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EXPERIMENTAL DEMONSTRATION OF THE IMPORTANCE OF WINGS TO PREY EVALUATION BY A SALTICID SPIDER. G. B. Edwards

Adults of several species of *Phidippus* (Salticidae) have been shown to use different attack strategies for adult Diptera than were used for larval Lepidoptera (Edwards 1930). I suspected that the flies' wings might have been a stimulus to the spiders which initiated the particular attack behavior used against flies, since nearly all captures of flies resulted in the spiders biting the flies in the thorax near the wing bases, regardless of the spiders' direction of attack. In order to test the hypothesis that presence or absence of wings was an important factor in prey evaluation, I needed a predator-prey system of known degree of interaction in which the prey could be manipulated. The predator I chose was *Plexippus paykulli* (Audouin), a pantropical species occurring commonly in Florida (Edwards 1979). The prey chosen was the ant *Camponotus abdominalis floridanus* (Buckley); *P. paykulli* had been reported to feed on alates of *C. a. floridanus*, but to ignore workers of various ant species (Edwards *et al.* 1974), many of which were potentially noxious or dangerous to the spiders.

Most reported instances of predation on worker ants by spiders have been of spiders more or less specialized as ant predators (e.g., Levi 1957, Edwards *et al.* 1974, Cutler 1980). On the other hand predation on alate ants is usually reported for spiders that are not ant specialists (e.g., Robinson and Robinson 1973, Edwards *et al.* 1974). While worker ants are usually equipped with potent offensive and defensive weapons in the form of stings or chemicals, elate ants (especially males) are less likely to be dangerous potential prey. Although many spiders likely use chemotactic means to identify ants, jumping spiders can visually evaluate ants without having to risk contact. Strong evidence exists that at least some jumping spiders can learn to avoid worker ants (Edwards 1980) or even particular species of ants (Edwards et al. 1974).

METHODS

Adult *P. paykulli* (14 males and 14 females) were captured on the walls of laboratory buildings at the University of Florida, Gainesville, and were kept in 7-dram, plastic, snap-cap vials. Prior to a test, food was withheld for 3-4 days (unless noted otherwise) and spiders were provided with water only. Spiders were tested randomly 1-2 times for 1-3 prey categories, with a mean of 2.3 encounters per spider and a maximum of 5 encounters per spider (with 1 female). Adults of *P. paykulli* average 10 mm in length and about 100 mg In weight. Minor workers and alate males of *C. a. floridanus* were used as the

test prey. The ants were about .75 the length and .10 the weight of the spiders.

A test ant was placed in the bottom of a wide-mouthed, glass gallon jar. A test spider was allowed to jump from its vial into the upper part of the jar, after which the jar was closed. Tests were terminated after 15 minutes if interaction between the ant and spider had ceased or earlier if interaction had been concluded. Test categories were: 1) alate ants, 2) unmodified workers, and 3) workers with false wings. False wings were elongate triangles of cigarette cellophane wrapper (7 mm long by 2 mm wide at the base of the triangle); a single false wing was attached horizontally to a worker ant by gluing the point of the cellophane triangle with water-soluble mucilage to the dorsum of the alitrunk of the ant. The ant was gently restrained with featherweight forceps while the false wing was applied. I am indebted to J. F. Carroll for suggesting the material for the false wings and for assisting with the experiment.

RESULTS AND DISCUSSION

Spiders vs. alates: All 5 males and all 7 females of *P. paykulli* tested captured alate male *C. a. floridanus* on the first capture attempt and all 12 spiders captured the alates by biting them near where the wings attached to the alitrunk.

Spiders vs. unmodified workers: A difference between the sexes was manifested for this prey category. Only 1 out of 12 females of *P. paykulli* attacked a worker; this 1 attack was successful in killing the worker. However, 5 of 9 males attacked workers, with 3 successes. No clear pattern was evident for successful vs. non-successful spiders, but in every successful case there were complicating factors. The successful female and 2 of the 3 successful males had previously had success against workers with false wings (which perhaps facilitated recognition and appropriate attack of the prey leading to an improved chance of success). Also, these same 2 males had been starved for inordinate periods of time, one for 7 days, the other for 14 days. The former spider was repelled twice by the defensive behavior of the ant before successfully killing the ant. The third male injured the ant on the first attack, was repelled, then captured the subsequently helpless ant. The 2 unsuccessful males were repelled 1 and 4 times, respectively. Most of the spiders that did not attack workers either watched the ants briefly then ignored them, or actively avoided them. One male stalked but did not attack an ant, while a single female approached and touched an ant with her legs I but did not attack.

Spiders vs. workers with false wings: Spiders of both sexes together were more likely to attack workers with false wings than they were to attack workers without wings. Ten of 11 males attacked these "pseudoalates" (with 5 successes) and 13 of 16 females attacked pseudoalates (with 7 successes). The 1 male and 3 females that did not attack pseudoalates did, however, stalk them. Of the unsuccessful male attacks, 3 were repelled once and 2 were repelled twice. In 2 of the captures by males, the spiders were repelled once and twice, respectively, before successfully attacking. Of the 6 unsuccessful attacks by females, 4 were repelled once, 1 was repelled twice, and the last bit the false wing and released the ant without attacking further. One female injured the ant on the first attempt, was repelled, watched the ant until it was rendered helpless by the spider's poison, then returned and fed on the ant. All other successful attacks by females were made on the first attempt.

Sometimes it appeared to the observers that the spiders were indecisive about attacking pseudoalates, since the spiders were presumably receiving mixed stimuli. Some spiders would stalk the ant, watch it, move to a different position, watch again, raise up high on the tarsi by extending the legs (for a different view?), all in an apparent effort to determine the identity of the intended prey. Occasionally a spider would reach out with a leg I and touch an ant. If, as usually happened, the spider finally attacked the ant, the ant would naturally try to defend itself; *C. a. floridanus* are strong biters and also employ formic acid. Frequently a spider was forced to release an ant one or more times, most likely as a result of the formic acid causing irritation, especially to the spider's mouth. In half the cases, the ant's defense was sufficient to inhibit the spider from continuing the attack. In the other cases, the spider was persistent and eventually was able to overpower the ant.

Previously I found (Edwards 1980) that naive *Phidippus regius* spiderlings learned to avoid worker ants, and adults of several species of *Phidippus* refused to attack worker ants (Edwards *et al.* 1974). It seems likely that many salticids would learn to avoid worker ants, with the exception of those that may specialize on ants, such as euophryines of the genera *Corythalia* (Edwards *et al.* 1974) and *Habrocestum* (Cutler 1980) - possibly the whole subfamily - and others such as the dendryphantine genus *Tutelina* (Wayne Maddison, personal communication). Alate ants are in general much less capable of self defense (there are some exceptions), and the most likely effect of the capture of an alate by a salticid would be to reinforce previous positive experiences with alate ants, or perhaps even with clear-winged insects in general.

The question at this point becomes, "How well can salticids identify potential prey?" At least one species of salticid, *Corythalia canosa* (Walckenaer) (reported as *Stoidis aurata*), can discriminate between different species of worker ants (of the same size but different color), apparently by visual means (although chemical means may be involved) (Edwards *et al.* 1974). Therefore, it is possible, theoretically, for some salticids to be able to distinguish alate ants from other winged insects, and even one kind of alate ant from another. From my recent studies of naive *Phidippus* spiderlings, I obtained good evidence that the attack behavior of the spiderlings contains instinctive components. These instincts are sufficiently sensitive to enable a spiderling to distinguish between wild-type and vestigial-winged *Drosophila* (winged vs. non-winged prey). But the attack behavior of adult *Phidippus* for house flies (*Musca domestica*) (Edwards 1980) is essentially the same as reported here for *Plexippus paykulli* attacking alate ants. I suspect that salticids may normally identify prey by associating the potential prey with one of a limited number of categories (perhaps a set of instinct-mediated categories modified by experience).

The clear wings of Diptera, Hymenoptera, and several other insect orders, have certain light refracting properties, which, along with particular behaviors such as grooming, might attract the attention of a visual predator. (The cellophane apparently effectively mimics the properties of the wings.) It is my contention that the possession of clear wings by a potential prey is: 1) an indicator of the motile ability of the prey, and 2) an indicator that the prey is not dangerous (unless this information is overridden by information to the contrary, such as the behavior of a hunting wasp). A certain hunting sequence is begun depending upon the type of prospective prey. Prey with clear wings initiate a particular bunting sequence (which is flexible, however, to the other categories of winged prey should be tested with salticids as predators to examine the generality of prey-capture behavior by salticids toward clear-winged prey; e.g., would a moth with camouflaging coloration evoke the same attack response as a house fly? The possibility that the attack behavior of a salticid might: be affected by any significant alteration of the body shape of the prey should also be examined. *Phidippus* spiderlings are known to be able to distinguish between different types (and shapes) of non-winged prey (Edwards 1980); attack behavior appears to be mediated largely by the prey's motile ability, so it is not clear just how important the body shape of non-winged prey might be. In the case of worker ants, at least, body shape does appear to be important.

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