Costly partner switching in human social networks reduces linking but maintains high cooperation

Peter Bednarik, Katrin Fehl, Dirk Semmann

CRC Evolution of Social Behavior, University of Göttingen, Germany

Summary

Cooperation among humans is common, but not very well understood. Recent models[1,2] find that certain network structures favor the evolution of cooperation, yet experimental evidence[3,4] suggests that static networks do not support cooperation in humans. We have conducted an experiment that allowed players to change their social links and included varying costs for building new links.

We find that the option to quit collaborations, even if very costly, seems to be sufficient to significantly increase cooperation levels among humans. In addition, we find that the behavioral exploration rate in humans is much smaller than expected.

Method

- Players started with 3 partners on a social network (Fig. 1A)
- With each partner they played an independent Prisoner's Dilemma (PD) game, meaning they could decide between either to cooperate(C) or to defect (D) (cf. Box)
- The experiment lasted for 30 rounds (unknown to players)
- Four treatments
  - One *static network treatment* (played PD games only)
  - Three d*ynamic network treatments*
    - no cost, low cost (0.10€), and high cost (0.50€)
    - Participants played PD games
    - Additionally, they could end their relationships and receive new partners (cf. Fig. 1B)
    - Costs occurred whenever a new link was formed

		partner C	partner D
focus player	C	0.25 €	-0.10 €
	D	0.40 €	0.00 €

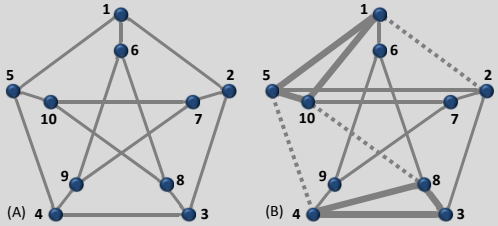

Fig. 1 ***Social network topology.*** Circles represent individuals and lines are links between individuals. *(A)* Initial network topology. *(B)* Example of link breaking (dotted lines: former links; bold lines forming a triangle: cluster).

Results

Cooperation:

- Cooperation levels were significantly higher in all dynamic networks compared to the static network - regardless of costs (Fig. 2).

Link breaking in the dynamic networks:

- Much more link breaking occurred in the treatment without costs. We found the least link-breaking rate in the high-cost treatment (Fig. 3).

Behavioral exploration rate

- When both partners cooperated, the link was broken with a rate of *0.0005.* The behavioral exploration rate is therefore smaller than this value.

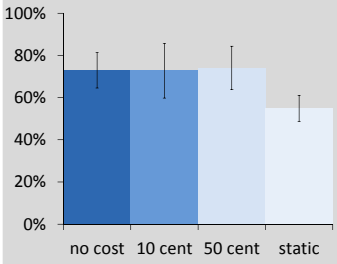

Fig. 2 ***Average cooperation level*** (±SD) of treatments.

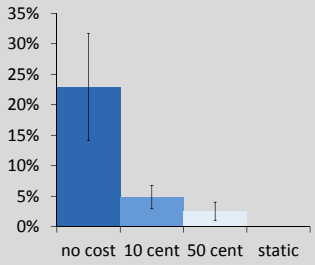

Fig. 3 ***Average link-breaking rates*** (±SD) of treatments.

Conclusion

- An option to quit collaborations to partners is enough to sustain **high levels of cooperation,** regardless of the costs to find a new partner.
- Humans make very **few mistakes**. We find a behavioral exploration rate almost 1000 times lower than expected[3].

[1] Pacheco, JM, Traulsen, A & Nowak, MA (2006). Active linking in evolutionary games. *J. Theor. Biol.*, *243*, 437-443.
[2] Pacheco, JM, Traulsen, A, Ohtsuki, H & Nowak, MA (2008). Repeated games and direct reciprocity under active linking. *J. Theor. Biol.*, *250*, 723-731.
[3] Traulsen, A, Semmann, D, Sommerfeld, RD, Krambeck H-J & Milinski, M (2010). Human strategy updating in evolutionary games. *Proc. Natl. Acad. Sci. USA*, *107*, 2962-2966.
[4] Fehl, K, van der Post, DJ & Semmann, D (2011). Co-evolution of behavior and social network structure promotes human cooperation. *Ecol. Lett.*, *14*, 546–551.