The Evolution of Cooperation & Trading

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Cooperation in changing interaction networks

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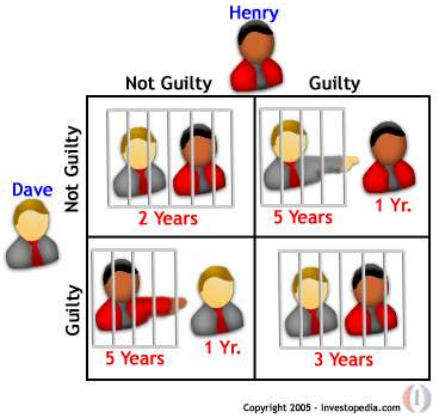
Prisoner's Dilemma

- Helper pays a cost (c)
- The helped gain a benefit (b)
- $b>c>0$
- In a well-mixed population defection is the ESS
- Cooperation can be maintained in a structured population (regular graph)



	C	D
C	b-c	-c
D	b	0

Nowak, M.A. and R.M. May, *Nature* **359**, 826 (1992)
Sigmund, K., *Nature* **359**, 774 (1992)

Animal social groups

- Association networks, which are not random
- The network is not a regular graph (small-world like)
- The network is seldom static
- Individuals can recognize each other

Lusseau, D., *Proc.Roy.Soc.B* **270**, S186 (2003)
Croft, D.P., Krause, J., James, R. *Proc.Roy.Soc.B* **271**, S516 (2004)

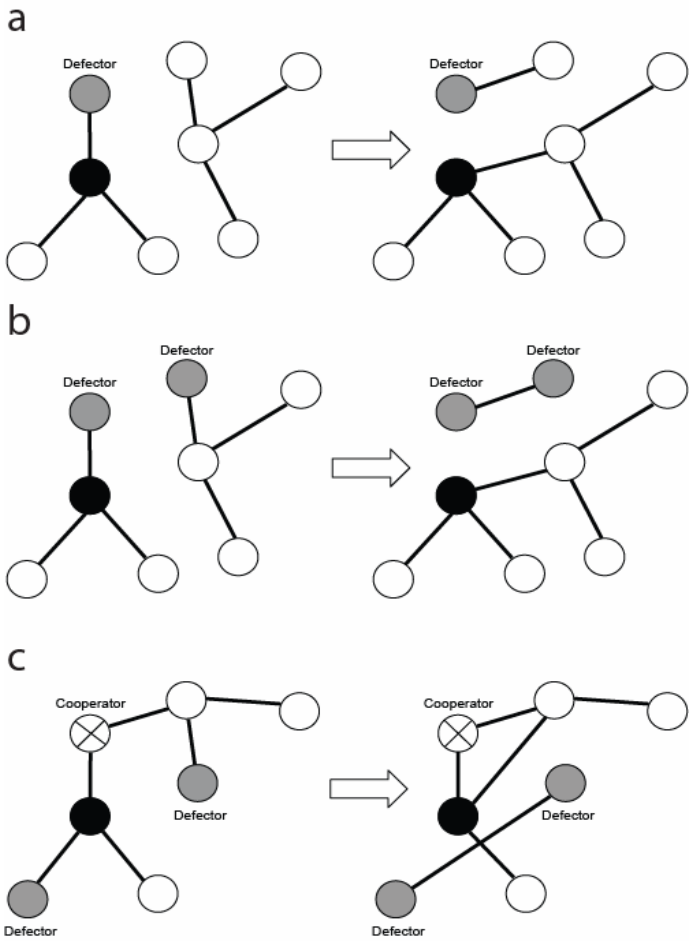
Research question

- Scale-free social network
- Dynamics network
- Preferential partner choice (no memory)

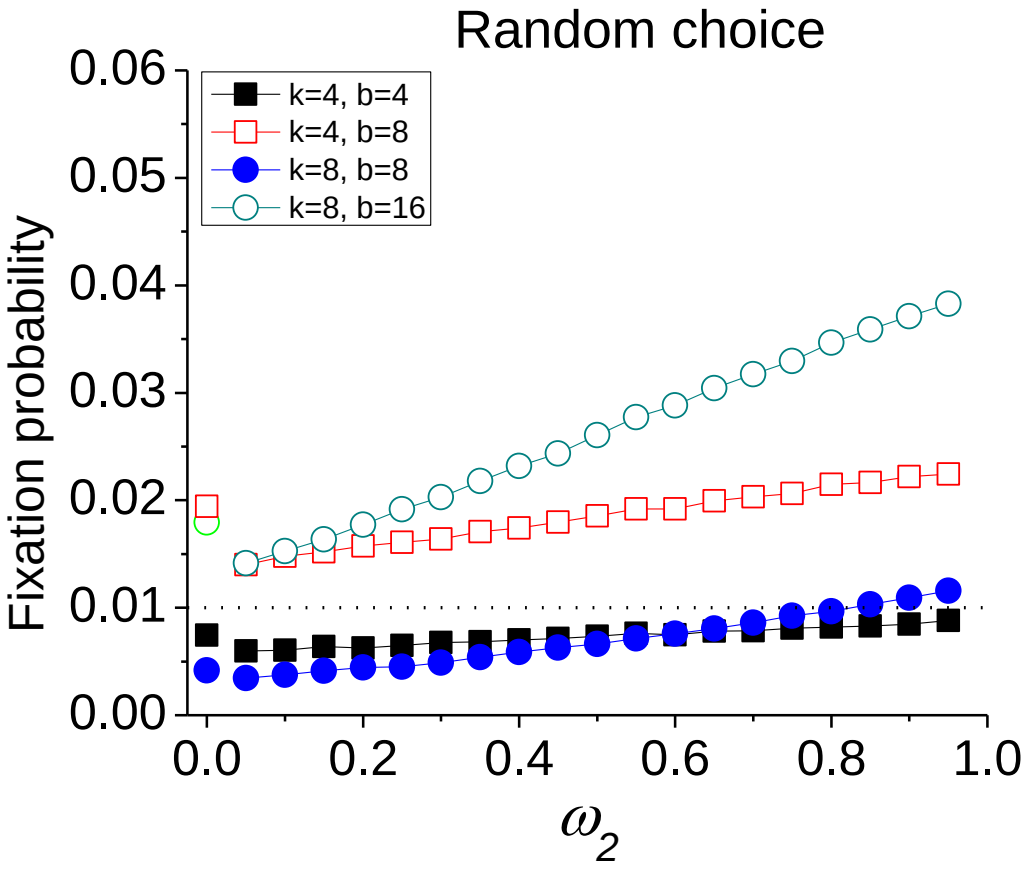
- In what conditions would cooperation spread in such a population?

Preferential partner choice – „Relinking”

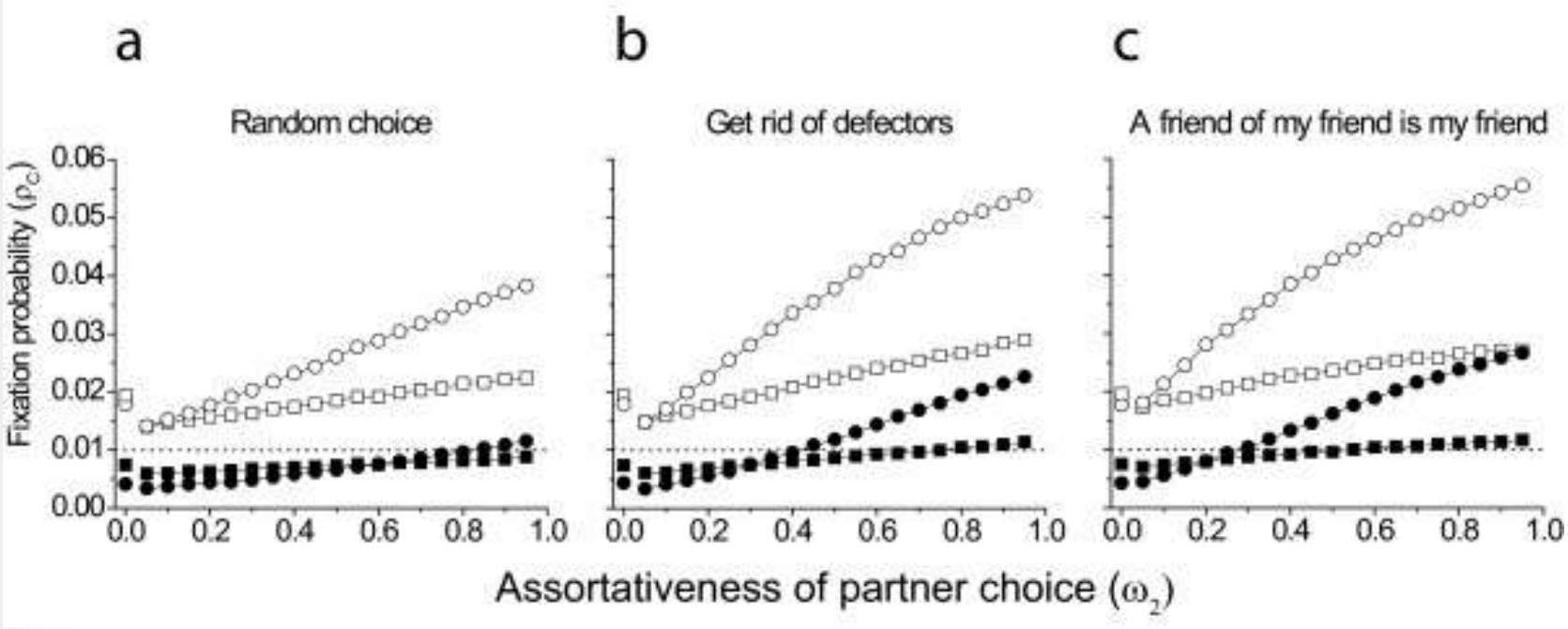
- Random choice
- Get rid of defectors
- The friend of my friend is my friend



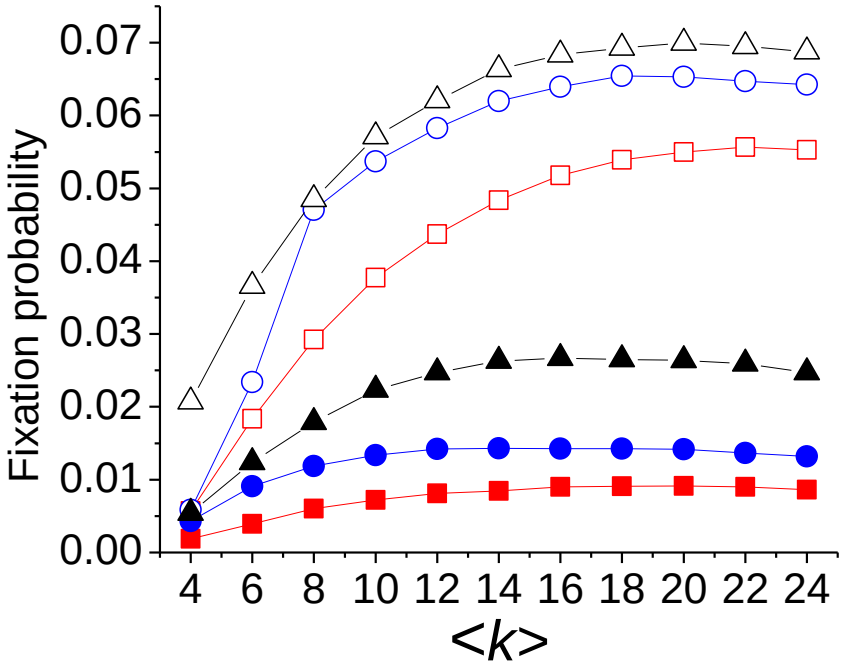
Higher intensity of preferential attachment is beneficial



More sophisticated relinking rule is better



Optimal group size



- In good agreement with data

Conclusions

- It is advantageous for cooperators to recognize each other and avoid defectors
- A behavioral change could be sufficient to achieve full cooperation
- There is an optimal (small) group size for cooperation

Thank you for your attention!

Kun Á. and Scheuring I. 2009. Evolution of cooperation on dynamical graphs. *BioSystems* **96**:65-68

Kun Á., Boza G. and Scheuring I. 2010. Cooperators Unite! Assortative linking promotes cooperation particularly for medium sized associations. *BMC Evolutionary Biology* **10**:173