

Effects of population structures on the evolution of cooperation

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Understanding the emergence of cooperation is a fundamental problem in evolutionary biology. To investigate this problem, evolutionary game theory has become a powerful framework. Two simple games have attracted most attention in theoretical and experimental studies: the Prisoner's Dilemma and the Snowdrift game (also known as the Hawk-Dove or Chicken game). In the Prisoner's Dilemma, the non-cooperative state is evolutionarily stable, which has inspired numerous investigations of suitable extensions that allow for cooperative behaviour to persist. In particular, based on spatial extensions of the Prisoner's Dilemma, it is widely accepted that spatial structure promotes the evolution of cooperation. This talk demonstrates that no such general predictions can be made for the effects of spatial structure in the Snowdrift game. In unstructured Snowdrift games, intermediate levels of cooperation persist. However, quite surprisingly, spatial structure reduces the proportion of cooperators for a wide range of parameters. In particular, spatial structure eliminates cooperation if the cost-to-benefit ratio of cooperation is high. In summary, these results caution against the common belief that spatial structure is necessarily beneficial for cooperative behaviour.