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Preface: DGAA Focused Issue on Dynamic Games and Social Networks

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The network of social relations among individuals has deep effects on many economic and social processes. It is evident that acquaintances bear an important factor in conveying opportunities and information. This has already been formally recognized by sociologists in the seminal paper of Granovetter [6], who analyzes the contacts that influence the job market. However, it has been incorporated into game theoretical modelling only in the recent past, because of the technical difficulties of including graph theory in a framework of full rationality, as indicated already by some attempts as Myerson [10]. Since the 1990s there has been an increased interest, from many disciplines, in the study of *complex networks*, and this has led to a new branch of research in game theory, that has been steadily increasing since then.

Formally, there are different ways in which the network topology can play a role in a game, either in the actions, because for example the network itself results from the strategy profiles, or through payoffs, because for example the network imposes limitations on the externalities between players.

The first works in this area applied a combination of solution concepts from cooperative and non-cooperative game theory to formal models of network formation. This stream of literature began with the seminal work of Jackson and Wolinsky [8], soon after being enriched with the adoption of dynamic approaches [7].

The study of explicit games played on endogenously fixed networks was developed some years later. First definitions are given by computer scientists in Kearns et al. [9], while Bala and Goyal [1] is among the first papers that apply equilibrium refinements based on stochastically perturbed dynamical processes. A comprehensive discussion of stochastic stability and its applications to the evolution of social structures can be found in Young [13].

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Since then, hundreds of papers applying game theory to networks have been published and these numbers are monotonically increasing. Some of them combine the two approaches discussed above, adding complex dynamical approaches borrowed from statistical physics, as for example Fosco et al. [5] started doing. Moreover, now many of these models have very specific applications, with a wide spectrum of economic and social phenomena analyzed, from international relations, to industrial organization, to friendships between adolescents.

This focused issue contains original articles that apply dynamical solution concepts to game theoretical network models. All of them fall in some of the categories mentioned above.

Bolletta and Merlino [2] study a marriage market in which marriage opportunities arrive either directly or are passed on by friends. They find that, when individuals can choose how much to invest in socialization, meetings through friends are first increasing and then decreasing in the arrival rate of direct offers. Such model helps in rationalizing the negative correlation between the advent of online dating and the decrease in marriages through friends observed in the USA over the past decades.

Delphini and Russu [4] analyze defensive medicine combining game theory and network analysis. Links in the network represent healing relationships between a physician and a patient. Physicians can choose between providing the optimal treatment or an inferior one, which is interpreted as practicing defensive medicine, while patients can choose whether to litigate or not if an adverse event occurs. They analyze different scenarios—varying cost of litigiousness, amount of compensations to damaged patients, and probability for virtuous physicians to be condemned to compensate a damaged patient—and find evidence that convergence to a virtuous steady state is not guaranteed.

Righi and Takács [11] study an evolutionary model of the Prisoner's Dilemma and find that third-party communication (gossip) allows for indirect reciprocity to emerge sustaining cooperation, but only under specific conditions. In particular, they show the important role played by perspective taking: a perspective taking reputational strategy can propagate and establish cooperation in the population independent of gossip frequency and population size, under various selection mechanisms of communication partners and targets, and assumptions concerning agents' memory.

Boncinelli et al. [3] are motivated by data on co-authorships in scientific publications and analyze a team formation process that generalizes matching models and network formation models, allowing for overlapping teams of heterogeneous size. They apply different notions of stability: myopic team-wise stability, which extends the concept of pair-wise stability to their setup, coalitional stability, where agents are perfectly rational and able to coordinate, and stochastic stability, where agents are myopic and errors occur with vanishing probability. The authors find that, in many cases, coalitional stability in no way refines myopic team-wise stability, while stochastically stable states are feasible states that maximize the overall number of activities performed by teams.

Sun and Parilina [12] consider a model of network formation where the players/nodes are exogenously divided in groups. They analyze different functional forms for the benefit from being connected and for the cost of connecting. They study under which conditions specific network structure forms and are stable, and under which conditions we observe in equilibrium segregation or integration of the different groups. In particular, they find the circumstances for which a player may prefer linking with players in other groups with a higher average link cost and reject linking with players in her own group.

We conclude by thanking Georges Zaccour, Editor–in–Chief of Dynamic Games and Applications, for his support and help. He had the idea of this focused issue, which we hope will contribute to a further diffusion of a dynamical approach to network games.

References

1. Bala V, Goyal S (2001) Conformism and diversity under social learning. Econ Theor 17:101–120
2. Bolletta U, Merlino LP (2022): Marriage through friends, dynamic games and applications. this issue
3. Boncinelli L, Muscillo A, Pin P (2022) Efficiency and stability in a process of teams formation, dynamic games and applications. this issue
4. Delphini D, Russu P (2022) The effects of defensive medicine in physician–patient dynamics: an agent-based approach, dynamic games and applications. this issue
5. Fosco C, Vega-Redondo F, Marsili M (2010) Peer effects and peer avoidance: the diffusion of behavior in coevolving networks. J Eur Econ Assoc 8:169–202
6. Granovetter MS (1973) The strength of weak ties. Am J Sociol 78:1360–1380
7. Jackson MO, Watts A (2002) The evolution of social and economic networks. J Econ Theory 106:265–295
8. Jackson MO, Wolinsky A (1996) A strategic model of social and economic networks. J Econ Theory 71:44–74
9. Kearns M, Littman ML, Singh S (2001) Graphical models for game theory. In: Proceedings of the seventeenth conference on uncertainty in artificial intelligence, pp 253–260
10. Myerson RB (1977) Graphs and cooperation in games. Math Oper Res 2:225–229
11. Righi S, Takács K (2022) Gossip: perspective taking to establish cooperation, dynamic games and applications, this issue
12. Sun P, Parilina E (2022) Impact of utilities on the structures of stable networks with ordered group partitioning, dynamic games and applications, this issue
13. Young HP (1998) Individual strategy and social structure, in Individual Strategy and Social Structure. Princeton University Press, Princeton