

Introduction

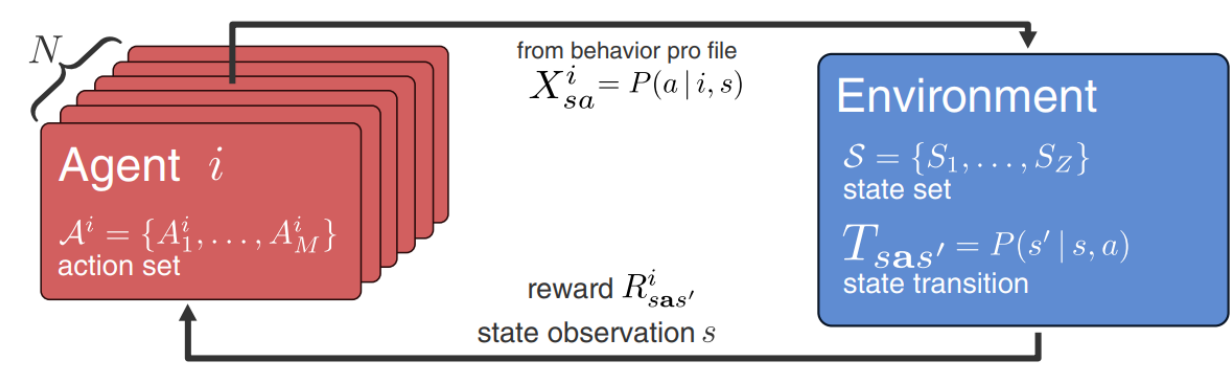
- Preventing catastrophic climate change hinges on sustained, global cooperation, yet presents a socio-ecological dilemma where maintaining long-term commitment remains a challenge.
- Identifying key drivers of cooperation is essential for effective climate action.
- While some conditions have been outlined (Barfuss 2022)), the role of **social information** requires further investigation

Objectives

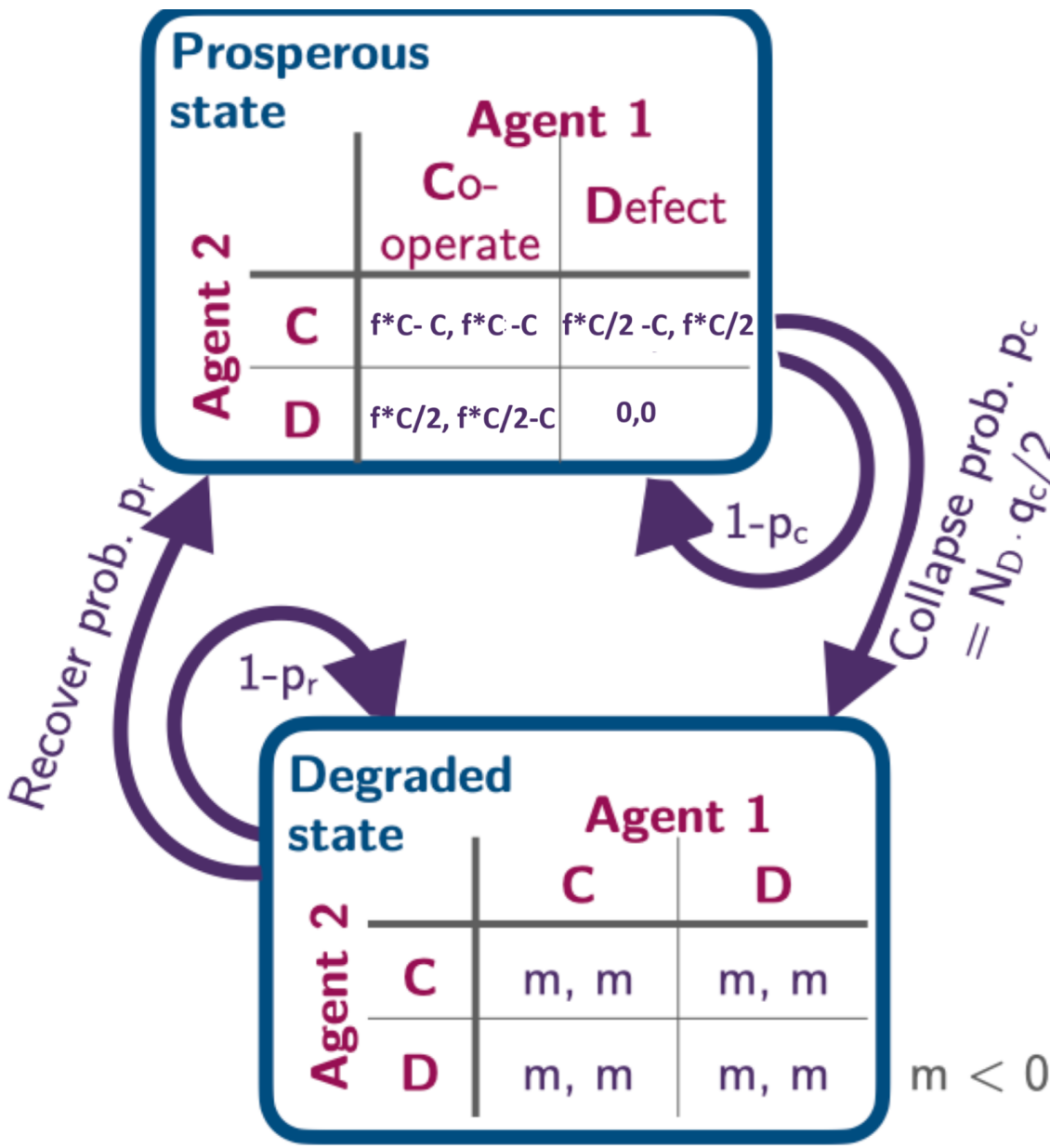
- Does social information promote cooperation – i.e. when strategies are based on others' actions?
- Compare the relative effectiveness of social & ecological reciprocity and examine interactions b/w them

Simulation Framework

- Multi-agent Reinforcement Learning Deterministic)
- Temporal Difference Updates
- Partial observability framework (Observed States < True States)

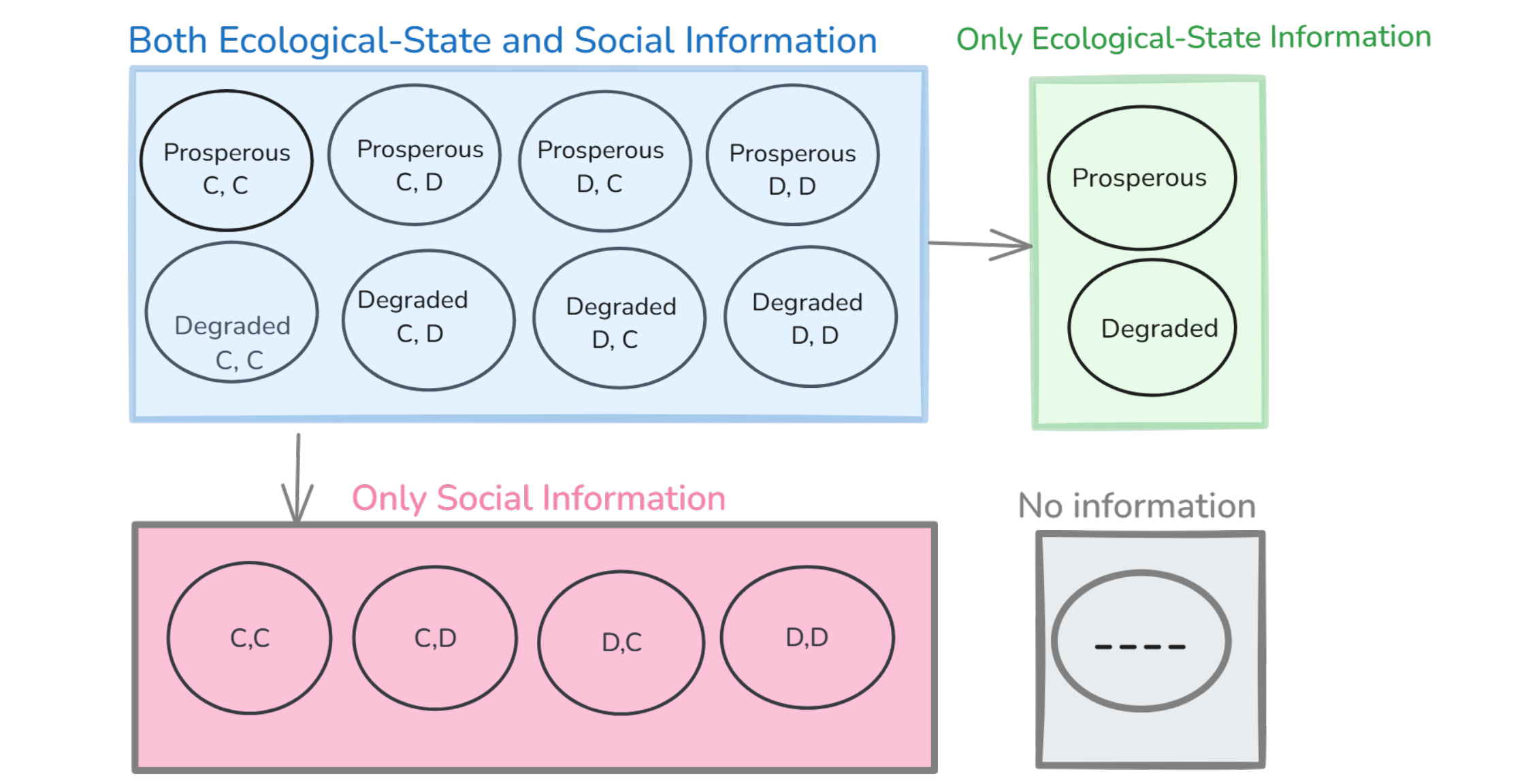


Game-Theoretic Model



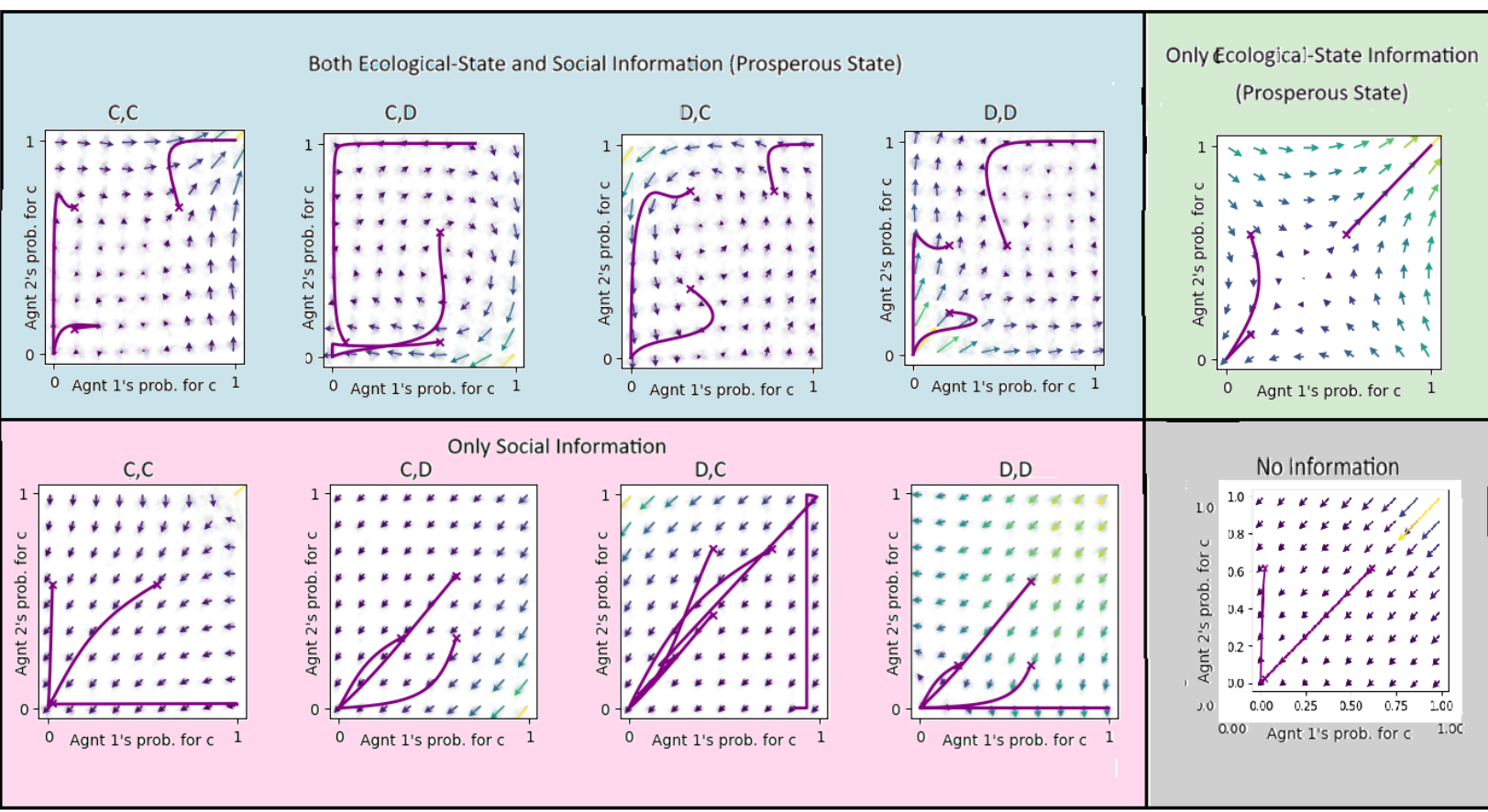
Ecological Public Goods Game

Treatments - Information Conditions



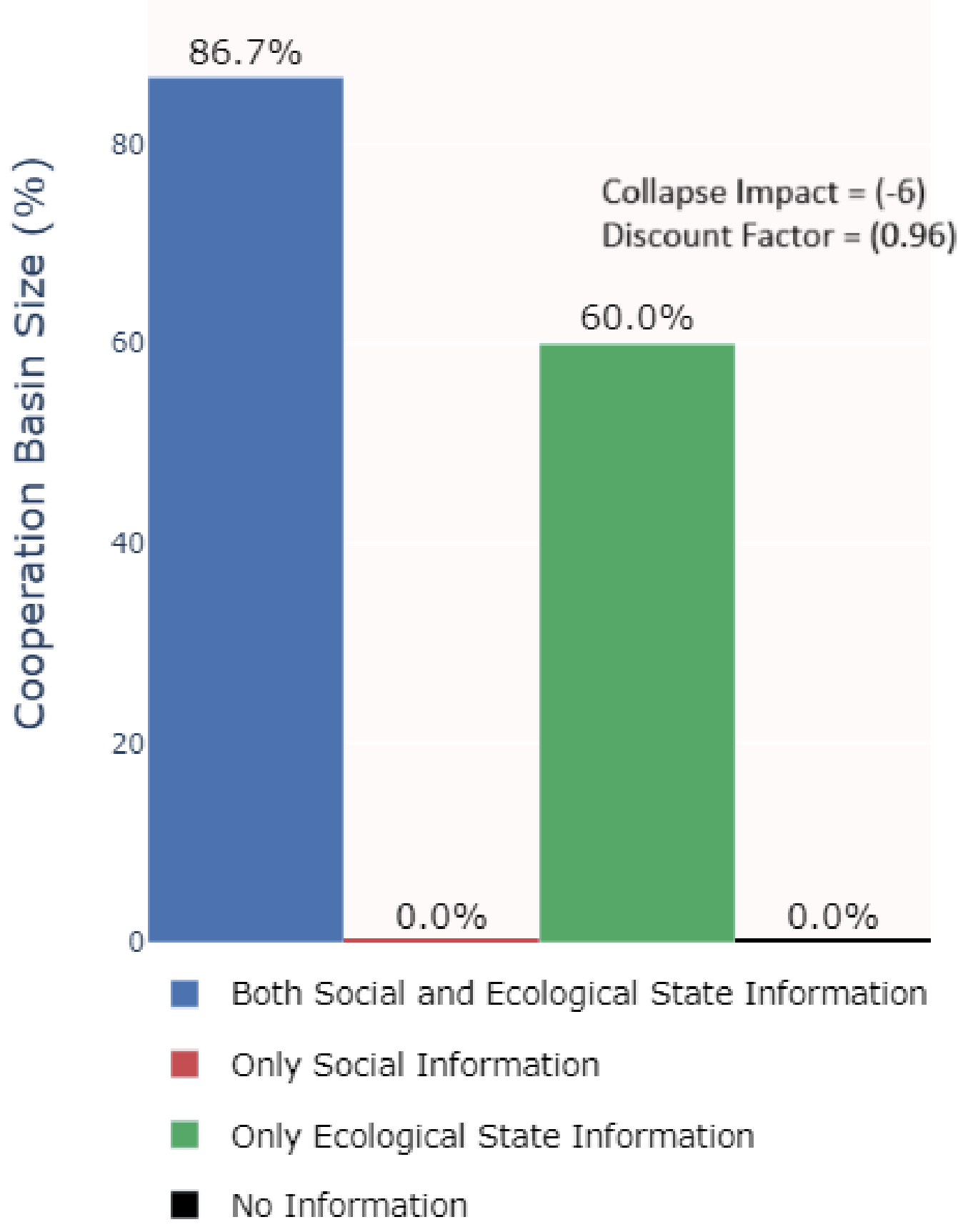
Social Information : Memory-1 Strategies

Cooperation Dynamics



- Agents assumed to have no choice in the degraded state.
- Phase portrait constructed based on average temporal-difference errors

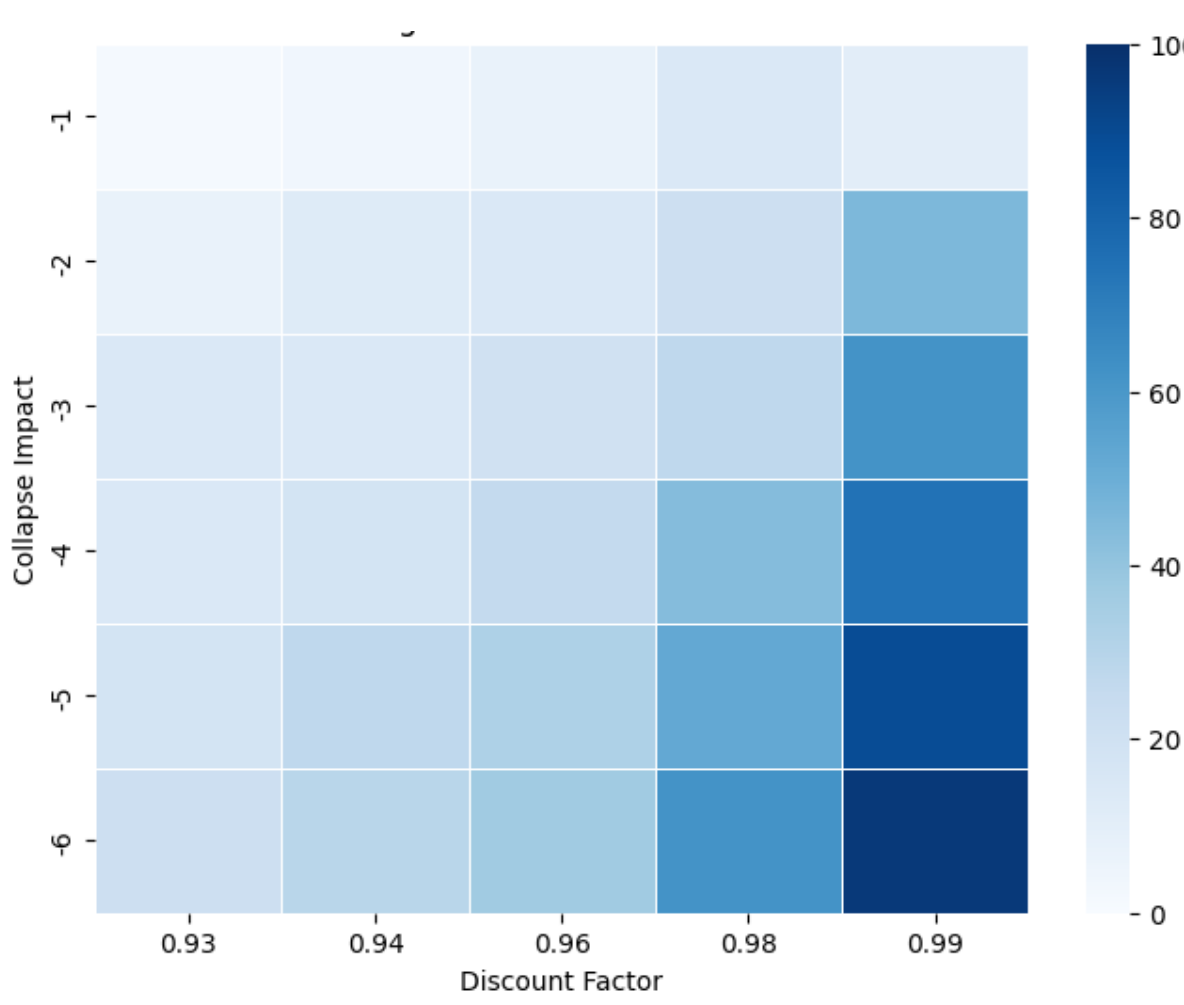
Cooperation Basin Size



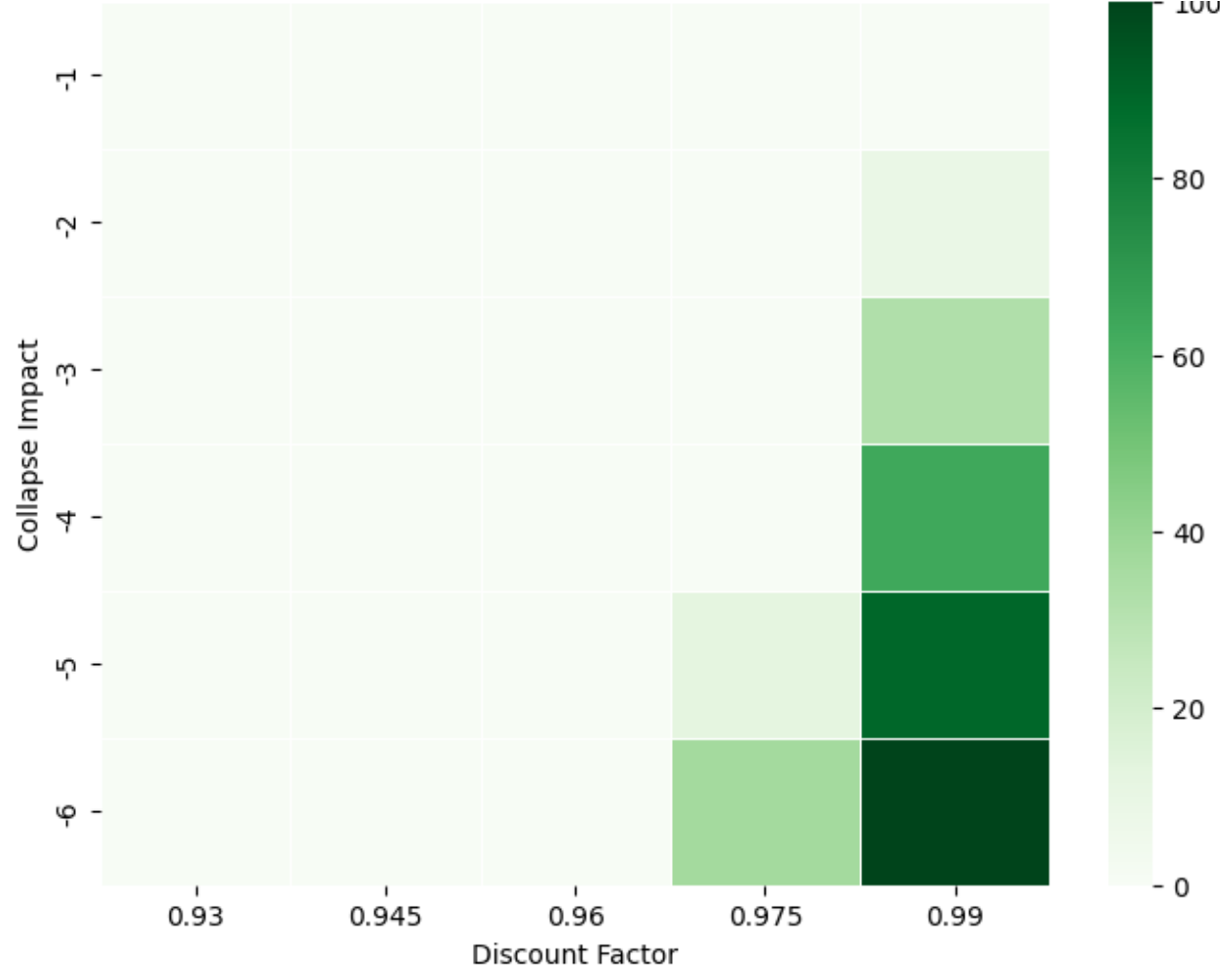
$$\sum P(C|s)P(s) > 0.6$$

Influence of Farsightedness & Collapse Impact

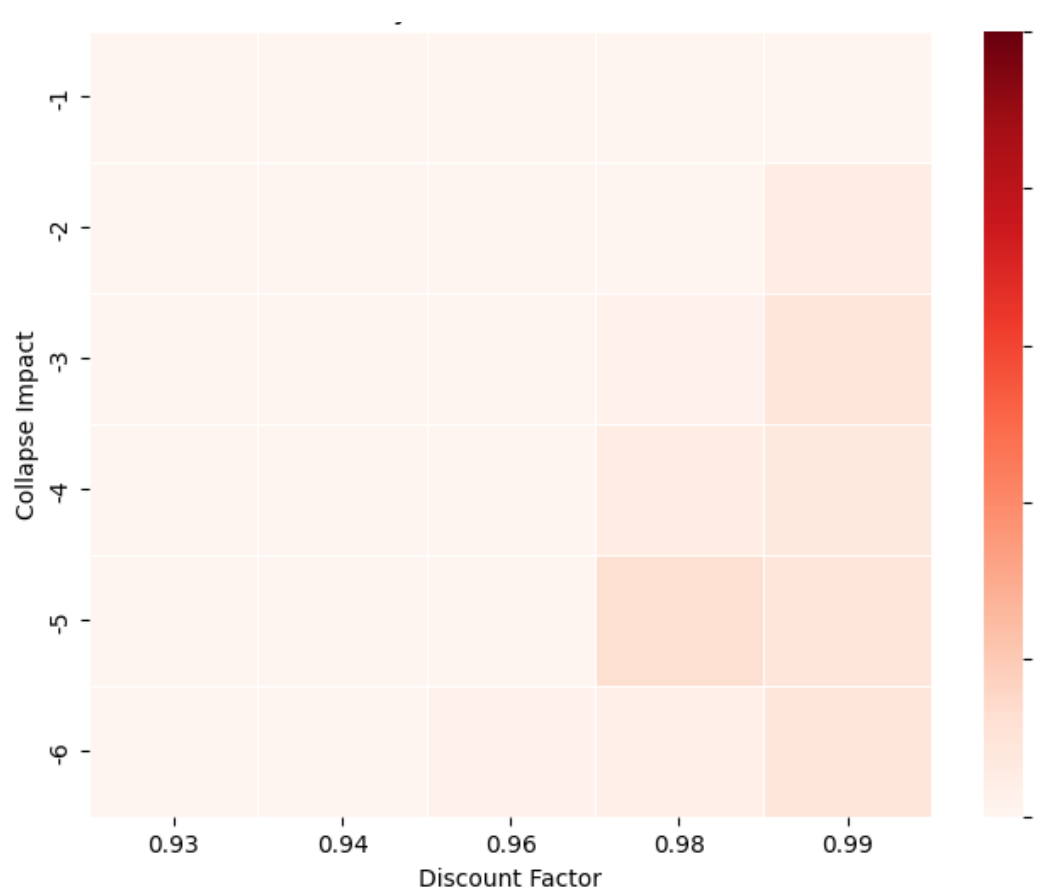
Both Ecological and State Information



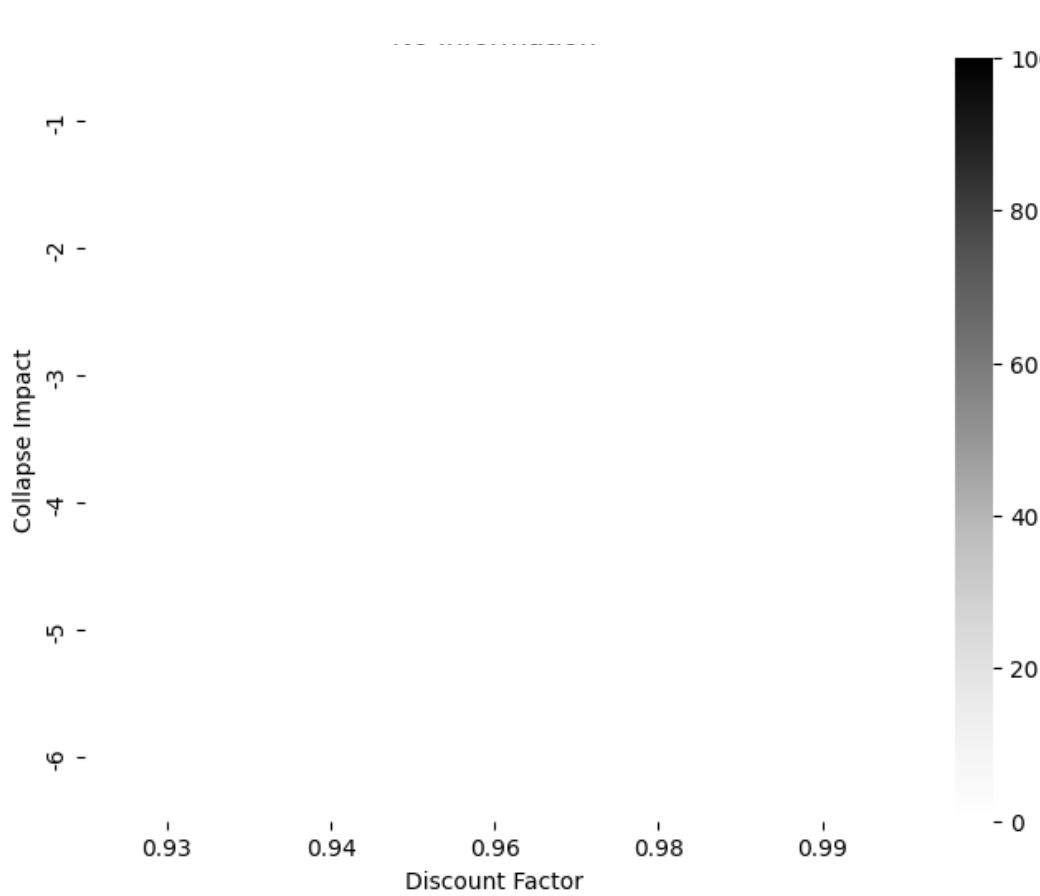
Only Ecological State Information



Only Social Information



No Information



Conclusion

- Social information alone, without environmental cues, appears insufficient
- Ecological information alone can promote cooperation, however is significantly enhanced by the presence of social information
- High collapse impact & good far-sightedness are pre-conditions for cooperation

Future Work

- Deriving equilibrium strategies under different informational conditions
- Examining the role of factors such as recovery rates and collapse leverage of agents
- Understand Role of Synergy Factor
- Generalise the model for n-agents

References & Supplementary

