Need-based transfers and account-keeping in social networks: How do alternative cooperative strategies scale-up?

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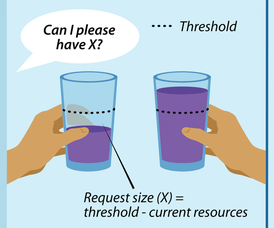
The Human Generosity Project

Need-based Transfers

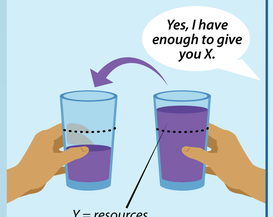
Resource sharing based on the need of recipient

How it works

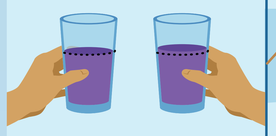
1 Request
Request to fill a need is made.



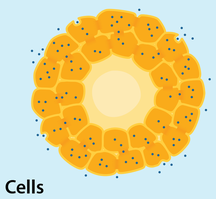
2 Response
Request is granted, as long as there are enough resources.



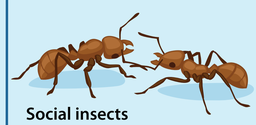
3 Outcome
Limited risk pooling between partners, better survival



Examples



Cells
Nutrient transfer in multicellularity



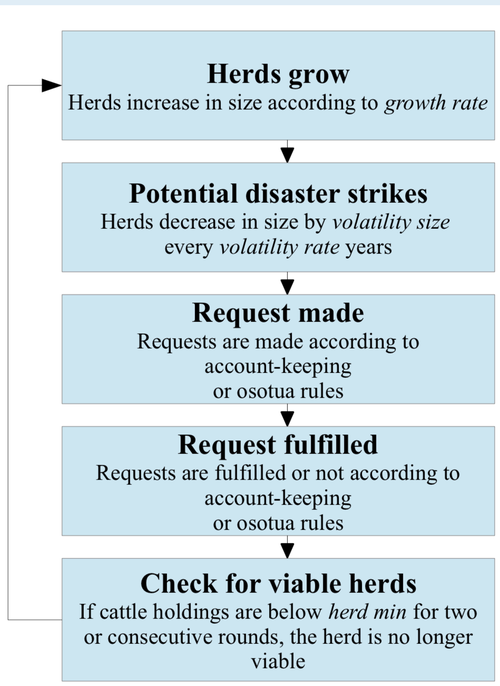
Social insects
Trophallaxis - food transfer from full to hungry ants

Vampire bats
Blood shared most with hungry bats

Humans
Livestock and food sharing systems

Methods & Materials

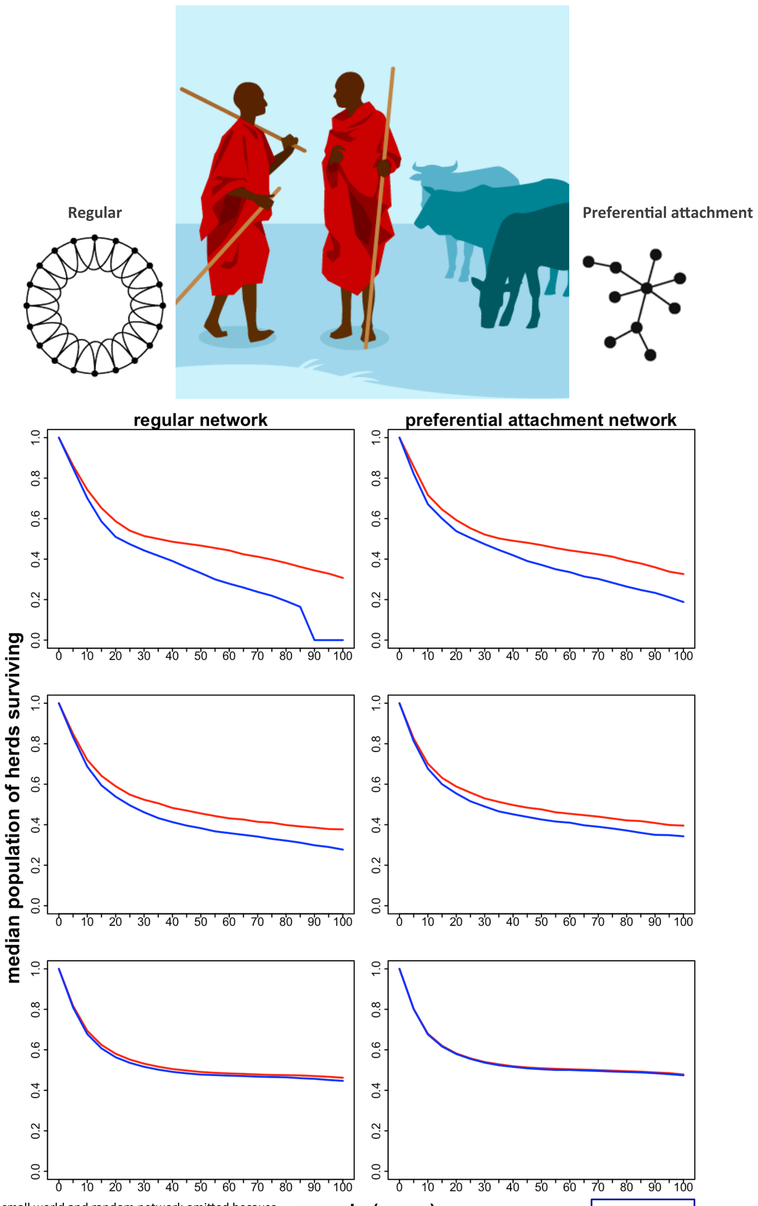
We use an **agent-based model** (Railsback and Grimm 2012) extending Aktipis et al 2011 to a **multiplayer network** where agents may interact with one another in different **network topologies**; simulations were run using NetLogo 4.0.1 (Wilemsky 1999). Statistical analyses were performed using R 3.1.3 (R Core Team 2014).



Results

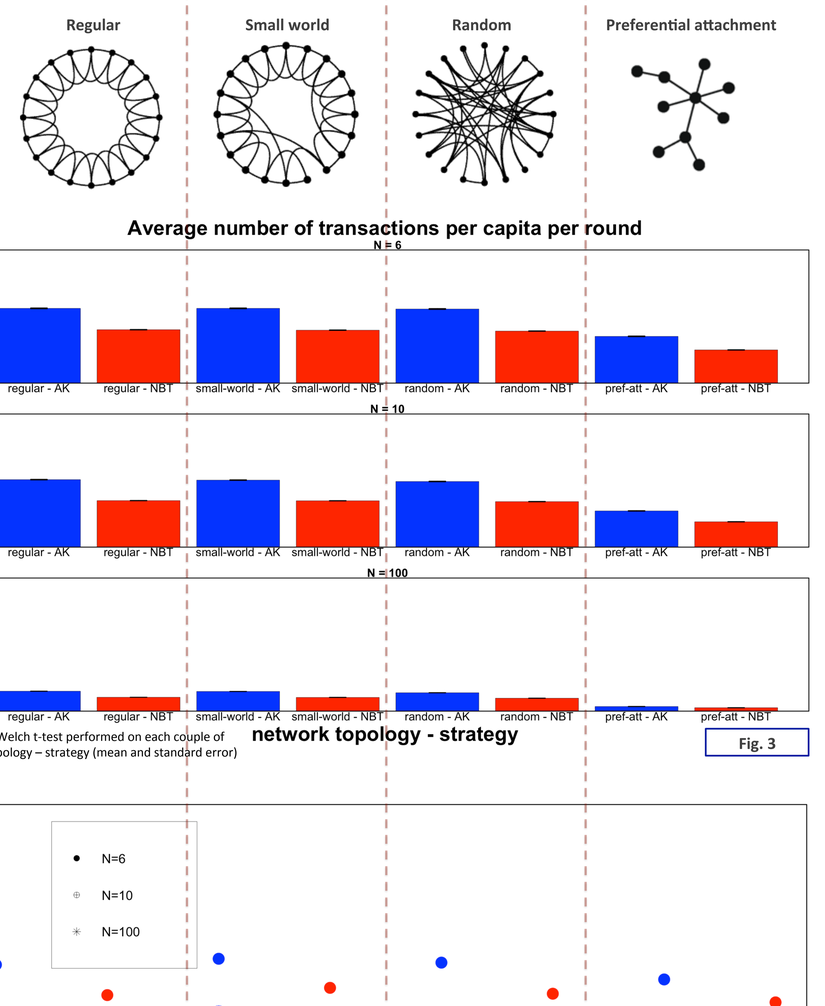
NBT strategy outperformed AK strategy in small networks (i.e., N ≤ 10, but not n = 100 – see Fig. 1 below). Moreover, for small networks (i.e., N = 6) the **AK strategy makes the system collapse** for all topologies, except for the preferential attachment network. These results suggest that in volatile environments the resilience of a social network is determined by the **nature of connections** more than by the **randomness of the distribution** of them. The analysis of the **transactions in networks** has shown that there is significant difference between the average number of transactions per capita per round in networks of agents adopting NBT strategy and AK strategy (see Fig. 2 below). Finally, the **Gini coefficient** (Gini 1909) analysis has shown that the inequality of the distribution of resources (see Fig. 3 below) is lower in small networks of agents adopting NBT strategy than in networks of agents adopting AK strategy.

How does the performance of NBT vs. AK change as we scale-up network size?



* Results of small world and random network omitted because very similar to results of regular network

Fig. 1



* Paired Welch t-test performed on each couple of network topology – strategy (mean and standard error)

Fig. 3

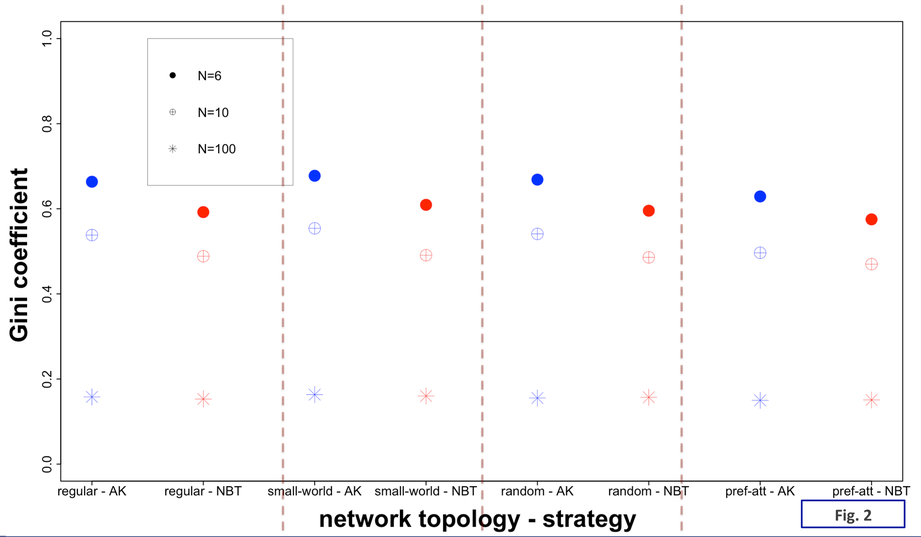


Fig. 2

Transfer Algorithms

Need-based transfers
Ask when in need
Give if able

Account-keeping
Accounting system with memory for
- Size of debt/credit
- Time incurred

Specified parameters for:
- Maximum tolerated delay
- Probability of repayment (given sufficient resources)

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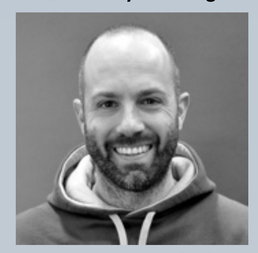

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