Emergence of collaboration in the Iterated Prisoner's Dilemma

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The prisoner dilemma is a well-known formalism used to represent situations where the benefits of cooperation for the group as a whole comes in opposition to the individual gain from selfish decisions.

While in its canonical form the iterated prisoner dilemma (IPD) only permits collaboration or defection, later refinement also permits an individual to punish his opponent for a given fee. In this presentation, we briefly present of computational model of this formalism, and show that this costly punishment does not efficiently promote collaboration and can not be directly responsible for its emergence. We also introduce a model for centralised punishment, which significantly outperforms its individual-based predecessor.

To study instances where the emergence of collaboration can not be explained by a centralised approach, we present another model investigating the Prisoner's Dilemma from a population perspective. A population of *players* is initialised and, at each iteration, they are paired for an IPD and the gains (resp. losses) are added to (resp. deduced from) their fitness level. To take aging into account, a fixed amount of fitness is deducted after each iteration.

If the fitness level of a given player reaches zero, he is eliminated from future iterations. If, on the other hand, it goes over a specified threshold, the player is *cloned*, and his behaviour therefore becomes more prevalent in the population.

A probability function is added so that a crisis may occur between any two iterations of the model. A crisis is implemented as the payment of a fee (significantly higher than the normal aging process), which may bring the player fitness below zero.

Using this approach, it is possible to investigate the influence of population dynamics and external crises (e.g. environmental) on the emergence of probability. Using a network representation of the population, it is also possible to track their influence on specific subgroups.