Black widow spiders dial up posture for survival and sex

December 14 2018, by Jeffrey Renaud

Black widow spiders can decode important vibrations that travel through their webs and up their legs. Credit: University of Western Ontario

A new study led by Western University's Natasha Mhatre shows that body dynamics and posture are crucial to how black widow spiders decode the important vibrations that travel through their webs and up their legs. Black widows rely on these vibrations for sexual signals, capturing prey and evading predators.

Mhatre recently moved to Western's Faculty of Science as an assistant professor in the department of Biology. She comes from the University of Toronto at Scarborough's Department of Biological Sciences where she conducted this study as a postdoctoral fellow with the Integrative Behaviour & Neuroscience Group, which is led by Andrew Mason.

For the study, Mhatre investigated how female black widow spiders use their sensory organs, which are called slit sensilla. (These are distributed all over their bodies and resemble tiny cracks in their exoskeletons). Mhatre focused particularly on the slit sensilla found at their leg joints, which sense web vibrations

She discovered that the freely-suspended spiders adopt different body postures to alter both the level and tuning of their sensory organs, meaning they can use posture – like a radio dial – as they intercept web vibrations often times critical to their own survival.

Mhatre also found that the weight of the spider has almost no effect on this radio-dial, which is great news for black widows feeling peckish or with child.

"If they are hungry or pregnant, a black widow's sensory perception isn't changed," explains Mhatre. "This is important because they can change their perception by posturing their body when they want to change it as opposed to their body condition changing and controlling it. Their perception is under their own control rather than it being out of their control."

An expert in vibrational and acoustic communication, Mhatre studies black widow spiders, as well as tree crickets, to better understand how sensory and motor systems interact with each other. She connects these data to ideas of embodied cognition and extended cognition.

Embodied cognition is the understanding that the mind is not only connected to the body but that the body, and its movement, also influence the mind. Extended cognition means that thinking and other cognitive abilities 'extend' beyond the physical body to include aspects of the environment in which an organism is embedded like a black widow spider and its web.

"This study shows that black widow spiders use embodied and extended cognition, meaning they have a few different levels of cognitive control over what they can perceive," explains Mhatre. "They can make their web and that's a slow process but they also have their body and that's a quick process. And they also have their brain on top of all that. This means that their brain has to keep track of what they're doing, which means there has to be a loop between the brain and the body. And that's very exciting in terms of things like behaviour and perception for not only animals but humans too."

Understanding how spiders think and move is also increasingly important for robot engineers and developers as their ability to maneuver in and around – and even upside down for black widows – diverse environments allow for far greater range of motion as opposed to models based on human legs or wheels.

The study, titled "Posture controls of mechanical tuning in the black widow spider mechanosensory system," has been posted on the preprint server BiorXiv in order to make the results widely available as soon as possible. It will soon be submitted to a peer-reviewed journal for formal review.

More information: Natasha Mhatre et al. Posture controls mechanical tuning in the black widow spider mechanosensory system, *BioRxiv* (2018). DOI: 10.1101/484238