
Short Communication

Dragline Attachment Pattern in the Neotropical Social Spider *Anelosimus eximius* (Araneae: Theridiidae)

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INTRODUCTION

The regularity of spiders orb webs has been considered a fascinating natural wonder by generations of naturalists. Although the majority of spider species build irregular three-dimensional networks, those who have evolved the two-dimensional spiral snare have drawn most of the attention (Vollrath, 1988). Even studies conducted on irregular webs are often explicitly devoted to the search of similarities with orb webs, resulting from behavioral preadaptations to this specific design (Eberhard, 1987, 1992).

So the question of the distance between attachment points in an environment that does not feature intrinsic regulating properties, like a three-dimensional web or vegetal structure, remains widely open. In the overall context of swarming in the cooperative spider *Anelosimus eximius* (Furey *et al.*, in preparation), our focus was on amplification mechanisms involved in group cohesion and coordination of several individuals' activities. From these observations, it appears that dragline attachment pattern has a direct influence on network design, and consequently on the population transfer's dynamics, which is confirmed by theoretical projections about the efficiency of silk-mediated exploratory recruitment (Saffre *et al.*, 1997, in press).

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RESULTS

Experiments were conducted in French Guiana (Kaw trail), in March 1997, with individuals randomly selected from spiders from two field colonies. So it is assumed that our sample is representative, at least for this time of the year. Experiments took place on the forest's edge, the natural habitat of *Anelosimus eximius* in French Guiana (Pasquet and Krafft, 1989). They consisted in allowing one individual at a time to walk along a horizontal artificial thread (polyester; ~1 m in length), while measuring the distance (d) between consecutive attachment points (cf. Fig. 1). An experimental sequence was considered over when the spider either reached the end of the setup or dropped from the thread. All intervals (including those delimited by the first and last attachment points) are taken into account, but not the distance between the last attachment point and the end of the setup. Each spider attached its dragline to the artificial thread before moving, so one of the first interval's extremities is always the point where it was deposited. Our sample is composed of 20 sequences, for a total of 86 intervals distributed on 18 specimens.

Our results indicate that the mean interval between two consecutive attachment points is 7.87 cm (SD = 7.13 cm). The survival curve resulting from the distribution of interval lengths (cf. Fig. 2a) is a typical exponential decay that can be fitted by the expression

$$F_d = e^{-\alpha d}$$

with $\alpha = 0.13$ ($r^2 = 0.97$) being the probability of attaching the dragline per unit (cm). In this constant-probability hypothesis, $1/\alpha$ is expected to match closely the mean interval length, which is indeed the case ($1/\alpha = 7.69$). This suggests that dragline attachment is not performed on a fixed-interval basis.

Although high interindividual variability was noted, particularly in the num-

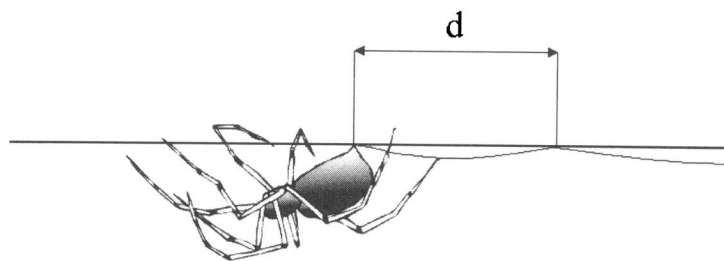


Fig. 1. Each spider is gently deposited on an artificial horizontal thread (polyester), using a soft paintbrush. The distance (d) between two consecutive attachment points is recorded.

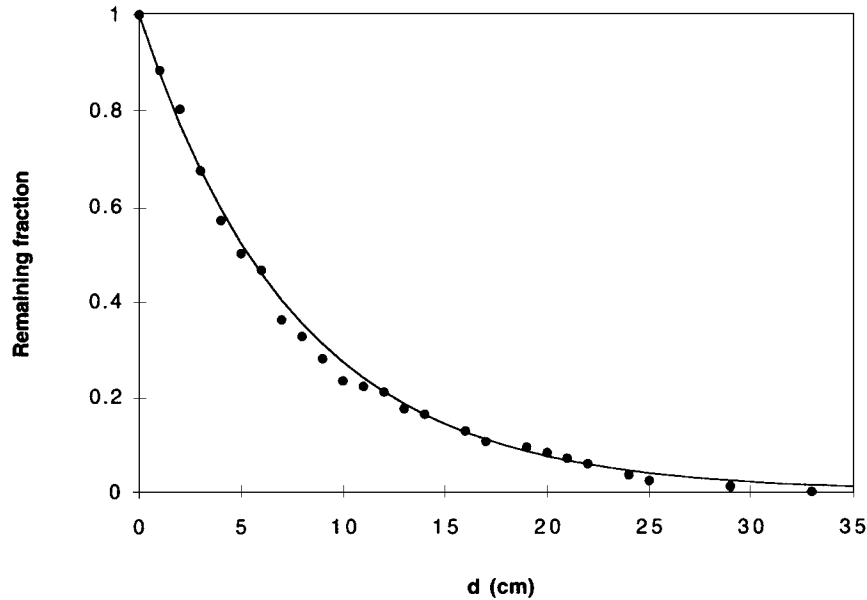


Fig. 2a. The remaining fraction of all recorded intervals plotted against the distance (d) to the nearest attachment point. The survival curve is a typical exponential decay ($n = 25$; $r^2 = 0.97$).

ber of recorded attachments, there is no correlation between this number and the mean interval length (Fig. 2b; $r^2 = 0.02$). Individual results are similar to global results: of five spiders for which at least six intervals were recorded, all exhibited a constant probability pattern (exponential-like survival curve: best fit $r^2 = 0.96$; worst fit $r^2 = 0.83$) and three had an individual α statistically identical to the global α (Student's test, $P < 0.05$). This confirms that the global distribution of interval lengths does not result from a combination between individual periodicity and interindividual variability: all spiders have a constant probability of attaching their dragline, although this probability can vary from one individual to the other.

DISCUSSION

The fact that a three-dimensional web-building social spider exhibits a non-periodic dragline attachment pattern raises a few questions.

The first of these involves the proximal causes (behavioral mechanisms) producing this unexpected pattern. Two hypotheses can be made: either there is an internal decision process based on some kind of random test or the constant probability pattern simply reflects the random occurrence of external events,

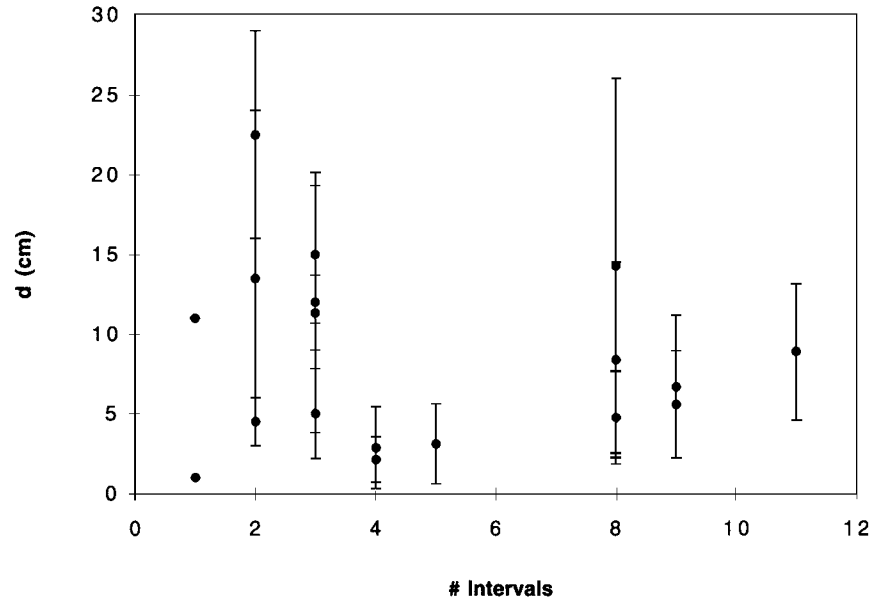


Fig. 2b. The mean interval length ($d \pm SD$) plotted against the number of recorded intervals for each spider. There is no correlation ($n = 18$; $r^2 = 0.02$).

acting as triggers to the attachment behavior. These can be either changes in local environmental conditions (wind, rain) or encounters with irregularities of the substrate. Although the second hypothesis can appear trivial, it is important to remember that, as experiments took place in *A. eximius*' natural habitat, external factors of this kind would play a part in the species' biology and are, consequently, a relevant field of investigation. It is possible indeed that, in the laboratory, a periodicity could appear, revealing an internal measuring capability of the spiders, but this would result de facto from artificial experimental conditions.

The second question is about the specificity of this behavior: Would other spider species, either social or solitary, orb-weavers or not, exhibit the same constant probability pattern in the same field conditions? Under the hypothesis that orb-weavers exhibit some kind of regularity in the dragline attachment pattern, is this also the case for three-dimensional web-builders, particularly other theridiids?

Generally speaking, how common is this type of random-occurring behavior in nature? Although it is usually thought that deterministic patterns are more widespread, a number of studies tend to indicate that this preconception is often mistaken, at least in arthropods (Deneubourg *et al.*, 1986). In

fact, it is most likely that many such patterns have remained unnoticed because the implicit search for deterministic traits have induced a methodological bias. Examples of probabilistic behavior can be found in spinning (Eberhard, 1990), trail-laying (Aron *et al.*, 1989), trial-following (Pasteels *et al.*, 1986; Calenbuhr and Deneubourg, 1992; Calenbuhr *et al.*, 1992), and foraging site exploration (Detrain *et al.*, 1997; Maillieux *et al.*, in preparation).

Finally, what is the impact of such a probabilistic pattern on a species' biology, particularly in a social environment? In the case of *A. eximius*' dragline attachment behavior, the production of a crucial foraging device (the web) is immediately concerned. To what extent its material structure and resulting efficiency are dependent on this behavioral plasticity is the central question that motivates our present and future work.

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