How to create less selfish societies?

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(GPEARI, Portugal) -- Cooperation, despite being now considered the third force of evolution, just behind mutation and natural selection, is difficult to explain in the context of an evolutionary process based on competition between individuals and selfish behaviour. But this puzzle, that has haunted scientists for decades, is now a little closer to be solved by research about to be published in the journal *Physical Review Letters*.

The work, by scientists in Portugal and Belgium, reveals that an increasing range of behaviours among the individuals of a population leads to cooperation, supporting the idea that democracy - where individuals are free to act as they wish - is in fact the path for better societies. Jorge Pacheco one of the authors of the study says: "The results support the idea that behavioral differences, on a grand scale, are instrumental in shaping us as the most sophisticated cooperating machines on this planet what is particularly interesting as it contradicts some social and political dogmas - such as Maoism and Stalinism - which, sometimes with rather unfortunate outcomes, have tried to enforce reduced behavioral diversity, supposedly with an aim to improve society."

Richard Dawkins never gets tired of reminding us that evolution is based on the survival of the fittest and on selfishness. Every cell, every living thing is designed to promote its own survival, if necessary at the expense of everything else. Still, cooperation is very much alive, and more, is widespread, being found in a multitude of living beings from the cells of a multicellular organism to insects and of course humans - the “big cooperators”. Some examples are easy to understand, like those among family members, but those are not enough to explain how an apparently disadvantageous behaviour is, nevertheless, so common.

The key, it seems, lies on specific conditions in which cooperators become the individuals with highest fitness, allowing their expansion within the populations. Very few examples have been found so far, however, and the simple observation of biological processes does not seem to be able to provide many more answers. An alternative is to use mathematical models to look for those conditions that allow cooperators to thrive.

With this in mind S. Van Segbroeck, J.M. Pacheco and colleagues from the University of Lisbon, Portugal and the Vrije Universiteit Brussel and the Universite Libre de Bruxelles in Belgium developed an artificial society in which individuals engage in a mathematical game called the "prisoner's dilemma" (or PD). In PD individuals interact with the choice of cooperating or defecting (not cooperate) and while cooperators provide a benefit to their partners (and pay a cost for that) defectors, not only have no costs, but also rip the benefits given by the cooperators. In the basic version of PD defectors "win" and cooperators gradually disappear. But recently it has been found that adaptive social networks - like human populations where individuals change behaviour all the time making new acquaintances and breaking others, continuously shaping and reshaping the social network structure - supported cooperation. This led Pacheco and colleagues to ask if specific behavioural diversity within this dynamic world could be linked to cooperators emergence.

To answer that they adapted PD to take into account the adaptive social dynamics of human populations, while also introducing behavioural diversity to test if this last parameter affected the viability (and consequently the emergence) of cooperators. As an example of behaviour variability they analysed partner fidelity. In fact, when a social connection is established, it is rapidly evaluated and, if disadvantageous -

like when one of the partners is a defector - it is broken but while some discontented individuals try to break contact (defect) very rapidly, others take much longer and it is this “time taken to defect unwanted links” that Pacheco and colleagues used as an example of behaviour variability to look for cooperation emergence.

The group started by considering a situation where only two break-up velocities existed - fast and slow - with the population, as a result, being constituted by fast and slow defectors - respectively FD and SD - and fast and slow cooperators (FC and SC) all depending how long the individuals took to break unwanted ties (although the time of a connection depends on both partners). In this situation they found that most of the population turns into SD because these would be the ones with higher gains/higher fitness, as their interactions with cooperators would last longer In the same way, most of the few cooperators surviving will be FC since they are the ones, among cooperators, losing less, as they spend less time interacting with defectors. So in this example, again, the model predicts that defectors will be the ones predominant in the population.

Next, the researchers increased the number of possible defecting speeds to an almost continuum of values between fast and slow, and, to their surprise, many Cs are now capable of surviving and even thrive in the population. The reason for that resides in the fact that many more types of defectors, and not only SD, are able to survive, and those faster Ds will provide an escape hatch for cooperators, which, by interacting mostly with cooperators and preferentially with the faster defectors, now manage, not only to survive, but also to dominate in the population. So in this case cooperators thrive and “invade” the population.

Van Segbroeck, Pacheco and colleagues’ model reveals that populations in which individuals exhibit higher diversity when handling their social contacts end up being much more cooperative, than those where no such diversity exists. This is particularly interesting if we consider that individuals always behave according to their own narrow-minded preferences and still, despite of this, cooperation blooms.

There are several interesting aspects to this work, and not the least because it helps to understand better the emergence of cooperation, a crucial force for better human societies. But like Pacheco says: “The results are even more exciting, if we take into account that diversity in individual behavior is on the basis of this result. Hence, we expect that societies in which individuals are free to express their inherent differences will be more cooperative than those in which individuals are constrained to exhibit very similar behavior. Of course, to extrapolate from such a simple model into complex Human Societies is both unreasonable and inescapable. In this respect, we may contrast democracies with dictatorships, religious freedom with religious indoctrination, and so on.”

Another important aspect of the research is the flexibility of the model developed by the team of researchers that can now be used to answer other questions like Pacheco explains: a great example is epidemics. There the dynamical process between individuals is the contagion due to a biological virus, and the model allows now to determine how the evolution of the number of infected individuals in the community affects and is affected by the dynamical network that supports the individuals.

More information: *Physical Review Letters*, 06 February 2009 online Early Edition, “Reacting differently to adverse ties promotes cooperation in social networks”

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