Researchers discover the most effective animal signal strategies

April 22 2014, by Marie Guma-Diaz,annette Gallagher

Satin bowbirds build specialized stick structures called bowers and decorate them with blue objects to attract females. Credit: J. Albert Uy, associate professor of biology in the College of Arts and Sciences, at the University of Miami

There are all sorts of signaling strategies in nature. Peacocks puff out their feathers and spread their colorful tails; satin bowbirds build

specialized stick structures, called bowers, and decorate them with blue and shiny objects; and European bitterling males show off bright nuptial coloration during spawning season. Each species has evolved a unique method to communicate with others.

"Signaling can have profound fitness implications for individuals that are either signaling or receiving the signal," says Gavin M. Leighton, doctoral student in the Department of Biology in the College of Arts and Sciences at the University of Miami and author of a new study on the effectiveness of signaling systems. "For instance, individuals may signal to attract mates, or they may signal to rivals in order to defend a territory," he says. "Additionally, many biological models of cooperative behavior require individuals to signal how cooperative they were in past interactions."

Effective communication is not just about the signaler, according to the study, the receiver also needs to assess the signaler efficiently. For instance, one of the most effective strategies from the perspective of female birds is assessing groups of males called leks, where females can assess multiple males in a short period of time.

"When receivers had to assess individual signalers one at a time, the accuracy of their ranking of signalers decreased compared to when all the signalers could be observed simultaneously," Leighton says.

The study also shows that individuals that used non-food items, like a twig, in their signaling display had the least effective strategy. Surprisingly, individuals that invest in ecological structures, such as building a nest, improved the ability of the females to rank signalers, but the effect was fairly weak.

"The most unexpected finding was that investing in some sort of temporally stable structure only weakly improved the ability for

receivers to assess signalers," Leighton, says. "I originally suspected that investing in a structure would allow individuals to quickly convey their signaling effort over time in a single, observable feature," he said. "While I did find that structures helped, the effect was not as strong as other the other variables."

In order to investigate specific characteristics of systems and provide the ranking of signalers by receivers, Leighton designed a computer model that represents salient features of many signaling systems, across a variety of scenarios. The model is called an agent-based model. It allows the researcher to program individual entities with specified behaviors. Then, the software provides the ranking information to the researcher. Included in the analyses were different species of birds, fishes and insects.

"The study systematically models a series of behavioral and ecological conditions," Leighton says. "To the best of my knowledge no one has performed a general analysis of these different types of signaling systems."

The study assumes that in every scenario individuals had perfect memory. In other words, when a receiver saw a signaling individual, they were able to unambiguously assign this effort to a specific individual. In nature, individuals probably make errors in assigning signaling effort or forget the effort of individuals over time.

"By itself, this seems like an unwarranted assumption, however, it is not easy to compare across signaling systems where memory also varies with the species in question," Leighton says.

In the future, the researcher would like to include variation in the memory of individual receivers in these models. "There may be effects of imperfect memory that influence signaling effectiveness and I think

this would be a good next step."

The study titled "The relative effectiveness of signaling systems: Relying on external items reduces signaling accuracy while leks increase accuracy" was supported with a grant from the National Science Foundation and is published in the journal *PLOS ONE*.

More information: "The relative effectiveness of signaling systems: Relying on external items reduces signaling accuracy while leks increase accuracy" , www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0091725

Provided by University of Miami