

## Jumping Spider Tricksters: Deceit, Predation, and Cognition

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In an emerald rainforest of northeastern Australia, a sunbeam pierces the canopy, touches broad green leaves on the way down, and beams onto a lichen-spotted rock surface. In the beam's circle, slow, careful motions of a brownish jumping spider are illuminated. The jumping spider belongs to the genus *Portia* and it is stalking its prey, a different species of spider sitting in its own web. *Portia* steps cautiously from the rock surface out onto the web, and stops. Delicately, *Portia* begins to pluck the web with its palps and legs, making signals that mimic the struggles of a trapped insect. When the prey spider ignores *Portia's* plucking, *Portia* varies the characteristics of signals, generating a kaleidoscopic of what appears to be a random selection of signals. Eventually, in response to one of these signals, the prey spider swivels toward *Portia*. Immediately, *Portia* backtracks to that particular signal and repeats it again and again. There being no further response from the prey, *Portia* eventually reverts to broadcasting a kaleidoscope. When the prey spider still moves no farther, *Portia* adopts another ploy.

Now *Portia* slowly and carefully stalks across the web toward the resident spider, intermittently making a variety of signals. From time to time, a soft breeze blows, ruffling the web. The ruffling of the web creates background noise in the web, and *Portia* exploits these moments, during which the resident spider's ability to detect an intruder are impaired, by stalking faster and farther during these periods than when the air is still. Nearing the resident spider, *Portia* makes a signal that elicits from the resident spider a sudden, rapid approach. However, the spider advances very aggressively, and *Portia* scrambles to the edge of the web, then turns around to look over the scene. Soon *Portia* moves away from the web and undertakes a lengthy detour, first going away from the prey and around a large projection on the rock surface, losing sight of the prey spider along the way. About an hour later, *Portia* appears again, but now positioned above the web on a small overhanging portion of the rock. After anchoring itself to the rock with a silk dragline, *Portia* next slowly lowers itself down through the air, not touching the web at all. Arriving level with the resident spider, *Portia* suddenly swings in, grabs hold of the unsuspecting spider and sinks its poison-injecting fangs into the hapless victim. So ends another spider-eat-spider episode from the rainforest, typical of hundreds that we have witnessed in the field and raising interesting questions about spider cognition. In the discussion to follow, we will return repeatedly to this hunting example.

When we began studying the species of *Portia* about 20 years ago, little was known about the behavior of these unusual tropical members of the spider family Salticidae (jumping spiders or salticids for short). About two dozen species of *Portia* have been described, distributed from Australia through the Indonesian and Malaysian island chains into China, the Indian subcontinent, and Africa. The adults tend to be 8-12 mm in body length, living in habitats ranging from low-elevation rainforest to montane pine forests to savannah.

Across all habitats, whenever *Portia* has been studied it has been shown to specialize on other spiders as prey, invade webs and practice aggressive mimicry (Jackson and Wilcox 1998). All *Portia* also build their own webs, which they use for capturing both insects and spiders. Web-based behavior is unexpected in a salticid. Typical salticids neither build nor invade webs. Instead, they use their acute eyesight to guide stalk-and-leap sequences on insects carried out on the ground, on tree trunks and in the foliage (Jackson and Pollard 1996). Remarkably, *Portia* also practices away-from-webs stalk-and-leap sequences. Being highly effective at prey capture in each setting (away from webs, in its own web and in another spider's web), *Portia* is among salticids a jack of all trades and the master of them all (Jackson and Hallas 1986).

It is the intricate details of web invasion and aggressive mimicry that especially raise questions about cognition. Web-building spiders from families other than salticids have simple eyes and only poor eyesight (Land 1985). Web signals (i.e., the tension and movement patterns of silk threads) can be envisaged as the language of the typical web-building spider (Foelix