Seeking the roots of collective cooperation

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No one enjoys paying taxes. Even so, we need taxes if we want our streets clean, a proper public health care system, an educated population or the maintenance of Earth's climate within habitable boundaries. This is what scientists commonly refer as public goods — benefits that everyone receives whether or not they contribute to them.

The missing link between paying and benefiting from a public good creates an obvious dilemma and temptation to cheat (not to cooperate): Why shouldn't I let the others pay for it?

A similar situation comes into play whenever the same resource is to be commonly explored by many – in which the so-called tragedy of commons is the ultimate outcome of selfish, non-cooperative behavior. Thus, coming to an understanding of the social mechanisms which are able to maintain and promote cooperation, remains of central importance in areas such as Biology, Ecology, Economics, Sociology, Political Science, Psychology, etc.

In general, Humans tend cooperate in many public goods dilemmas ranging from family issues to global warming. Paradoxically, current theoretical studies based on (evolutionary) game theory invariably predict, and economic experiments corroborate, that the temptation to forego the public good mostly wins over collective cooperative action. However, up to now, individuals have been treated as equivalent in most respects, in sharp contrast with real life situations, where diversity is ubiquitous. In their recent article, published by the prestigious *Nature* journal, ULB and FNRS chargé de recherches Francisco C. Santos, in a

joint work with Marta D. Santos and Jorge M. Pacheco from the University of Lisbon, have shown how diversity provides an escape from the tragedy of the commons.

They introduce diversity via realistic social networks, graphs in which individuals occupy the vertices while the links define the group sizes and social structure of the population. This opens the possibility that the act of cooperation may depend on one's social context/ranking. They show that the diversity associated with the number and size of the public good dilemmas each individual participates and with the individual contribution to each public good promotes high levels of altruist behavior.

Moreover, as explicitly computed, besides introducing profound modifications in the evolutionary outcome of cooperation, diversity also plays an important role in what concerns the wealth distribution in populations, when one interprets their results in a more economically-oriented perspective. Their results suggest that cooperation blooms whenever the act of giving is more important than the amount given.

Obviously, real life lies somewhere within the extreme limits that Santos et al. use as caricatures of social systems. The authors provide a very simple description, which, however, is able to provide insights into the richness, beauty, variety and complexity of collective social interactions, ubiquitous especially among Humans.

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Marta D. Santos (b. 1986) is about to finish her graduation in Theoretical Physics at the University of Lisbon. This is her scientific debut, supported by an undergraduate research grant from the Portuguese Science Foundation and supervision of Jorge M. Pacheco.

Jorge M. Pacheco (b. 1958) is currently Associate Professor at the University of Lisbon. He is active in a variety of research topics, ranging from many-body physics to mathematical description of evolutionary processes such as human cancer, evolution of cooperation and complex networks.

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