SOE 18: Evolutionary Game Theory and Economic Models (joint with BP and DY)

Time: Thursday 11:00–12:15 Location: GÖR 226

SOE 18.1 Thu 11:00 GÖR 226

Learning dynamics explains human behavior in Prisoner's Dilemma on networks — •Giulio Cimini[1] and Angel Sanchez[1,2] — [1]Grupo Interdisciplinar de Sistemas Complejos (GISC), Universidad Carlos III de Madrid, 28911 Leganés, Madrid, Spain — [2]Instituto de Biocomputación y Física de Sistemas Complejos (BIFI), Universidad de Zaragoza, 50018 Zaragoza, Spain

Cooperative behavior lies at the very basis of human societies, yet its evolutionary origin remains a key unsolved puzzle. Whereas reciprocity or conditional cooperation is one of the most prominent mechanisms proposed to explain the emergence of cooperation in social dilemmas, recent experimental findings on networked Prisoner's Dilemma games suggest that conditional cooperation also depends on the previous action of the player—namely on the 'mood' in which the player currently is. Roughly, a majority of people behave as conditional cooperators if they cooperated in the past, while they ignore the context and free-ride with high probability if they did not. However, the ultimate origin of this behavior represents a conundrum itself. Here we aim specifically at providing an evolutionary explanation of moody conditional cooperation. To this end, we perform an extensive analysis of different evolutionary dynamics for players' behavioral traits—ranging from standard processes used in game theory based on payoff comparison to others that include non-economic or social factors. Our results show that only a dynamic built upon reinforcement learning is able to give rise to evolutionarily stable moody conditional cooperation, and at the end to reproduce the human behaviors observed in the experiments.

SOE 18.2 Thu 11:15 GÖR 226

Human coordination in the presence of local and global information: A laboratory experiment — •Alberto Antonioni[1,2], Marco Tomassini[1], and Angel Sánchez[2] — [1]University of Lausanne, Switzerland — [2]Universidad Carlos III de Madrid, Spain

Pure coordination games arise in many situations that affect the functioning of society. In fact, many frequent social and economic activities require individuals to coordinate their actions on a common goal since in many cases the best course of action is to conform to the standard behavior. In particular, social coordination can be studied through coordination games between individuals located in space. Here we study the behavior of humans in the laboratory when they play a pure coordination game in a setting in which subjects are situated in a virtual two-dimensional grid space and can move around. We compare a local information setting situation to one in which global information is available. In the local information treatment subjects can see only the eight cells that are their spatial neighbors in the grid and they can decide if they want to move and/or pay a cost to switch to the other strategy type. In the global treatment subjects are in the same condition as before but they possess also the global information about the current fraction of strategies in the population. We observe that in the local information treatment people tend to converge to two separated monomorphic clusters each playing a different strategy. In contrast, in the global setting this can lead to full predominance of one strategy when strategy fluctuations reach a threshold such that imitation of the majority sets in.

SOE 18.3 Thu 11:30 GÖR 226

Differential value of information in non-cooperative games — Nils Bertschinger[1], David H. Wolpert[2], •Eckehard Olbrich[1], and Jürgen Jost[1,2] — [1]Max Planck Institut für Mathematik in den Naturwissenschaften, Leipzig — [2]Santa Fe Institute, NM, USA

We study how players value changes in the information structure of non-cooperative games with imperfect information.

We use the functionals central to Shannon's information theory to quantify amounts of information study how changes in the values of those functionals are related to changes in the expected utility of the players. Our approach is based on the Multi-Agent Influence Diagram representation of games, and is based on a generalization of the concept of marginal utility in decision scenarios to apply to infinitesimal changes of the channel parameters in non-cooperative games. Using that framework we derive general conditions for the possibility of a negative value of information, and show that generically, these conditions hold in all games unless one imposes a priori constraints on the allowed changes to information channels. In other words, in any game in which a player values some aspect of the game's specification beyond the information provided in that game, there will be an infinitesimal change to the parameter vector specifying the game that increases the information but hurts the player.

We demonstrate these results numerically for a leader-follower game and discuss their general implications.

SOE 18.4 Thu 11:45 GÖR 226

Stability of Zero-Sum Games in Evolutionary Game Theory — •Johannes Knebel, Torben Krüger, Markus F. Weber, and Erwin Frey — Ludwigs-Maximilians-Universität, München, Deutschland

Evolutionary game theory has evolved into a successful theoretical concept to study mechanisms that govern the evolution of ecological communities. On a mathematical level, this theory was formalized in the framework of the celebrated replicator equations (REs) and its stochastic generalizations.

In our work, we analyze the long-time behavior of the REs for zero-sum games with arbitrarily many strategies, which are generalized versions of the children's game Rock-Paper-Scissors (1). We demonstrate how to determine the strategies that survive and those that become extinct in the long run. Our results show that extinction of strategies is exponentially fast in generic setups, and that conditions for the survival can be formulated in terms of the Pfaffian of the REs' antisymmetric payoff matrix. Consequences for the stochastic dynamics, which arise in finite populations, are reflected by a generalized scaling law for the extinction time in the vicinity of critical reaction rates.

Our findings underline the relevance of zero-sum games as a reference for the analysis of other models in evolutionary game theory.

(1) J. Knebel, T. Krüger, M.F. Weber, E. Frey, Phys. Rev. Lett. 110, 168106 (2013)

SOE 18.5 Thu 12:00 GÖR 226

Opportunistic strategies and the emergence of responsible punishment — •Arne Traulsen — Max-Planck-Institute for Evolutionary Biology, Evolutionary Theory Group, Plön, Germany

One way to promote cooperation among selfish actors is to allow for the opportunity to punish those peers who do not cooperate. However, the vast majority of models and behavioral experiments considers situations in which actors cannot assess whether it is likely that they will be punished. If this information is available, opportunistic strategies that act according to this information become possible and lead to the emergence of responsible punishment targeted at non-cooperators only, without the problems of antisocial punishment, second order free-riding or spite. Also for institutional, so called pool punishment, such opportunistic strategies are successful, which implies that the presence of punishment institutions should be made public.