Incorporating agent-based simulation and gaming in studying public goods provision

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概要—   Under the context of public service contribution and collaboration, group-based learning on improving the ability of using tools for online contents contribution and collective activities is also important, yet its impact is still unclear. This work incorporates agent-based simulation and gaming to investigate the impact of group-based learning on cooperation in heterogeneous groups where individuals differ in their ability to contribute. We unfold public goods game to agent-based models incorporating a group-based learning mechanism to explore the individuals' collaborative decision in addition to the influence from either the environment or their past experience. A corresponding gaming is designed and played to triangulate the simulation results, and has the potential to improve further simulation models. Simulation results suggest that small groups with competent individuals are prone to contribute more. Group learning is more effective in the context of contributions associated with a high cost but its influence is overwhelmed by other factors, such as a high responsive rate to the past experience, in those easy-to-operate contributions.

Keywords: Gaming and simulation

1   Introduction

Collective contribution to public goods are becoming important in modern social welfare. Citizens' engagement and collaboration in public affairs are encouraged and leveraged to tackle a broad range of public problems. This work aims to investigate the impact of this group-learning on cooperation in heterogeneous groups where individuals differ in their ability to contribute. This work also offers an alternative method by combining simulation and human experiments in exploring the cooperation behaviors.

2   Agent-based models

We unfold public goods game to agent-based models incorporating a group-based learning mechanism in addition to the learning process from either the environment [1] or their past experience [2] to explore the individuals' collaborative decision. A corresponding game is designed and experimented to triangulate the simulation results and to improve the further agent-based model design.

We examine the influence of this group-based learning when only learning from self's past experience is considered (e.g. Fig. 1 plots the average contribution rate under a combined impact of responsive rate, marginal return rate and ability improvement in Fig. 1), or learning from the environment. For the gaming session, we also plot the average contribution rate of 20 iterations for 4 cases respectively (e.g. Fig. 2).

3   Data analyses

The simulation results suggest that small groups composed with competent individuals are prone to contribute more; group learning is more effective in the context of high-cost contributions yet its influence is overwhelmed by other factors in low-cost contributions, such as a high responsive rate to the past experience, a high marginal return rate, and a larger initial endowment. A gaming session is designed to triangulate the simulation results. The results are compliance
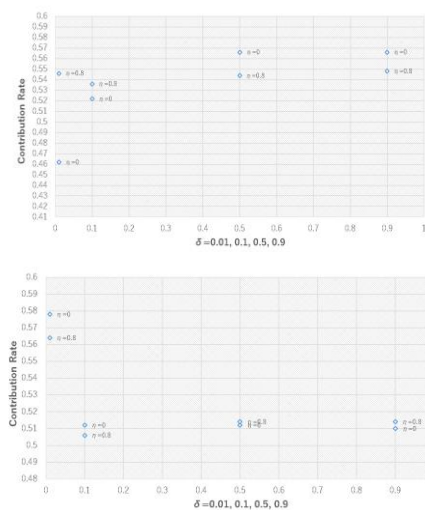

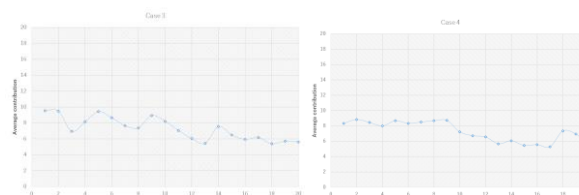
Fig. 1: Learning from self's past experience

Fig.2 Contribution rate of gaming

with simulation results to certain extent, but more sophisticated game design is required to validate the simulation results. Also, it would be interesting if we incorporate computational autonomous agents in the gaming session to study more complex mechanisms.

参考文献

1)   H. Deguchi. Economics as an agent-based complex system – toward agent-based social systems sciences, (2004)

2)   H. H. Nax and M. Perc. Directional learning and the provisioning of public goods. Scientific Reports, 8(8010): 1/6 (2015)