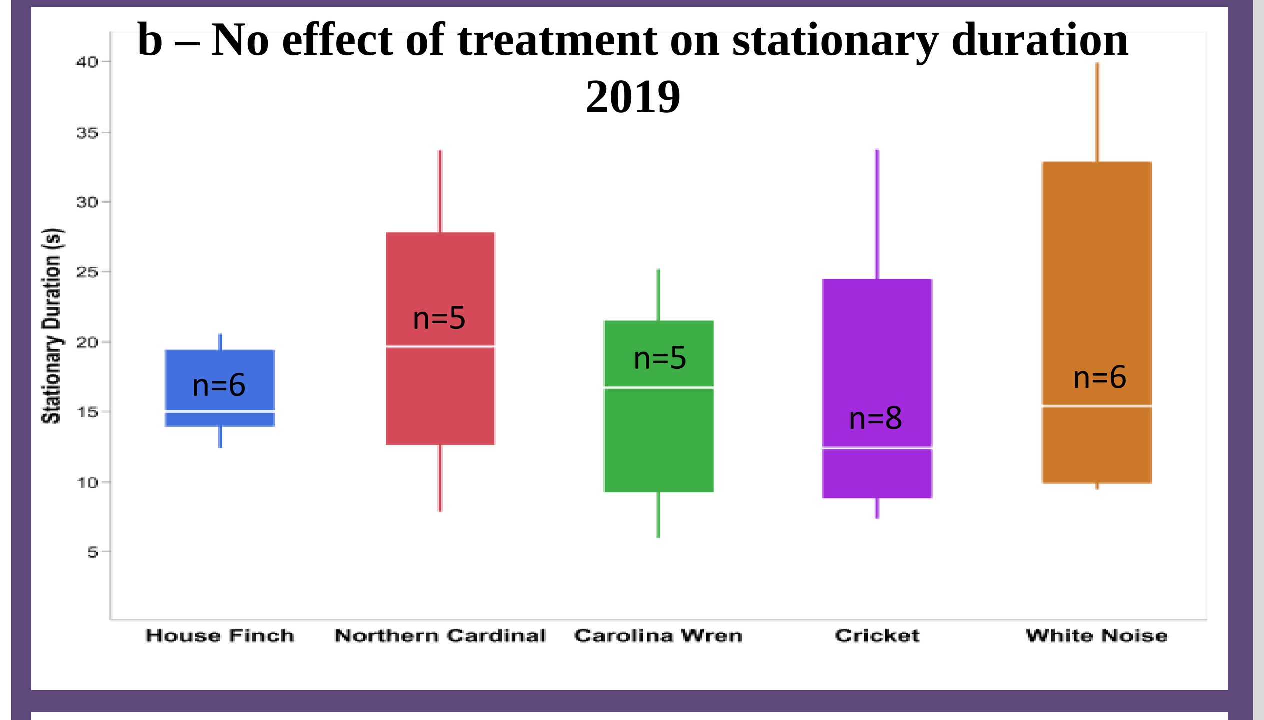
2020 Experiment

As in 2019, a single juvenile was used per trial and was given time to acclimate to the arena before the experiment proceeded. Here, instead of live prey, we used a smartphone to playback video of a cricket (figure 1). Treatment groups (n=18-20/treatment) here included one of three avian cues (house finch, norther cardinal, and Carolina wren) coupled with the incidental vibrations produced by the virtual cricket. Here, the control consisted of only the cues created by the virtual cricket. Each trial lasted the duration of the cricket playback, 1 minute. We observed, scored, and analyzed behavior in the same way as 2019 although our ethogram differed slightly (Table 1).

Results

In both years we did not detect a significant affect of treatment on juvenile spider antipredator behavior (Figures 2a-d). Although, in 2020 there appears to be a trend that is approaching significance (Figure 2d; Chi square = 6.32, p = 0.09, df = 3); juvenile spiders remained stationary for the shortest amount of time when exposed to Carolina wren acoustic cues (played back as a substrate-borne vibration).





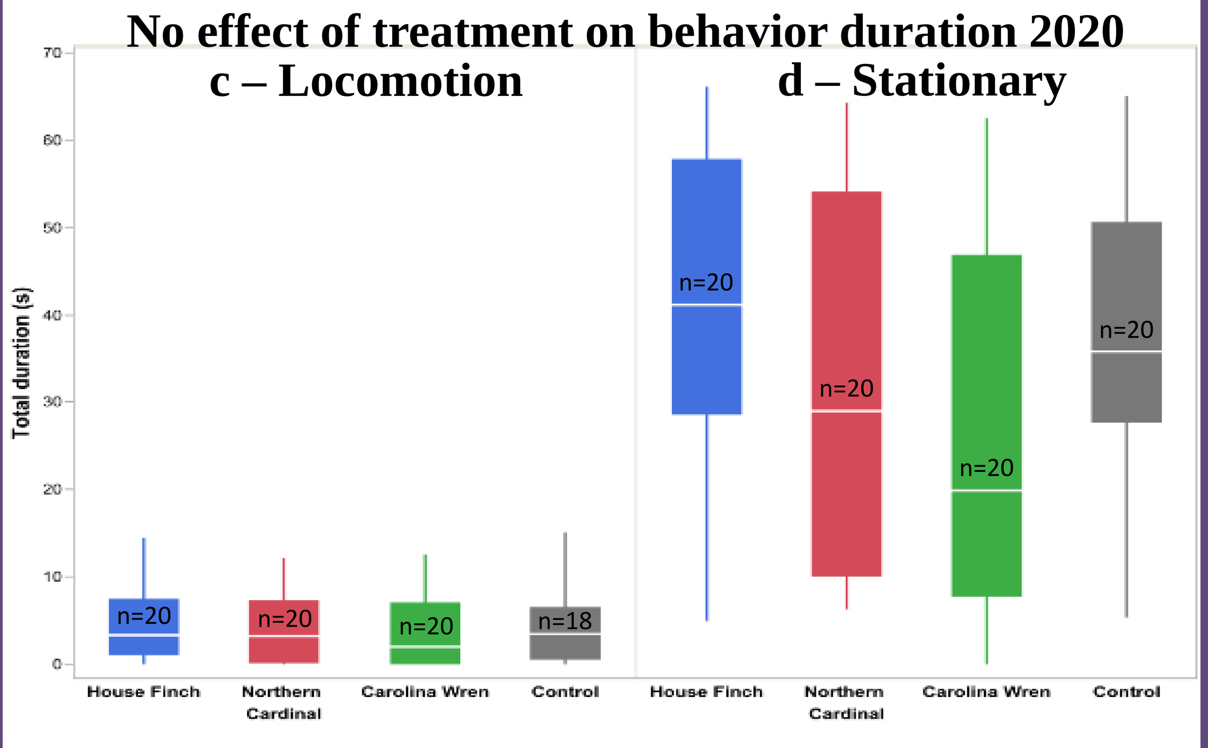


Figure 2a-d: Boxplots showing the distribution of each treatment with sample sizes. line = median, Filled box = Interquartile range, Whiskers = min and max values.

Discussion

Our results suggest that juvenile spiders do not respond to predatory cues with antipredator behavior in the presence of prey. Although, the trend of response (particularly total time stationary) does match some of the data from Lohrey *et.al.*, (2009). Thus, we reject both our prediction and hypothesis. There are many possible reasons/factors that may have led to these results…

- While all three birds used in the trials are present in Kentucky year-round, only the Carolina wren are still nesting in October. This means juvenile wolf spiders collected during October may not have experience with avian predators, or their calling songs, when they were collected.
- While juvenile spiders did not respond, as predicted, to vibrational cues they may response to these calls if played back acoustically (as in Lohrey *et.al.*, 2009).
- In 2019 weekly feeding schedules were often disrupted due to supply issues with cricket prey.
- In 2020, due to timing constraints we were unable to correctly scale the virtual crickets. While prey appeared much larger, spiders still oriented towards (108 vs. 113 events) and approached the virtual crickets (50 vs 49 events).

While the above issues may have affected our results, the fact that there was no effect of treatment on juvenile wolf spider antipredator behavior was surprising. Juvenile *Schizocosa* sp. wolf spiders appear as juveniles at the start of spring and then again in late summer; temporally this may lead to innate and/or experiential differences in which predatory cues elicit antipredator behavior.

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References Cited

Cocroft, R. B., Hamel, J., Su, Q., & Gibson, J. (2014). Vibrational Playback Experiments: Challenges and Solutions. In *Studying Vibrational Communication* (pp. 249–274). Springer.

Gibson, J. S., & Cocroft, R. B. (2018). Vibration-guided mate searching in treehoppers: directional accuracy and sampling strategies in a complex sensory environment. *The Journal of Experimental Biology*, *221*(6), jeb.175083.

Gunnarsson, B. (2007). Bird predation on spiders: ecological mechanisms and evolutionary consequences. The Journal of Arachnology, 35(3), 509-529.

Lohrey, A. K., Clark, D. L., Gordon, S. D., & Uetz, G. W. (2009). Antipredator responses of wolf spiders (Araneae: Lycosidae) to sensory cues representing an avian predator. *Animal Behaviour*, *77*(4), 813-821.