Cooperation Prevails When Individuals Adjust Their Social Ties

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Previous studies

- Static graph, fixed connections
- Strategy evolution
- Selfish, strong win (defectors - PD)

Popular social dilemmas of cooperation

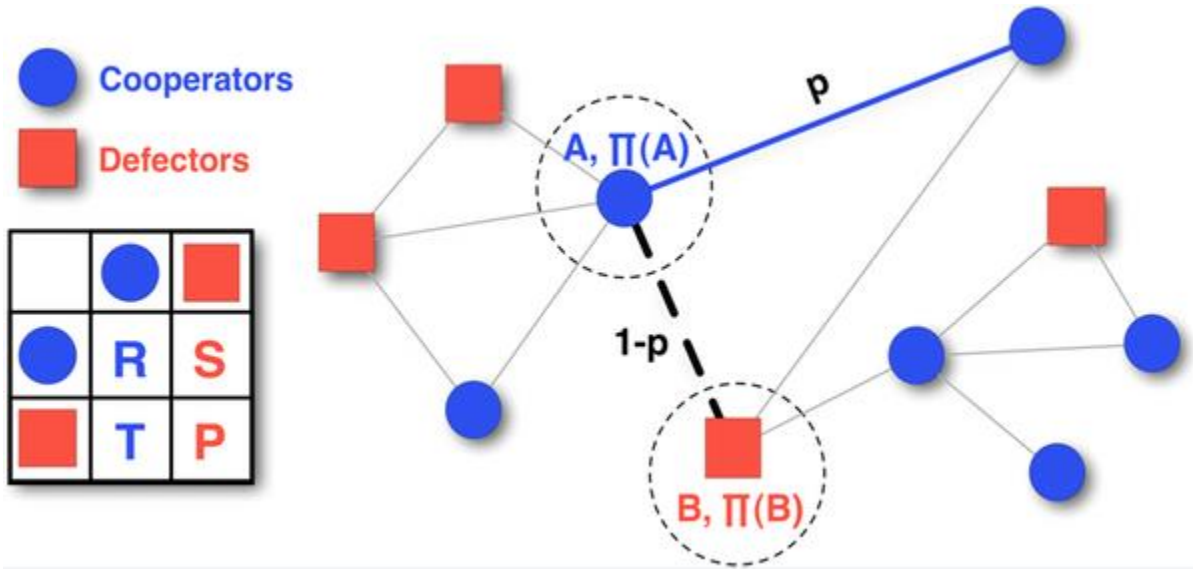
- Snowdrift game (SG) $T > R > S > P$
- Stag-hunt game (SH) $R > T > P > S$
- Prisoner's dilemma (PD) $T > R > P > S$

A Minimal Co-Evolutionary Model

A is satisfied with the edge if the strategy of B is a cooperator.
If *A* is satisfied, she will decide to maintain the link.
If dissatisfied, then she may compete with *B* to *rewire* the link.
Rewiring being attempted to a random neighbour of B.

- A wants to change, B doesn't
- Both want to change

Normalization:
R = 1
P = 0
0 <= T <= 2
-1 <= S <= 1



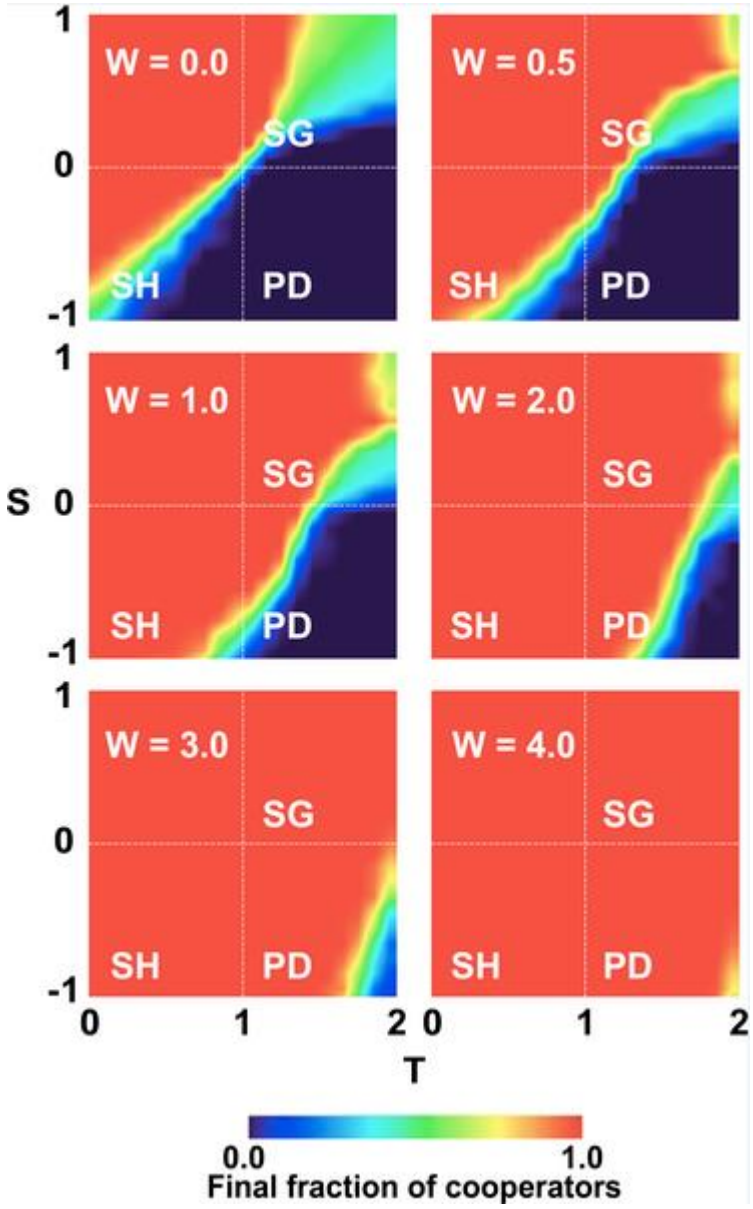
Results of co-evolution

- W = Te / Ta time-scale
- Te - strategy
- Ta - structure

- W critical = 4

- PD is the hardes for cooperators

- Avarage number of ties (degree): 30



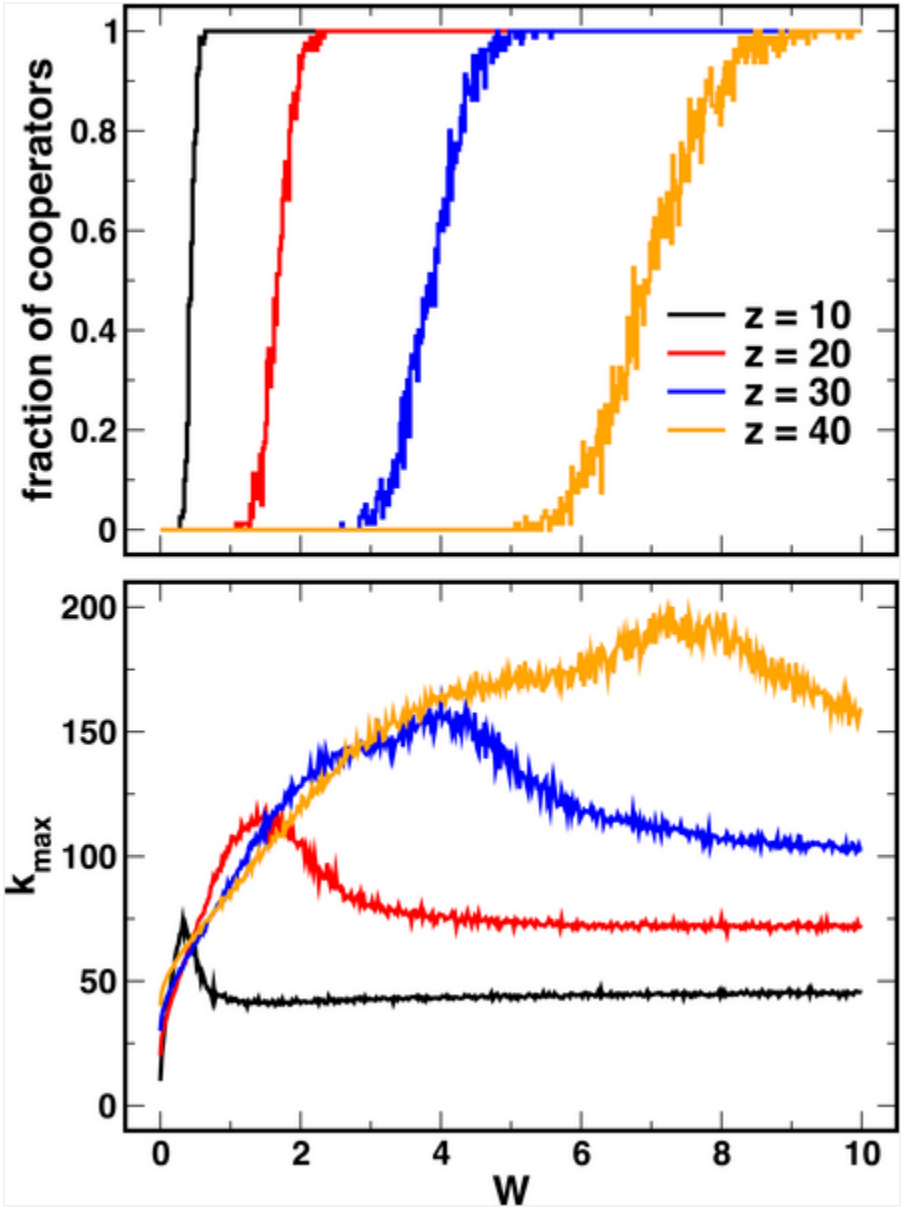
Avarage degree

- PD ($T = 2$, $S = -1$)
- W = 0..10
- If W = 0, cooperators have no chance
- Around W critical, it changes
- Above W crit. defectors are wiped out

Maximum degree

- There is a peak at W critical
- interplay between strategy and structure is maximal

- Homogeneous -> heterogeneous



Heterogeneity

- PD (T = 2, S = −1)
- cumulative degree distributions
- variance of the degree distribution
- the amount of heterogeneity depends on the underlying social dilemma
- Red: the conflict between strategy and topology dynamics is the strongest
- SG: surviving cooperators will accumulate many links
- one may state that the temptation to cheat (*T*) induces a more pronounced increase of the heterogeneity than the disadvantage of being cheated (*S*)