

Biologists consider unifying framework to explain evolutionary puzzles

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Birds are commonly thought of as being the paragon of monogamous fidelity, staying true to their mate for life. Yet, in most bird species, some nests contain offspring of individuals other than the one's tending the nest.

Why would a bird invest in another bird's offspring when genetically such parenting would seem to provide no [evolutionary advantage](#)? Many scientists are trying to understand how evolution leads to this phenomenon called "extra-pair parentage."

Erol Akçay, a postdoctoral fellow at Stanford University, is one such scientist who has examined the function of extra-pair parentage. His research has drawn some surprising conclusions, including the idea that extra-pair parentage might result from reproductive "agreements" and transactions between breeding individuals, instead of being the result of males and females "cheating" on each other.

Akçay is part of a group of leading theoretical biologists, ecologists, and mathematicians who will gather at the National Institute for Mathematical and Biological Synthesis (NIMBioS) at the University of Tennessee, Knoxville, June 10-12, to develop a new unified framework for [evolutionary biology](#) - one that accounts for phenomena like the cooperative behavior exemplified by extra-pair parentage.

The group's goal is to integrate the dynamics of how biological systems function and how these functional dynamics evolve. Functional

dynamics refers to the processes that make an organism work, such as the physiological processes of the body, the hormones and cells, and the behavior of individuals. Evolution looks at how organisms change over time. "These two approaches actually complement each other and need to be looked at together," Akçay said.

Using bird behavior as an example of functional dynamics, Akçay said, male and female [birds](#) care for their offspring, defend against predators, and bring food to the nest. "But should what the birds are doing be viewed as cooperation or competition?" he asks. "In other words, to assure the survival of their offspring, are the birds working together or separately as individuals?"

From an evolutionary perspective, if the birds are working as a team, Akçay continues, how does their teamwork evolve over time? If they're working as individuals against each other, how does each bird play against the other to make the other do more work?

Akçay's research has been conducted under the guidance of Stanford University professor Joan Roughgarden, who, along with Akçay, is co-organizing the Function and Evolution Working Group at NIMBioS. One of the world's most influential theoretical ecologists, Roughgarden is the author of two books that challenge the Darwinian theory of sexual selection, which says that competition for mates and choice for genetic benefits drives the evolution of certain traits. Roughgarden's new "social selection" theory argues, however, that cooperative processes of breeding, rather than competition and conflict, drive the evolution of reproductive behavior. Akçay and Roughgarden have developed mathematical models that use cooperative game theory to test their hypotheses.

The NIMBioS working group, "Integrating Functional and Evolutionary Dynamics at Multiple Scales," aims to introduce new mathematical

methods to biology. "The hope is that by doing this work, we will give applied researchers an easier way to utilize evolutionary theory in their work, and ultimately, it will give us a better understanding of how living things evolve," Akçay said.

Source: University of Tennessee at Knoxville

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