O Cricket, Where Art Thou: Do Black Widow Spiders Remember the Site of Prey Capture in a Complex Web?

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Introduction

- The ability to form and retain memories varies among species of animals.
- This variation can be used to explore how cognitive abilities are shaped by the ecological challenges faced by animals. Studies have shown that web-building spiders form memories of the contents and layout of their webs (Rodríguez et al., 2015).
- We analyzed the contents of memory in *Latrodectus hesperus*, commonly known as the Western Black Widow spider.
- These spiders build three-dimensional webs with two distinct components (*Figure 1*): a horizontal top sheet under which the spider sits and waits for prey, and a set of taut vertical gum-footed lines that extend downwards from the sheet and have sticky ends that connect to the substrate below (Benjamin & Zschokke, 2003).

Hypotheses and Predictions

- Memory hypothesis - spiders form a memory of having captured prey.
- Prediction - spiders will search for prey that they have captured and then lost.

- Location content hypothesis - spiders form memories of the sites at which they have captured their prey.
- Prediction - spiders that caught prey in the gum-footed lines will be more likely to search for lost prey on the floor than spiders that caught prey in the sheet.

Experiment

- We collected female *L. hesperus* spiders in Medford, OR in June of 2018 and 2019 and then housed the spiders in the lab in individual containers.
- To begin our experiment, we placed the spiders in plastic boxes and allowed them one week to construct webs that included both sheet and gum-footed line components.
- We randomly assigned spiders to control groups that were fed normally, had a small hole cut in the web to mimic damage from prey capture, had their prey stolen and immediately returned, or to treatment groups that were offered prey in the gum-footed lines or sheet then had their prey stolen.
- We stole prey from treatment spiders after they had finished normal prey capture behavior. We observed all spiders for one hour after our experimental manipulations. We filmed all trials and used the videos to record whether spiders searched and the number of times searching spiders searched the floor around the gum-footed lines.

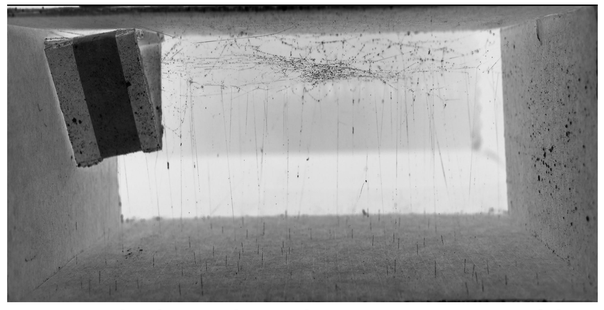

Figure 1 The figure shows the two components of the webs of *L. hesperus*: the sheet at the top of the web, and the gum-footed lines that extend from the sheet to the substrate below.

Results

- Spiders that captured and lost prey (n = 41) were significantly more likely to search their webs than spiders in control groups (n = 30) (*Figure 2*).
- Spiders fed in the gum-footed lines (n = 40) were not more likely to search on the floor than spiders fed in the sheet (n = 21) (*Figure 3*).

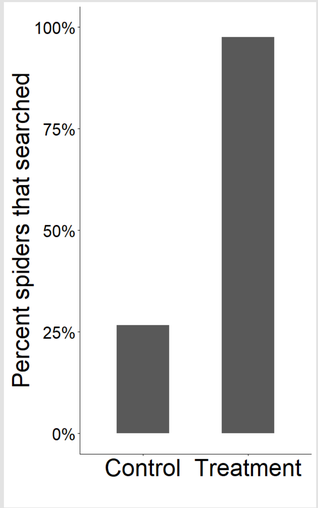

***Figure 2* Percent of spiders that searched in control and treatment groups**. Spiders in treatment groups that captured and lost prey were significantly more likely to search than spiders that did not experience prey theft ($\chi^2_{1,1}$ = 45.24, $p < 0.001$).

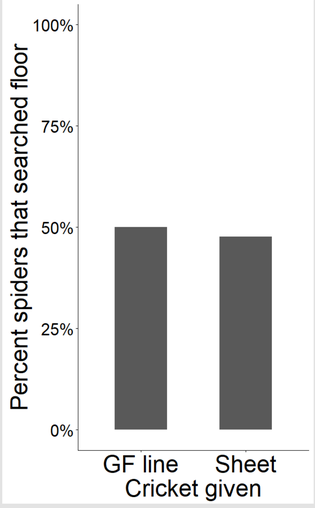

***Figure 3* Percent of spiders that searched on the floor after theft of prey that was offered in a gum-footed line or in the sheet**. Spiders did not differ between prey capture locations in the likelihood of searching on the floor after their prey was stolen ($\chi^2_{1,1}$ = 0.02, p = 0.88).

Discussion

- Our results support the hypothesis that *L. hesperus* form memories of having captured prey: spiders that captured and lost prey were more likely to search their webs than control spiders.
- However, the results do not support the hypothesis that these memories include information about the site of prey capture: spiders who were fed in the gum-footed lines did not search on the floor more often than spiders who were fed in the sheets of their webs.
- We conclude that while *L. hesperus* does form memories of its prey, they do not appear to be adapted to acquire information about the site of prey capture or use this information in prey recovery efforts.

References

Benjamin, S. P., & Zschokke, S. (2003). Webs of theridiid spiders: construction, structure, and evolution. *Biological Journey of the Linnean Society, 78*, 293-305.

Rodríguez, R. L., Briceño, R. D., Briceño-Aguilar, E., Höbel, G. (2015). *Nephila clavipes* spiders (Araneae: Nephilidae) keep track of captured prey counts: testing for a sense of numerosity in an orb-weaver. *Animal Cognition, 18*, 307-314.