DY 15: Evolutionary Game Theory (joint session BP/DY/SOE)

Time: Tuesday 15:00–16:00 Location: H37

DY 15.1 Tue 15:00 H37

How selection pressure changes the nature of social dilemmas in structured populations — •Flavio Pinheiro[1,2], Francisco Santos[1,3], and Jorge Pacheco[1,4] — [1]ATP-Group CMAF at Universidade de Lisboa, Lisbon, Portugal — [2]Centro de Física at Universidade do Minho, Braga, Portugal — [3]Departamento de Engenharia Informática & INESC-ID, IST-UTL, Lisboa Portugal — [4]Departamento de Matemática e Aplicações at Universidade do Minho, Braga, Portugal

When members of a population engage in dyadic interactions reflecting a prisoner's dilemma game, the evolutionary dynamics depends crucially on the population structure, described by means of graphs and networks. Here, we investigate how selection pressure contributes to change the fate of the population. We find that homogeneous networks, in which individuals share a similar number of neighbors, are very sensitive to selection pressure, whereas strongly heterogeneous networks are more resilient to natural selection, dictating an overall robust evolutionary dynamics of coordination. Between these extremes, a whole plethora of behaviors is predicted, showing how selection pressure can change the nature of dilemmas populations effectively face. We further show how the present results for homogeneous networks bridge the existing gap between analytic predictions obtained in the framework of the pair-approximation from very weak selection and simulation results obtained from strong selection.

DY 15.2 Tue 15:15 H37

How 'first carrot, then stick' incentives promote cooperation — •Tatsuya Sasaki[1,2], Xiaojie Chen[1], Åke Brännström[3,1], and Ulf Dieckmann[1] — [1]International Institute for Applied Systems Analysis, Laxenburg, Austria — [2]University of Vienna, Vienna, Austria — [3]University of Umeå, Umeå, Sweden

Social institutions often use rewards and penalties to promote cooperation. As providing such incentives tends to be costly, it is important to find efficient strategies for gauging positive and negative incentives as a situation demands. Most game-theoretical studies of cooperation have, however, modeled rewarding and punishing in isolation and by focusing on peer sanctioning, through which each player separately decides whether or not to sanction a co-player.

Here, we study how a sanctioning policy we call 'first carrot, then stick' affects the evolution of cooperation in public good games. Assuming the existence of institutions that can provide incentives on a limited budget, we examine an adaptive sanctioning policy that switches the incentive from rewarding to punishing when defectors decrease below a certain frequency. We find that in well-mixed populations this policy is more efficient in promoting and maintaining full cooperation than either rewards or penalties alone. We also demonstrate that this finding extends to spatially structured populations. Such an institutional hybrid incentive with adaptive feedback is a simple yet unifying solution for encouraging cooperative behaviors.

DY 15.3 Tue 15:30 H37

Learning, Evolution and Population Dynamics — Juergen Jost and •Wei Li — MPI for Math. in the Sci.

We study an iterated game, in which players from opposite populations are randomly paired, for the investigation of the interplay between individual optimization and population effects and for the comparison of different strategies and learning schemes. Players can rely on the information from previous encounters. A population adapts by selection, and/or the members of the population could learn individually, e.g., by reinforcement learning, or socially, via imitation.

The situation each player faces is changing, as coevolution exerts a high pressure on any learning strategy. Thus, the game between the populations is about quickly finding and converging to a favorable equilibrium. Within the population, the contest is about getting higher pay-offs.

The first aspect favors simple evolutionary schemes or learning strategies over more complex ones. The second aspect relates to the most effective use of the information from previous rounds or available within some social network inside the population.

We find an improved reinforcement learning that outperforms most evolutionary strategies, as well as the standard reinforcement learning with optimal parameters. The best imitating strategy here is payoff-biased. Imitating behavior can spread within a mixed population who can defeat a pure population with solely individual learners, independently of the precise learning scheme employed.

DY 15.4 Tue 15:45 H37

Banish or vanish? The evolution of cooperation by social exclusion — •Tatsuya Sasaki[1,2] and Satoshi Uchida[3] — [1]International Institute for Applied Systems Analysis, Laxenburg, Austria — [2]University of Vienna, Vienna, Austria — [3]Rinri Institute, Tokyo, Japan

Fines and exclusion are ubiquitous, yet very different ways of punishing freeriders. In the former, punishers are allowed to fine freeriders at a cost to themselves. It is clearly difficult for only fines to promote cooperation due to this punisher's cost. Less clear is the latter, in which punishers are allowed to exclude freeriders from the common good at a cost to themselves. When does exclusion solve the commons dilemma?

We investigate the replicator dynamics in standard public good games with costly exclusion. Costly exclusion reduces the group size, but not necessarily the group benefit, and thus, the punisher's net payoff may increase through excluding freeriders. We demonstrate how exclusion of freeriders can establish a coercion-based regime. Our results do not require a genetic relationship, repeated interaction, reputation, or group selection. Instead, only a limited number of freeriders are required to prevent the second-order freeriders from eroding the social immune system.