# Sizing Up the Memory of Western Black Widow Spiders, *Latrodectus hesperus* (Araneae: Theridiidae)

Audrey Schlais*, Clinton Sergi, Rafael Rodriguez
UW-Milwaukee Biological Sciences Department

## Introduction

- Cognitive capabilities vary widely among animals.
- Understanding this variation requires relating cognitive abilities the ecology of different species.
- Web building spiders form memories of the contents of their webs, which they use to regulate recapture efforts when they lose prey (Rodriguez et al. 2015).
- To date, this research has been limited to spider species that build two-dimensional orb webs.
- We analyzed the memory capability of a spider that builds complex, three-dimensional webs, *Latrodectus hesperus*, black widows.
- We used the spiders' behavior of searching for prey they have captured and lost as the behavioral assay of the spiders' memory content (Rodriguez et al. 2015).

## Hypothesis/Predictions

- Memory hypothesis: the spiders form a memory about having captured prey.
- Prediction:

i. The spiders will search for prey they have captured and then lost.

- Memory-content hypothesis: the spiders' memories of captured prey includes details about the size of the prey.
- Predictions:

i. Search times should vary with prey size.
ii. The number of search bouts will vary with prey size.

## Methodology

- We collected spiders in June of 2018 and 2019 in Medford, OR. We used only female spiders that had not mated before being collected. We then housed spiders in the lab in individual containers until we began this experiment in July 2019.
- We gave treatment spiders a prey item (one *Acheta domesticus* cricket) and allowed them to complete the prey-capture sequence (flicking silk at and wrapping the cricket) before we removed the prey.
- We offered spiders a range of prey sizes: 15.5g to 331g (mean 111g).
- We included a sham control group (which we removed and immediately returned the prey to the spider); and disturbance control group (in which a hole was cut into the web to simulate the effect of the spider cutting out its prey).
- Trials included: $n$ = 41 spiders for treatments in which we stole prey, and $n$ = 30 for control groups; total $n$ = 71.
- We observed each spider and recorded for one hour after the prey had been stolen or web damage occurred.
- To relate prey size to search times, we used the ratio of prey mass over spider mass, to use a measure of relative prey size.

## Results

- Spiders that captured and lost prey were three times as likely to search as spiders in the control groups (Fig 1).
- Spiders that captured and lost prey searched on average nine times longer than spiders in the control groups (Fig 2).
- Spiders' search times were not affected by cricket mass (Fig 3).
- Searching behavior included waving of front legs, plucking web threads and walking/running about the web.

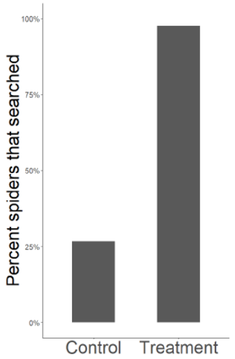



**Figure 1: Percent spiders that searched in control and treatment groups.** Spiders in the treatment groups that had their prey stolen were more likely to search than spiders that did not experience prey theft ($\chi^2_{1,1}$ = 45.24, p < 0.001).

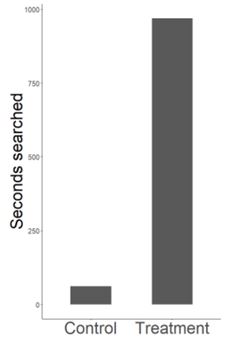



**Figure 2: Time spent searching by spiders in control and treatment groups**. Among spiders that searched, spiders in the treatment groups searched longer than spiders in the control groups. ($F_{1,1}$= 27.42, p < 0.0001)

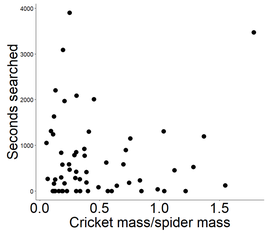
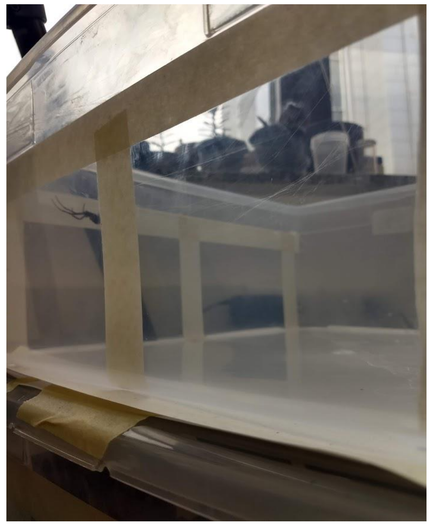



**Figure 3: Variation in spider search times according to ratio of cricket mass to spider mass**. Relative cricket mass did not have an effect on the length of time spiders spent searching ($F_{1,1}$ = 0.078, p = 0.78).

## Discussion

- We report memory of having captured prey in a spider that makes complex, three-dimensional webs, *L. hesperus* black widows.
- These memories prompt the spiders to exert effort to re-acquire prey when lost.
- However the spiders' memories do not appear to include details about prey features, such as size.
- Thus we find support for the memory hypothesis but not the memory-content hypothesis.
- Our findings suggest *L. hesperus* may be adapted to recover items on their web that they have lost, but not to adjust their recapture efforts on the basis of those items' features.



## References

Rodríguez RL, Briceño RD, 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.