Female Gaze and the Evolution of Male Courtship Displays in Jumping Spiders

MOREHOUSE LAB

Andrew J Costa, David Outomuro, & Nathan I Morehouse

Department of Biological Sciences, University of Cincinnati, Rieveschl Hall, Cincinnati, OH 45221, USA

University of CINCINNATI

Introduction

Studying how organisms communicate with their conspecifics is important to better understand social and sexual behavior. There has been extensive research on male displays but very little is known on how females allocate their attention during those male displays (Yorzinski et al. 2013). **The aim of this project was to study female gaze during male displays using jumping spiders.**

Figure 1. Six species of jumping spiders showing diversity of coloration and pattern. From left: *Habronattus dossenus, H. borealis, H. decorus H. formosus, H. virgulatus,* and *H. pugilis.*

Methods

Male jumping spiders perform courtship displays that include colors and patterns on their limbs and body (Maddison et al. 2003). Jumping spiders have four pairs of eyes (Fig. 2A), but only the anterior medial eyes are capable of high resolution and color vision (Zurek et al. 2015). The anterior medial eyes are equipped with movable retinas which makes this animal group an excellent model to investigate questions on retinal gaze and attention. Using an eye-tracker (Jakob et al. 2018), we studied the gaze responses of the anterior medial eyes of females to a playback of a male courtship display in the species *Habronattus dossenus* (Fig. 1 far left and 2B). Males of this species show a complex courtship display that involves side to side motion of the green-colored forelegs and raising of the red-colored third pair of legs. We presented the same females with color and grayscale playbacks of a male display.

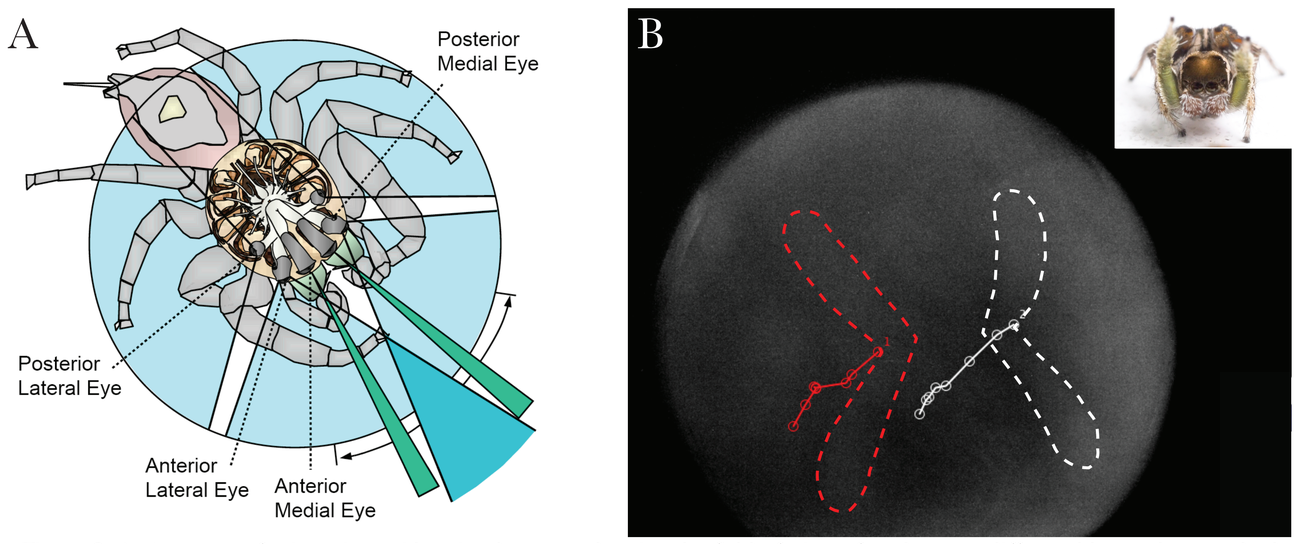
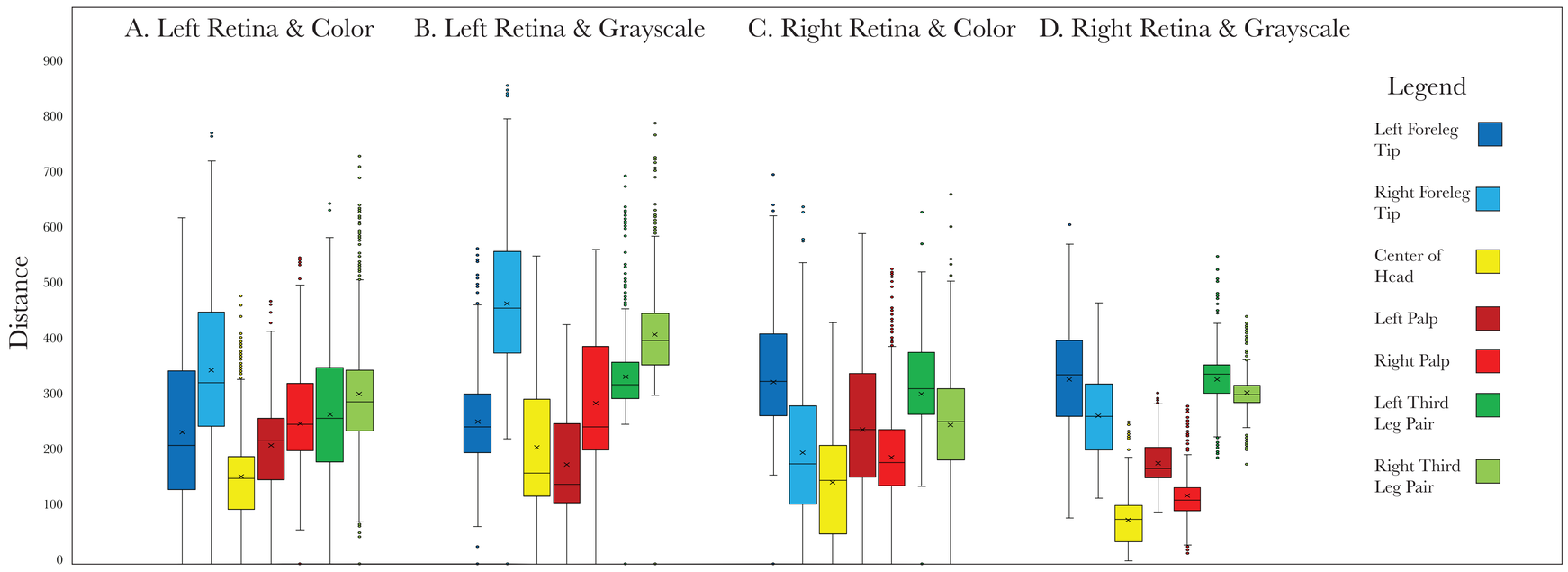


Figure 2. A. Anatomy of a jumping spider visual system, showing the field of view of each eye as different blue and green shades. The anterior medial eyes have a narrow field of view (green). B. Tracking of the centers of the retinas of the anterior medial eyes (red and white) when following a male display playback (top right corner).

Results

Our findings suggest that each of the female retinas delegate their attention to the corresponding side of the male display (Fig. 3A-D). The distances from each retina to the elements of the male display do not show differences between color and grayscale video playbacks (Fig. 3A-D). The female gaze tracks specific moving elements of the male display, i.e. the colored forelegs and third pair of legs (Fig. 3E). Over the course of the male display, the retinas got closer to the display elements after an instance of movement (Fig. 4).



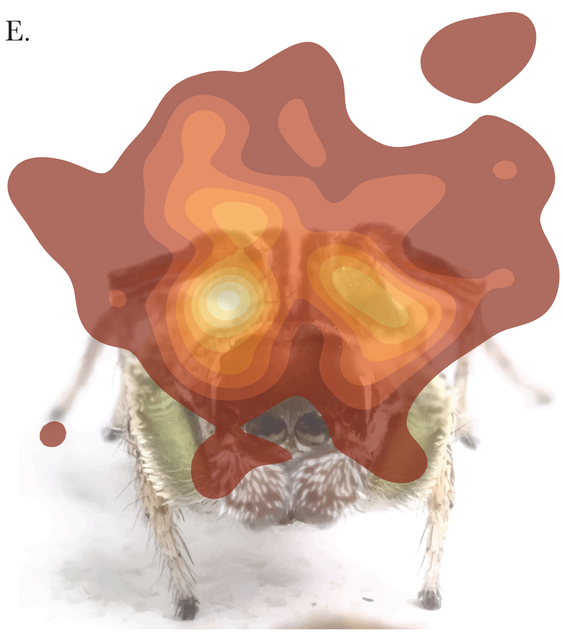


Figure 3A-D. Distances between the left and right retinas of the female anterior medial eyes, to the different elements of the male display (color or grayscale). E. Heatmap showing frequency of location for the right and left female retinas during the male display. The heatmap is shown superimposed on the male display. Places of interest include areas where the third leg pair and foreleg tips move during courtship.

Conclusions

Our study of female gaze may provide new insights into how male displays evolve under female choice and sexual selection. We know that color and motion both play a role in courtship (Taylor et al. 2014). Color and motion in courtship differ across species (Fig. 1) and the results of this work show that motion shapes where females look during mating displays. Our future research will expand similar research questions across species of the same genus of jumping spiders where male display largely differs in movements and colors. Are females exploiting certain regions of the male display? Are males exploiting female attention?

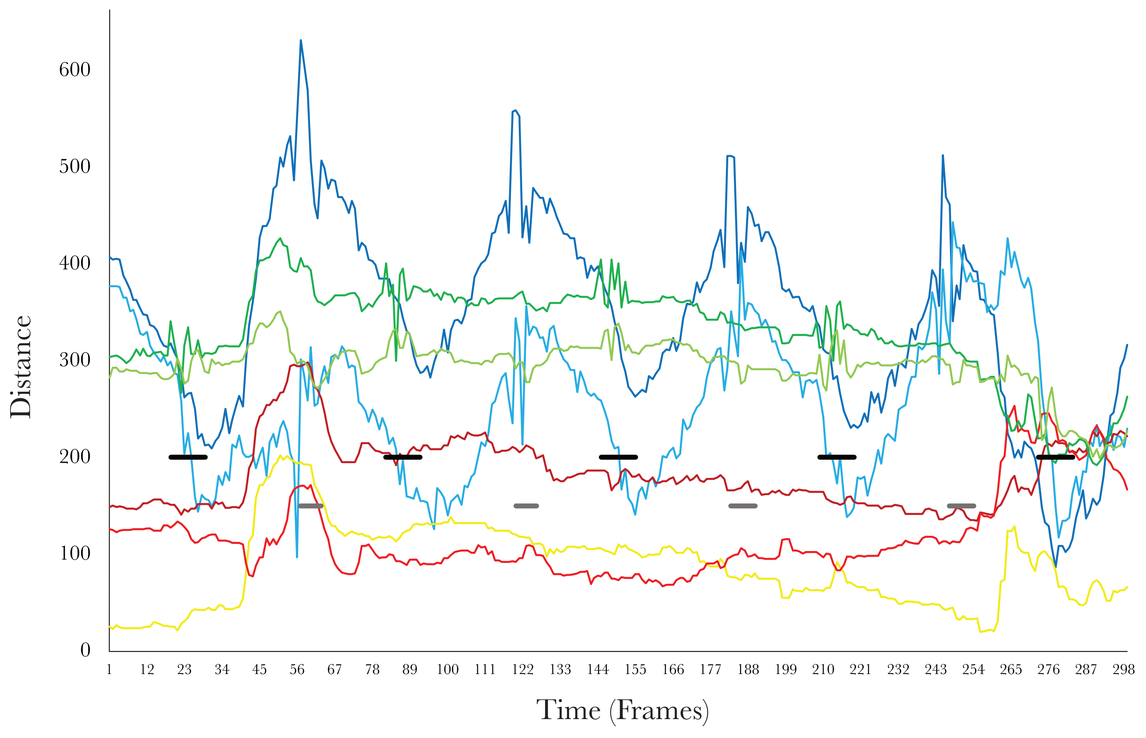


Figure 4. Changes in distance over time between the anterior medial eye retinas and the elements of the male display. This example corresponds to a left retina of one of the females studied. The horizontal thick lines mark events of display of the third pair of legs (black) and the foreleg tips (gray). For color correspondance see legend (Fig. 3).

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