Workshop Report

Evolutionary Games: Mathematical Theory and Biological Insights

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From May 11-16, 2026, we hosted the workshop *Evolutionary Games: Mathematical Theory and Biological Insights* at NITMB in Chicago. The purpose of this workshop was to gather together researchers in evolutionary game theory (EGT) from different parts of the globe and discuss the status of the field, current topics of interest, and the most pressing questions going forward.

By way of background, evolutionary game theory is a modeling framework for analyzing frequency-dependent interactions in biological, social, and artificial systems. Originally adapted from economic models and applied to animal behavior, EGT has become a foundational tool for studying phenomena ranging from microbial competition and tumor progression to cultural dynamics and cooperative AI. The field's mathematical foundations have expanded over the years, incorporating tools from dynamical systems, probability theory, partial differential equations, and network science. This diverse modeling toolkit has enabled researchers to examine how social behaviors evolve in structured populations, how empirical data can inform game parameters, and how environmental feedback shapes evolutionary dynamics. (Note that this paragraph was also part of the description of the workshop in the online advertisement, which was meant to give a broad description of the field.)

The workshop included 34 talks, each 20 minutes long. The talks were deliberately not split into themes to avoid losing audience interest in case a theme was not of particular interest to some of the participants. Something that worked well was the division of talks into blocks of 4-5 speakers, followed by an hour-long Q&A session at the end. We allowed one question after each talk, during speaker transitions, but otherwise asked participants to hold their questions for the Q&A. We briefly reminded the audience of the topic of each talk at the top of the Q&A, and one of the four organizers moderated it. They all resulted in healthy discussions that spilled over into subsequent breaks and meals. This format allowed the workshop to stay on schedule, even when some speakers went over time (which is inevitable in at least a few of them). In those cases, we cut short the "formal" Q&A session at the scheduled time and asked the audience to bring additional questions to the speakers during free time later. We were happy with how this went and feel that it generated a lot of productive discussions.

On Wednesday, we had a variety of students/postdocs give both talks and posters. While some of the students opted to give 20 minute talks, others presented a poster in the late afternoon, which overlapped with the evening banquet. Each of the seven poster presenters gave a 2-minute flash talk prior to the poster session as an advertisement for their poster. This was also a way for students to formally introduce themselves to the rest of the group.

One of the ongoing activities arising from the workshop is a special feature in *Population Biology Modeling & Theory* from the Stanford University Press (https://pbmt.journals.sup.org/index.php/pbmt/announcement/view/13). We proposed a special

feature to this journal prior to the workshop to collect work arising from and/or related to the themes of the workshop. It was approved in advance, and we had sessions on Thursday and Friday discussing themes and goals. Our group discussion resulted in the following broad themes as starter topics for papers in the special issue:

- Highlighting EGT as a broad, flexible framework for complex biological and social systems.
- Models with continuum limits of strategies/alleles, with connections to quantitative genetics and adaptive dynamics.
- How selection is mediated through population structure and levels of biological organization.
- Connections to algorithmic game theory, including more complex forms of cooperation.
- Connecting EGT to data (measuring payoff matrices and matching qualitative behavior).
- Assumptions in EGT models about the role of timescales, mutation rates, selection strength, and migration rates and how they matter when applying EGT to real systems.
- Role of population size and assumptions about extinction, especially as they relate to quasi-stationary behavior. How do these assumptions translate into ODE and PDE limits?

The special issue already has commitments for papers in preparation from five sets of authors. And at least two other sets of participants are planning a more focused, small working-group proposal for NITMB.

One notable feature of the talks and discussions in the workshop were connections formed between researchers that like to explore similar biological problems using different mathematical frameworks. One such area of overlap at this workshop was the modeling of spatial evolutionary dynamics and evolutionary competition across levels of organization, which have often been studied separately by applied mathematicians and physicists using either deterministic approaches like PDEs and dynamical systems models or by using stochastic modeling frameworks like interacting particle systems and nested birth-death models. In the case of modeling multilevel selection, discussion at the workshop has led to ideas for collaboration on the rigorous derivation of continuum models from individual-based stochastic models. These discussions have already led to preliminary results on scaling limits of stochastic models of evolutionary dynamics and have generated ideas for future work and a proposal for an NITMB focused research group.

Overall, we believe this workshop was a great success and—to the best of our knowledge—it was the first organized gathering in evolutionary game theory of this size in around 15 years (with the last one being held at Banff). Apart from the special issue and research that will come out of the workshop, it generated a lot of conversations about having gatherings like this more often, and we are extremely grateful to NITMB for the opportunity to host it in 2026.