On the emergence of cooperation under vigilance in networked societies

María Pereda
Universidad Carlos III de Madrid. Mathematics Department. GISC. Email: mpereda@math.uc3m.es

Abstract

Understanding the evolution of cooperation is one of the most fascinating challenges in many disciplines ranging from biology to economics. There is a large amount of literature describing the mechanisms for cooperation in humans to emerge and to be sustained: direct reciprocity, indirect reciprocity, spatial selection, group selection, and kin selection; and how these promoters of cooperation play a role under different scenarios: network settings or spatial distributions. Nevertheless, recent experimental results with humans showed that structuring a population is not enough to obtain cooperative outcomes. Another way to understand the evolution of cooperation in human societies consist in deciphering the cooperative behavior in ancient communities from historical records. In a previous work we studied cooperation in the Yamana society that inhabited the Beagle Channel in Argentina, with respect to sharing beached whales (a scarce, unpredictable and valuable resource). In that work the authors observed that the emergence of an informal network of vigilance promoted cooperation.

Historically, ancient societies have exploited the power that images of watchful eyes have on people. We have examples in totem monuments decorated with eyes to enhance charitable behaviors in tribes; in different religions using this power promote honesty, which is coherent with the *Supernatural Monitoring Hypothesis*, which states that the perception of being watched promotes pro-social behavior.

The essential idea is that being watched can play an important role in promoting pro-social cooperative behavior. Several field studies have found evidence of humans exposing a pro-social behavior when being observed by others (recently confirmed in a field experiment 2,000 individuals) and also under the presence of subtle cues of being watched. The observability effect (the increase of cooperation under vigilance) seems to be driven by our reputational concerns, bringing the indirect reciprocity mechanism into play.

This work explores the effect of vigilance on the cooperation in networked systems, in the framework of the Prisoners' Dilemma game. We study the bidirectionally-coupled vigilance and game dynamics. We quantify the impact of the topological structure of the network, and the interplay between vigilance and behavior, on the outcome of cooperation. Moreover, we study the impact of vigilance on cooperation when the individuals have to afford a cost to become vigilant actors. We also analyze the influence of network multiplexity, i.e. the interconnection of different topological structures for the vigilance and the game networks, and the impact of correlated multiplexity, i.e. when node degrees of the multiplex layers are not randomly distributed but correlated.

Our results show that vigilant actors can significantly affect the levels of cooperation, not only by enhancing cooperation in regions of the phase diagram where cooperation is expected to hold, but also by altering the critical point for the emergence of cooperation.