Spider webs more effective at ensnaring charged insects

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This shows a cross-spider, *Araneus diadematus*, in its orb web. Like many spiders, this species produces several types of silk: a stiff kind for the radial spokes of the web, and a more flexible one for the spirals. The flexible silk is easily deformed by the electrostatic charge of nearby insects, increasing the effectiveness of the web at capturing prey. Credit: Victor Manuel Ortega-Jimenez, UC Berkeley.

Flapping insects build up an electrical charge that may make them more easily snared by spider webs, according to a new study by University of California, Berkeley, biologists.

The positive charge on an insect such as a bee or fly attracts the web, which is normally negatively or neutrally charged, increasing the chances that an insect flying by will contact and stick to the web, said UC Berkeley post-doctoral fellow Victor Manuel Ortega-Jimenez.

He also suspects that light flexible spider silk, the kind used for make the spirals on top of the stiffer silk that forms the spokes of a web, may have developed because it more easily deforms in the wind and electrostatic charges to aid prey capture.

"Electrostatic charges are everywhere, and we propose that this may have driven the evolution of specialized webs," he said.

Ortega-Jimenez, who normally studies hummingbird flight, became interested in spider webs while playing with his four-year-old daughter.

"I was playing with my daughter's magic wand, a toy that produces an electrostatic charge, and I noticed that the positive charge attracted spider webs," he said. "I then realized that if an insect is positively charged too it could perhaps attract an oppositely charged spider web to affect the capture success of the spider web."

In fact, insects easily develop several hundred volts of positive charge from the friction of wings against air molecules or by contacting a charged surface. This is small compared to the several thousand volts we develop when walking across a rug and which gives us a shock when we touch a doorknob, but is sufficient to allow a bee to electrostatically draw pollen off a flower before landing.

To test his spider web hypothesis, Ortega-Jimenez sought out cross-spider (*Araneus diadematus*) webs along streams in Berkeley and brought them into the lab. He then used an electrostatic generator to charge up dead insects – aphids, fruit flies, green-bottle flies, and honey bees – and drop them into a neutral, grounded web.

"Using a high speed camera, you can clearly see the spider web is deforming and touching the insect before it reaches the web," he said. Insects without a charge did not do this. "You would expect that if the web is charged negatively, the attraction would increase."

Ortega-Jimenez plans to conduct further tests at UC Berkeley to determine whether this effect

occurs in the wild, and find out whether static charges on webs attract more dirt and pollen and thus are a major reason orb web weavers rebuild them daily.

The researchers report their findings in the July 4 issue of *Scientific Reports*.

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