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Abstract. Under what conditions can cooperation emerge and be sustained? Previous studies abstract cooperation and defection using the spatial Prisoner's Dilemma (PD) game. We study a local reputation mechanism in which agents can remember defectors, abstain from interacting with them, and warn nearby agents. Simulations find that local reputation is effective in sustaining cooperation and punishing defection. Further, we find that the size of agent memory and amount of gossip are not significant factors, provided that the locality range of gossip is greater than the agent movement speed.

1 Motivation and Experimental Design

Reputation systems strongly boost cooperation in spatial exchange games such as spatial PD [2, 6]. Similarly, allowing game participants to pass information, either directly [4] or indirectly [1], increases the rate of cooperation.

We aim to explore the limits of local reputation—built up via gossip—in promoting and sustaining cooperation. Agent's behaviour is defined by the finite state diagram shown in Figure 1. We expand over prior work [5] by giving agents a (limited size) memory to keep track of defectors and to allow them to share this information by gossiping with other agents in a certain range.

2 Results and Discussion

Agents are one of two types: cooperator or defector. We allow agents to remember the five most recent defectors and to ask nearby agents in a Moore neighbourhood of radius 1, 2 and 3 if they remember an agent defecting in a certain number of

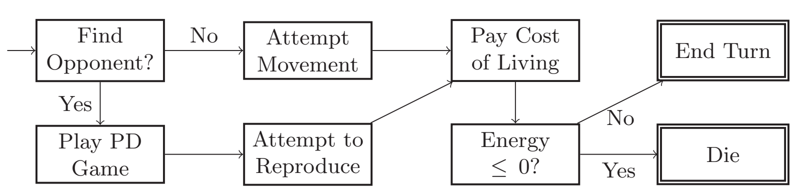

Fig. 1. Agent behaviour diagram: showing the decision flow of an agent's single turn

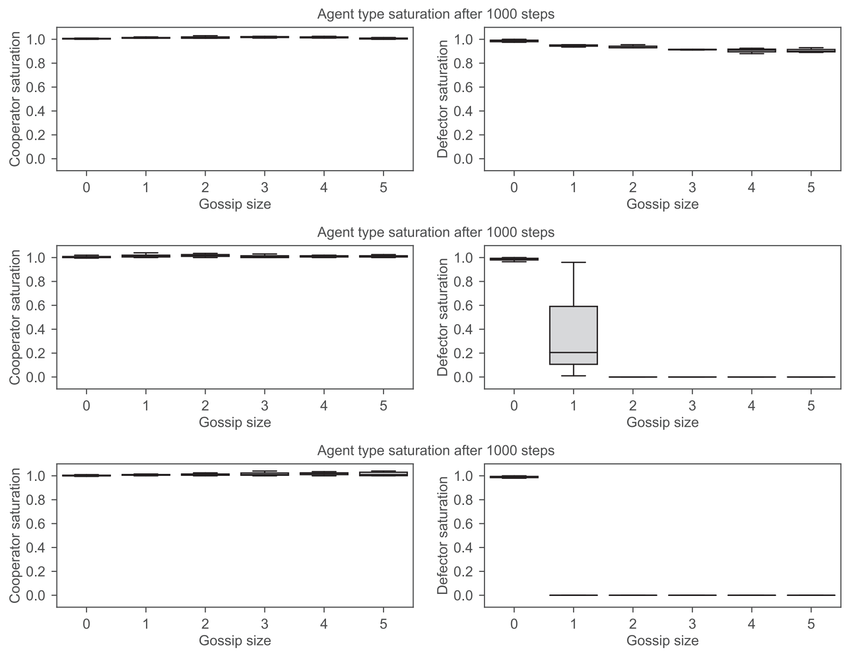

Fig. 2. Cooperator agent saturation for various gossip sizes after 1000 steps. Left column: no gossip, right column: with gossip mechanism. Top row to bottom: gossip radii 1, 2 and 3, respectively. Std. dev. of 30 simulation runs, outliers removed

past encounters—varying between 0 and 5. We run the simulation for 1000 steps and plot the saturation percentage of cooperator agents in Figure 2.

The introduction of gossip is a strong deterrent of defection and quickly leads to cooperator-only populations, as seen in the right column. We find that the size of the memory and the size of the gossip are not significant factors, only speeding up the convergence slightly.

Our simulation results also find that the most important factor in predicting cooperator success is the range at which gossip can be exchanged; the amount of information included in the gossip has negligible effect. If the gossip can move faster than agents, cooperators will flourish. Otherwise, defectors can reach full population saturation.

We studied a local reputation mechanism in spatial PD. Several directions can build on our results. Notably, we assumed all information is transferred with 100% fidelity. However, not all strategies that perform well in noiseless environments can do so under the presence of noise [3]. If the agent behaviour is unpredictable enough, the gossip mechanism could deter more cooperator–cooperator interactions: the pros and cons in noisy environments deserve investigation.

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