

Social susceptibility: Leader-follower dynamics of influential individuals in a social group

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Stegodyphus dumicola were hand-painted to enable researchers to keep track of individuals. Credit: Jonathan Pruitt

This is the story of a spider, small but bold.



This particular arachnid, in fact, has helped to debunk the Great Man Theory, a 19th-century notion positing that highly influential individuals use their power—be it personal charisma, intelligence, wisdom or political skill—to maximize their impact in shaping the course of history.

How better to test that theory than with Stegodyphus dumicola?

Working with these African social spiders in their native habitats, UC Santa Barbara evolutionary ecologist Jonathan Pruitt created a model for exploring leadership dynamics and social susceptibility—the tendency of individuals to change their behavior in response to interactions with influential group members. He found that the social susceptibility of the population majority—and not the influence of key individuals—is what drives leadership. The results appear in the journal Current Biology.

"We knew from previous studies that in a social group, the rare presence of bold individuals—who constitute between 1 and 5 percent of a population—radically changes collective behavior," said Pruitt, an associate professor in UCSB's Department of Ecology, Evolution, and Marine Biology (EEMB). "This new research evaluates whether the rise and fall of societies could be contingent on having just one or a few of these key individuals and whether the profitability of their presence might change based on the environment."

Pruitt and his team set up 240 experimental societies across two different precipitation gradients in Africa: one in the Namib Desert heading north to Angola and a second from the Kalahari Desert heading east to Lesotho. Some of these colonies contained particularly bold spiders (putative leaders) and some did not. The researchers then monitored these colonies' behavior and survival for the next six months.

The scientists determined the boldness of individual spiders by exposing



them to a directional jet of air. Because *S. dumicola* cannot see well, they interpret air movement as a predator such as a bird, bat or wasp. Their response? A death-feigning posture wherein they tuck their legs and huddle into a ball. Bold individuals don't hide for long, but shy ones can take 20 minutes to an hour to recover.

"We wanted to see whether the presence of these particularly bold individuals changed how a society behaves collectively, and whether the aggressiveness of a society determined the likelihood of its members surviving or dying together in a sudden extinction event," Pruitt explained. "We found no association between how a society behaved and whether it lived or died at wet sites; nor did bold individuals have a large effect on colony behavior at these sites. However, we found a very tight association between the presence of bold individuals and societal aggressiveness at arid sites, and colonies containing bold individuals were far more likely to survive in these habitats."

The fact that the same rare personality types existed at both dry and wet sites, but varied in their degree of apparent <u>social influence</u> across these habitats, allowed the investigators to decipher, for the first time, whether it is the traits of the leaders or the social context in which they reside that truly drives their influence. As it turned out, the population majority determined whether these key group members could emerge at all, thus debunking the Great Man Theory and its parallel hypotheses regarding "keystone individuals" in a variety of animal societies. Instead, social influence appears to emerge from shy, generic spiders.

"When we took bold individuals from a wet site, where they didn't have any social influence, and put them with shy spiders from an arid site, those shy individuals were willing to follow the bold ones regardless of where they were from," Pruitt noted. "So, it wasn't the unique social influence of bold individuals from arid sites but rather the social susceptibility of the population majority that made an advantageous



social order emerge."

To further scrutinize their findings, the scientists substituted bold individuals of another independently evolved species of social <u>spider</u> that occurs in southern Africa. Adding bold *Stegodyphus mimosarum* to groups of shy spiders in both wet and dry sites reproduced the same result at wet sites: The shy individuals were unresponsive to bold foreigners. However, the shy spiders from dry sites, who were used to food-restricted environments, responded equally to bold spiders of both species. Thus, for arid *S. dumicola*, anything even coarsely approximating the phenotype of a leader is enough to instigate followership in these populations.

"Shy *S. dumicola* from arid sites are susceptible to any indication of a bold individual in their groups, and the social susceptibility endemic to these sites succeeds in creating an advantage that increases a colony's chances of survival," Pruitt said.

More information: Jonathan N. Pruitt et al, Selection for Collective Aggressiveness Favors Social Susceptibility in Social Spiders, *Current Biology* (2017). DOI: 10.1016/j.cub.2017.11.038

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