When does stochastic learning in game theory fixate?

John Realpe-Gomez

We study a complementarity game as a systematic tool for the investigation of the interplay between individual optimization and population effects and for the comparison of different strategy and learning schemes. The game randomly pairs players from opposite populations. It is symmetric at the individual level, but has many equilibria that are more or less favorable to the members of the two populations. Which of these equilibria is then attained is decided by the dynamics at the population level. Players play repeatedly, but in each round with a new opponent. They can learn from their previous encounters and translate this into their actions in the present round on the basis of strategic schemes. The schemes can be quite simple, or very elaborate. We can then break the symmetry in the game and give the members of the two populations access to different strategy spaces. Typically, simpler strategy types have an advantage because they tend to go more quickly toward a favorable equilibrium which, once reached, the other population is forced to accept. Also, populations with bolder individuals that may not fare so well at the level of individual performance may obtain an advantage toward ones with more timid players. By checking the effects of parameters such as the generation length or the mutation rate, we are able to compare the relative contributions of individual learning and evolutionary adaptations.

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John Realpe-Gomez, Bartosz Szczesny, Luca Dall'Asta, and Tobias Galla

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How small are small mutation rates?

Bin Wu, Altrock, Wang, and Traulsen

In recent years numerous analytical advances have been made in the field of evolutionary game theory. Some of them consider processes in which strategies can mutate between each other. Often the assumption of small mutation rates is made to keep the analysis tractable [1,2,3]. For small mutation rates the population is monomorphic most of the time. Occasionally a mutation arises. It can either reach fixation or go extinct. The evolutionary dynamics of the process under small mutation rates can be approximated by an embedded Markov chain on the pure states. Previously it was shown that in the limit of mutation rates going to zero the embedded Markov chain is a good approximation [4].

Here we derive an upper limit until where the approximation holds good. For a coexistence game it is necessary that the mutation rate \( \mu \) is less than \( N^{-1/2} \exp[-N] \) and for all other games, it is sufficient if the mutation rate is smaller than \( (N \ln N)^{-1} \). Our results hold for a wide class of imitation processes under arbitrary selection intensity.

References: