

High Level Programming for Experimental Economics

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1 Summary

This seminar paper partially extends the study by Nockur, Pfattheicher, and Keller (2021), *Different Punishment Systems in a Public Goods Game with Asymmetric Endowments*, by introducing two additional dimensions to the experimental design.

First, the degree of endowment inequality is increased beyond the original asymmetric treatment in order to examine whether more extreme resource disparities generate stronger behavioral responses. In the original design, asymmetric endowments did not substantially reduce the contributions of advantaged participants [4]. However, more pronounced inequality may generate different behavioral patterns. The present study therefore implements a highly unequal endowment distribution that more closely resembles real-world income dispersion [3].

Second, the information environment is modified. In addition to the complete-information setting, an incomplete-information condition is introduced in which participants observe others' contributions but not their endowments. In many decentralized real-world environments, individuals do not have full information about others' resources. This treatment provides a more realistic institutional setting.

Building on this framework, the present study examines how stronger inequality and informational ambiguity interact with different punishment institutions. Overall, the extension evaluates whether extreme inequality and imperfect information alter contribution behavior, punishment dynamics, and payoff distributions in public goods games.

2 Experimental Design

Participants are randomly assigned to groups of four and remain in fixed groups across all rounds. The experiment consists of **12 rounds** in total. The punishment institution changes midway through the session. Rounds 1–6 are conducted under peer punishment, whereas rounds 7–12 are conducted under democratic punishment. Thus, all groups first experience decentralized peer punishment and subsequently transition to a democratic punishment regime. This fixed sequence allows us to examine whether cooperation dynamics change when punishment authority shifts from individual enforcement to majority-based enforcement.

Each round consists of three stages:

1. **Contribution Stage:** Each participant receives an endowment and decides how much to contribute to the public good.
2. **Redistribution Stage:** Contributions are multiplied by 1.6 and equally redistributed among group members.
3. **Punishment Stage:** Participants make punishment decisions according to the punishment institution active in that block of rounds.

2.1 Endowment Conditions

Three endowment profiles are implemented:

- Symmetric: (30, 30, 30, 30)
- Asymmetric (small): (40, 40, 20, 20)

- Asymmetric (large): (60, 30, 20, 10)

The symmetric and asymmetric (small) conditions replicate the experimental design in which two advantaged and two disadvantaged members are assigned different endowments [4].

In addition, the present study introduces a more unequal three-tier distribution (asymmetric large) in order to examine whether stronger resource inequality affects cooperation and punishment dynamics. Larger asymmetries in endowments may generate more pronounced behavioral differences, particularly in contribution levels and punishment decisions.

Endowments remain fixed for each participant across all rounds.

2.2 Punishment Systems

Peer punishment is a decentralized system in which individuals incur costs to sanction other group members. Previous research shows that peer punishment can increase cooperation compared to situations without punishment. However, peer punishment may reduce overall welfare because punishment is costly and antisocial punishment can occur [5]. Moreover, under imperfect monitoring, individual punishment can become less effective and may even decrease welfare, as noise in the observation of contributions can lead to misdirected punishment and retaliation [1].

Democratic punishment introduces a collective decision rule in which sanctions are implemented only if supported by a majority vote. Compared to decentralized peer punishment, democratic punishment increases cooperation and overall payoffs while reducing antisocial punishment [5, 1]. By filtering punishment decisions through majority voting, democratic punishment strengthens the relationship between contribution behavior and subsequent sanctions and improves efficiency [1]. In addition, democratic punishment enhances fairness perceptions, satisfaction, and interpersonal trust among group members [5].

Two punishment institutions are implemented:

- **Peer Punishment:** Each player can assign punishment points to other group members. Each point costs the punisher 1 MU and reduces the target's payoff by 2 MUs. The total punishment budget is capped at 9 MUs.
- **Democratic Punishment:** Players first propose punishment points. Execution requires majority approval (at least two of three other group members). Punishment is implemented only if approved.

2.3 Information Conditions

The experiment additionally varies the information environment regarding endowments. Two information modes are implemented:

- **Complete information (full):** Participants observe both contributions and endowments of all group members.
- **Incomplete information (incomplete):** Participants observe contributions of all group members, but only their own endowment. Others' endowments are not disclosed.

The incomplete-information treatment builds on the framework of endowment heterogeneity and informational asymmetry developed in [2], where endowments may be unobserved and institutional outcomes differ depending on the information structure.

3 Hypotheses

H1 (Absolute contribution bias under incomplete information). When only contribution amounts are observable, punishment decisions may be based primarily on absolute contribution levels rather than on contributions relative to endowment. As a consequence, low-endowment individuals may face disproportionately high punishment despite contributing a comparable share of their resources. This may result in systematically lower payoffs for low-endowment participants [2].

H2 (Dynamic adjustment of low-endowment individuals). Under incomplete information, low-endowment participants may increase their contributions over successive rounds in order to avoid punishment. This dynamic can place low-endowment individuals at a structural disadvantage, as they must contribute a larger share of their resources to avoid sanctions.

H3 (Stronger inequality amplifies contribution gaps). When endowment inequality becomes more extreme, differences in contribution behavior may widen. In particular, high-endowment individuals may exhibit stronger free-riding tendencies as inequality increases [2]. This may lead to greater dispersion in relative contributions and final payoffs.

4 Reference

References

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