加权条件策略公共物品博弈

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- 演化博弈
- 条件策略
- 加权条件策略博弈

Public goods games

模型

- 两种类型
  - 合作者 -对公共基金贡献c
  - 背叛者 -不贡献

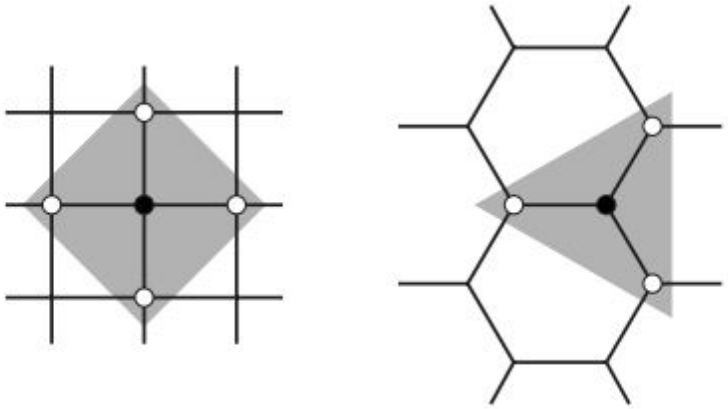
- groups of size: g
- 总的贡献被放大r倍并平分给每个参与者（无论贡献与否）

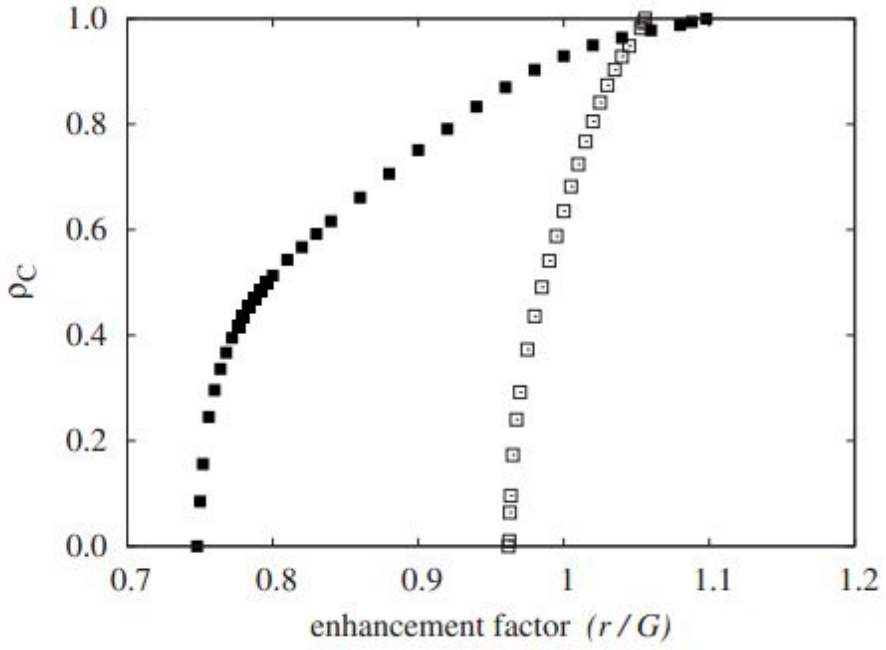
$$P_c = \left(\frac{rn_c}{N} - 1\right)c$$

$$P_d = \frac{rn_c}{N}c.$$

- g<r，背叛占优

spatial structure





- larger groups indeed lower the enhance-ment factor that is needed to sustain cooperation

spatial structure

- Spatial structure supports cooperators in public goods games.
- ↳ Cluster formation reduces exploitation and enables cooperators to survive.

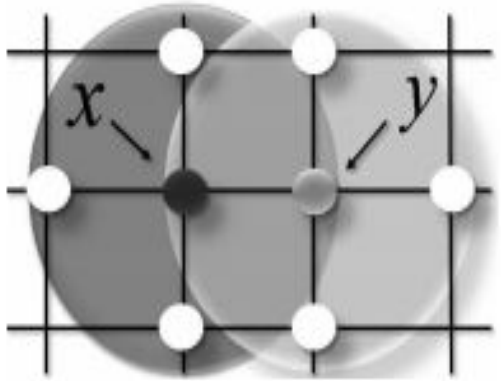
Conditional strategy

- humans or animals, will likely behave differently under different circumstances
- Conditional cooperators will contribute to the common pool only if there is a sufficiently high number of other conditional cooperators in the group

Conditional strategy

- each player x is designated either as a conditional cooperator with strtegy C_i(i=0,1,2,3,4),
- or a defector(Sx =D, or Sx =C_5)

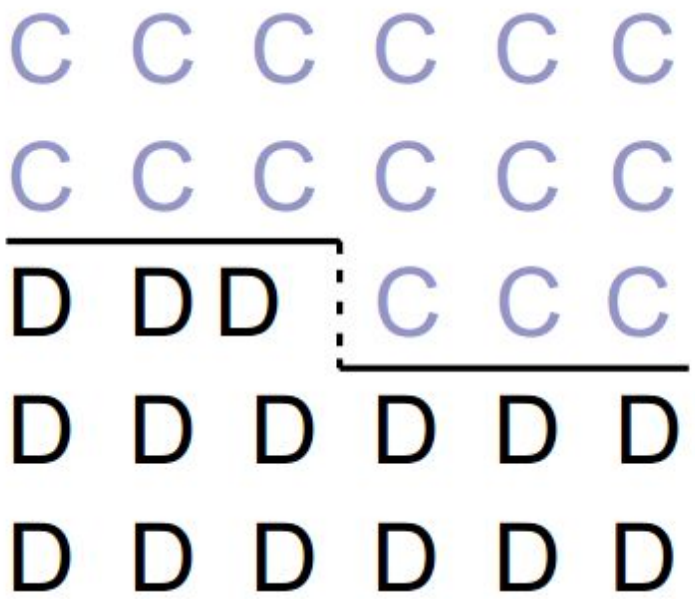
- conditional cooperator with
- strategy Ci will invest a fixed
- amount (without loss of
- generality,tobeequalto1)to the group
- only if there are at least i other players
- in the group who are also cooperators



Conditional strategy

- critical synergy factor

$$\frac{r}{G}\sum_{i=j+1}^{G-1} i = \frac{r}{G}\sum_{i=j+1}^{G} i - (G-j).$$

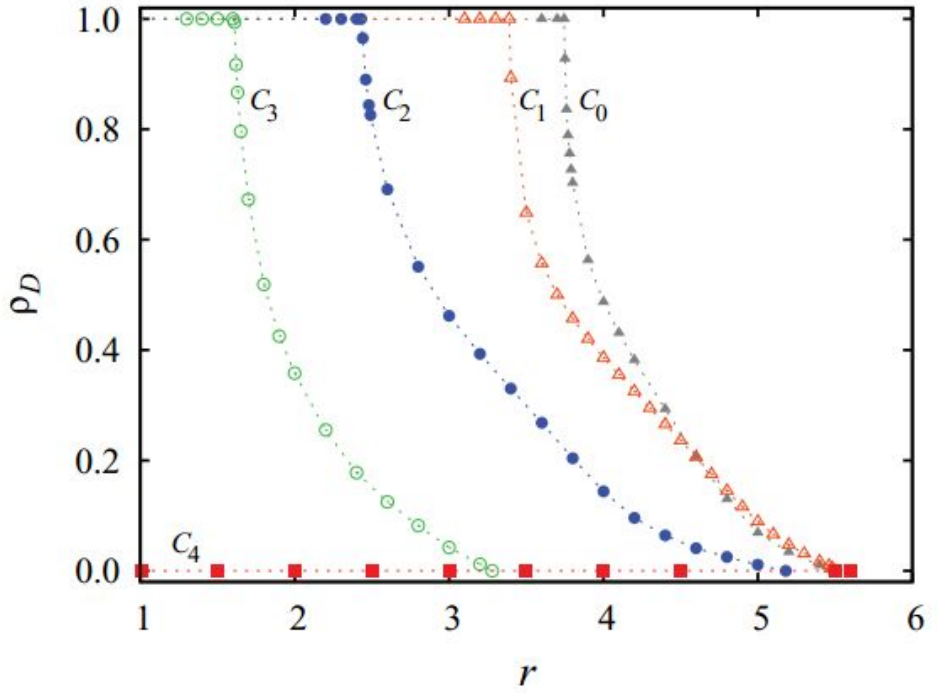


- $r_c^j = G - j$

G: group size

Conditional strategy

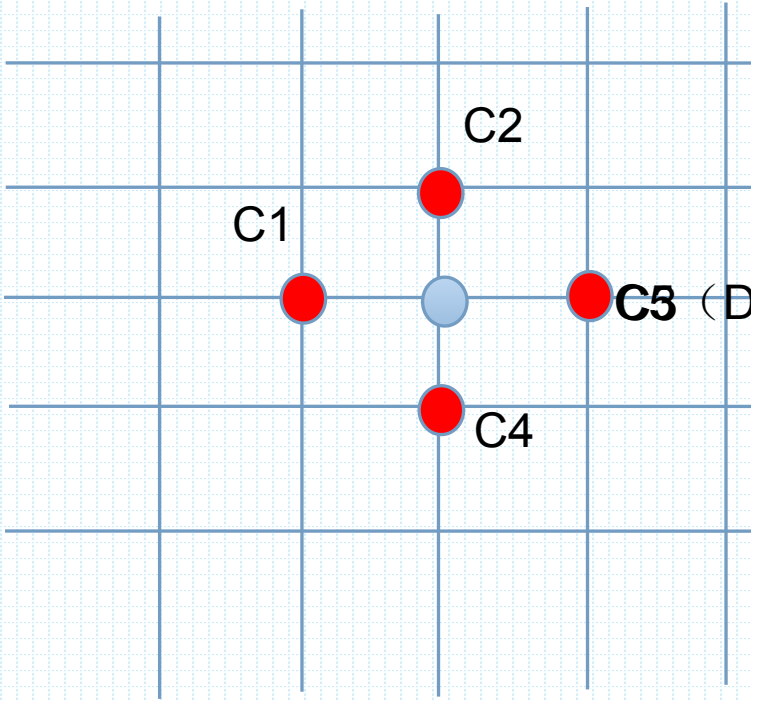
- 不同策略组合
- 背叛者比例随放大倍数关系



Weighted conditional strategy

Consideration

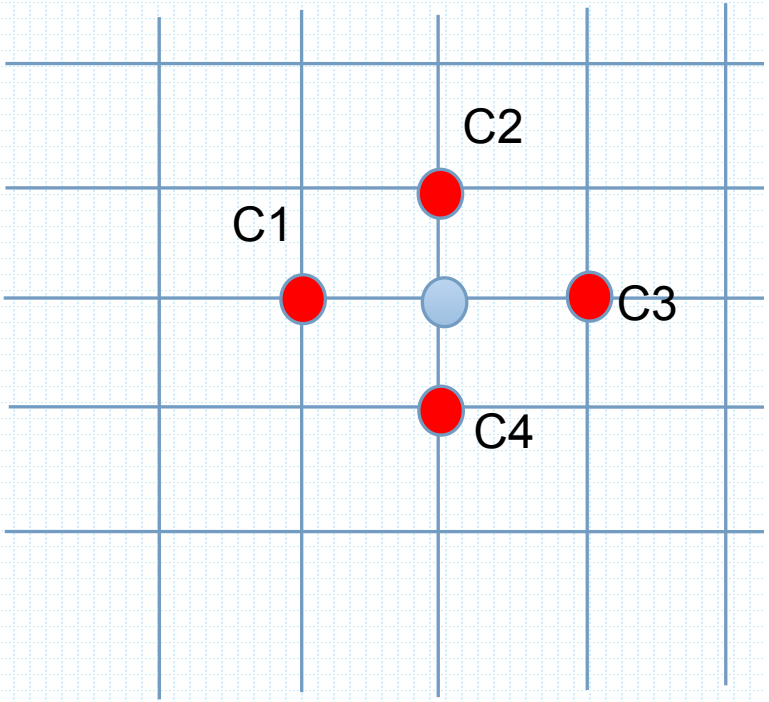
- a more rational individual's contribution behavior should be mainly influenced by the less cautious neighbors rather than the cautious ones
- the neighbors who are more cautious will have a larger probability of choosing defection instead of cooperation



Weighted conditional strategy

- 有效合作者个数

$$N_c = \left\lfloor \sum_{j=1}^{4} n_j \times e^{-\alpha \times j} \right\rfloor$$



- a cautious cooperator has a smaller effect on the individuals' contribution behaviors than a less cautious one

- For example:
- N1=4,N2=3(alpah=0.1)

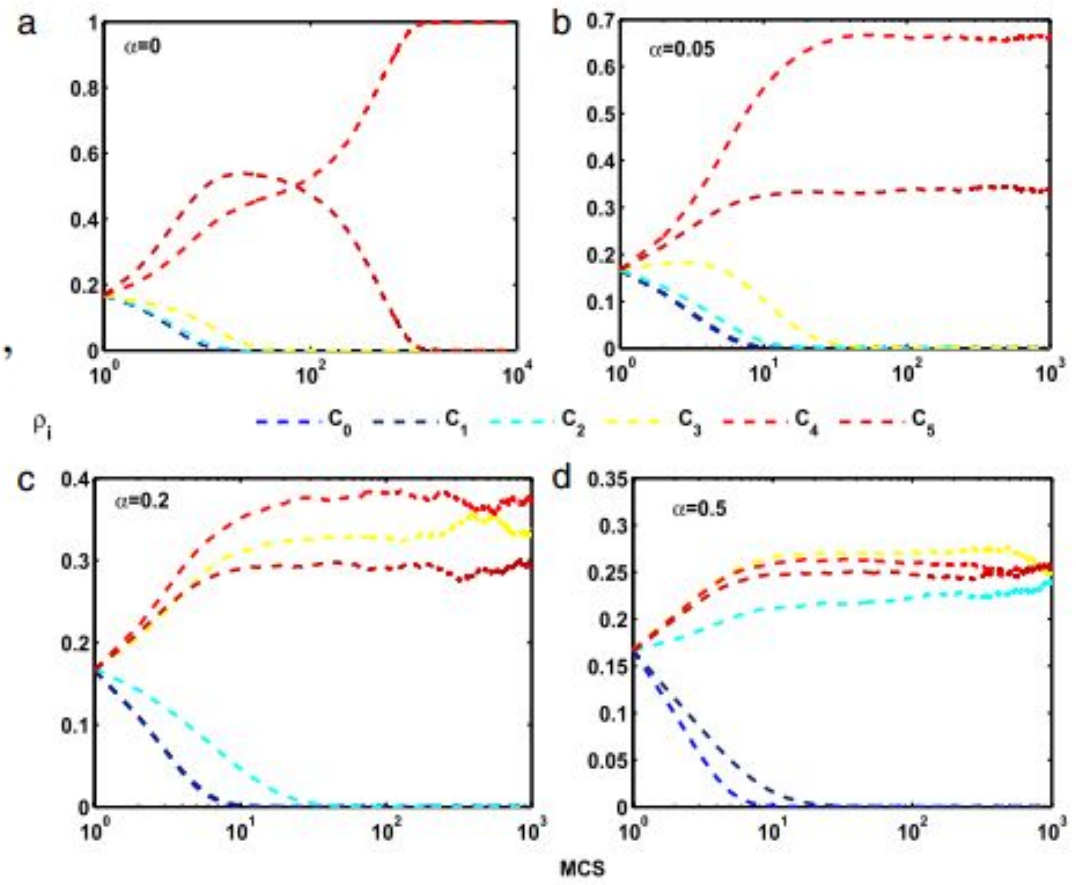
Weighted conditional strategy

low r=1.05

- update rule：

$$W(s_x \leftarrow s_y) = \frac{1}{1 + e^{[(P_{sx} - P_{sy})/K]}},$$

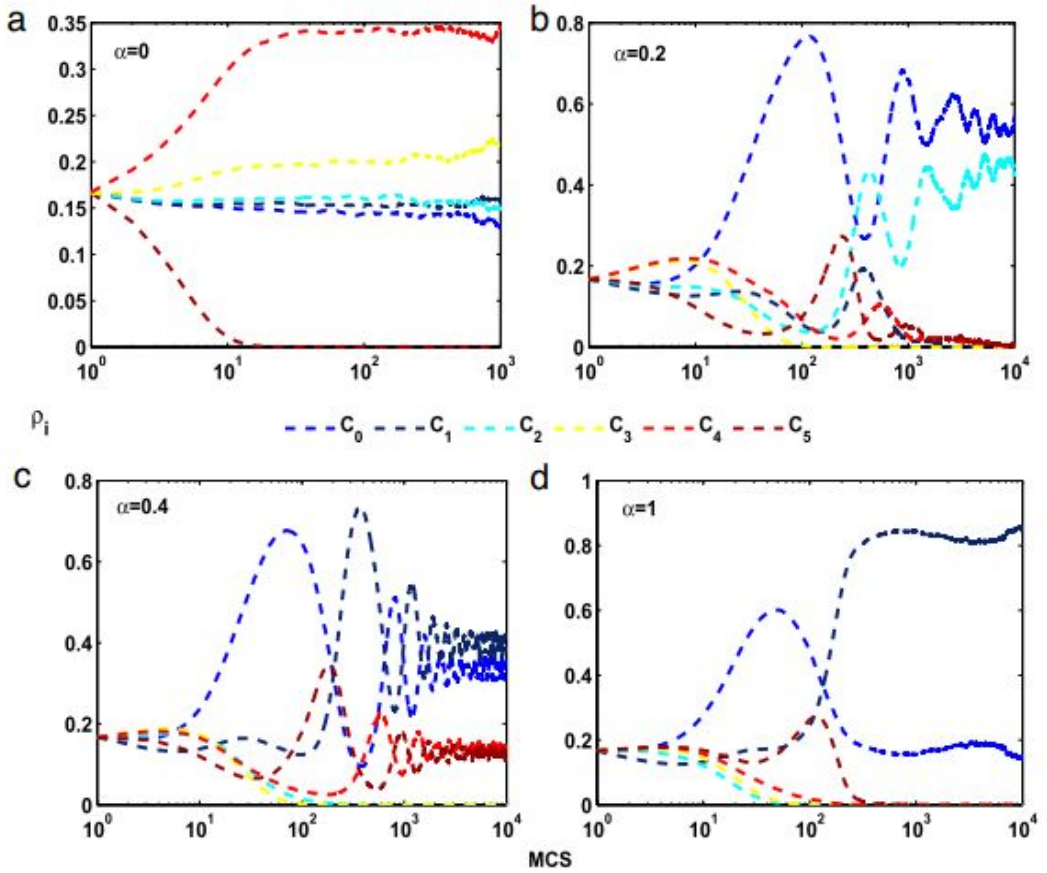
- The number of strategies coexist in the system increases



Weighted conditional strategy

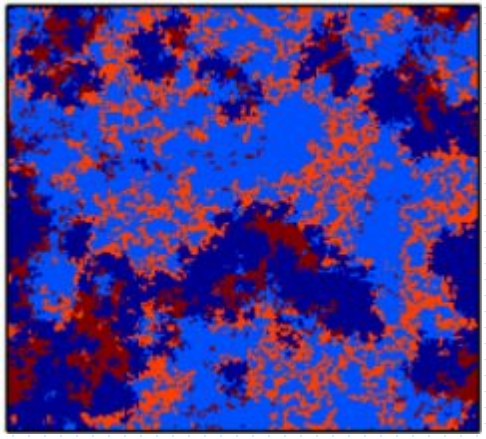
high r=4.5

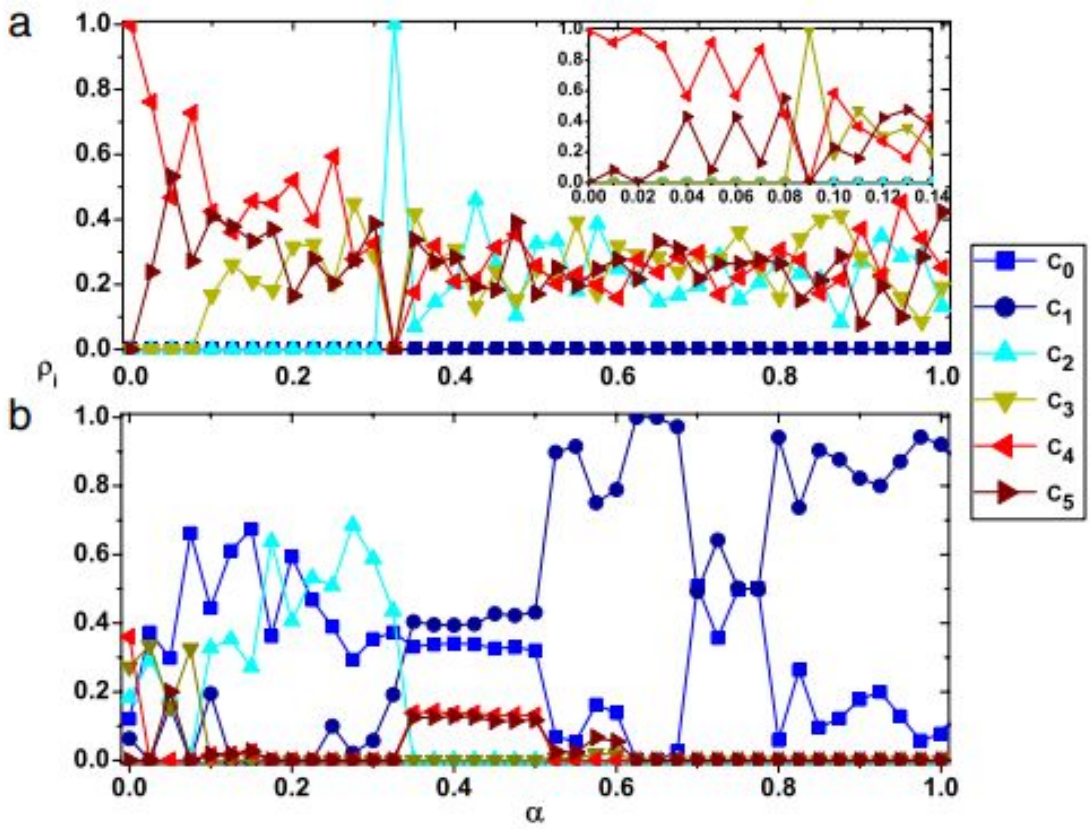
- the kinds of strategies are fewer than the un-weighted model
- the time evolution of survived strategies shows an intense oscillation



Weighted conditional strategy

- The frequencies of the six strategies as functions of the weight parameter





Weighted conditional strategy

- critical synergy factor
  - C_2 $\left\lfloor 4e^{-2\times 0.35} \right\rfloor = 3$
  - C_3 $\left\lfloor 4e^{-3\times 0.09} \right\rfloor = 3$

Weighted conditional strategy

- low r:

  the introduction of the weight is conductive to the existence of the conditional strategies.

- higher r:

  the less cautious cooperators easily survive in the lattice

Weighted conditional strategy

- Limition:

- In addition, it should be pointed out that the
- more conditional cooperators will not be distinguished from defectors(C5)

- Cause

- the fact that more players'
- contribution conditions are harder to meet as α increases

- 谢谢！