

Conditional Cooperation in Network Public Goods Experiments

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Introduction

Private Provision of Public Goods on a Network

- private provision of public goods using voluntary contributions
- individuals only benefit from local or neighborhood provision levels

Conditional Cooperation

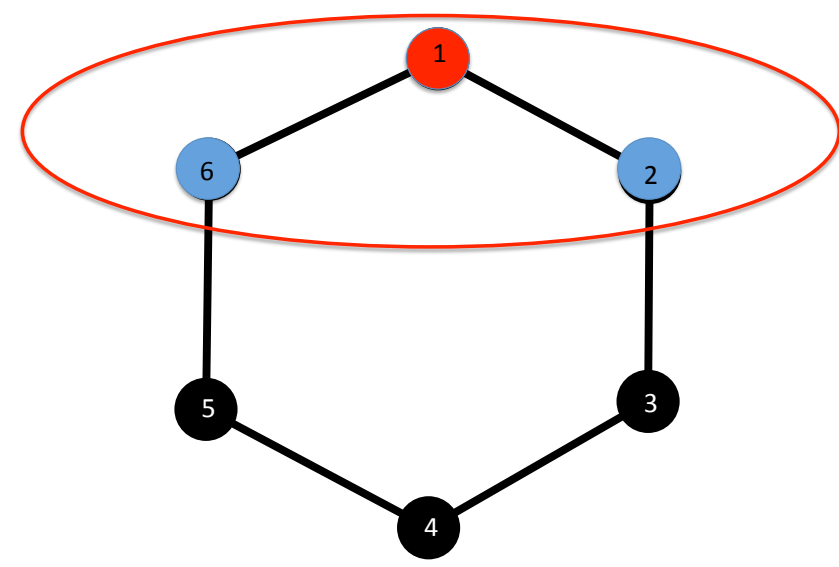
- A substantial fraction of individuals are **conditional cooperators**;
 - contribute more when they expect others to do the same
 - exhibit a **self-serving bias** – only partially match the expected contributions made by others
- Other individuals follow unconditional strategies
 - some contribute everything (full contributors);
 - some contribute nothing (free-riders)

Objectives

- To examine the pattern of contribution decisions by heterogeneous groups in a network public goods experiment.
- Classify subjects into categories of **cooperative types**.
- Identify the effect of **conditional cooperation** in a network environment.

Network Public Goods Game (NPGG)

- 6 players arranged on a circle network
- Each player is endowed with 100 tokens to allocate between a **public good** and private consumption
- A player's public good consumption is determined by the total level of contributions in the player's neighborhood
- Payoffs are given by



$$\pi_i = 100 - g_i + 0.4 \left(g_i + \sum_{j \in N_i} g_j \right)$$

where g_j is player j 's contribution, N_i is the set of player i 's direct neighbors in the network

- The Circle Network above shows that Player 1's neighborhood includes player 2, and player 6
- Players' neighborhoods overlap, allowing for different levels of public good consumption

Experimental Design

- 6 sessions with 72 total subjects
- In each session, subjects participated in 4 independent matches
 - Each match consisted of 15 periods of the NPGG in fixed groups
 - Between periods, subjects observed the total contributions made in their neighborhood
- Treatment variation - subjects also observed 1 of 4 conditions:
 - Average contribution in their neighborhood (C-N)
 - Average contribution in the whole group (C-G)
 - Average payoff in their neighborhood (P-N)
 - Average payoff in the whole group (P-G)

Overview of Results

- We find considerable heterogeneity in the cooperative types of players in the NPGG
- In the standard public goods game, previous work has consistently shown that average contributions **decay** with repeated play
- In groups with a single free-rider, the process of decay among conditional cooperators is faster, although still **spreads gradually across the network**
- On the other hand, even in groups without any free-riders, an unconditional full contributor can only prevent (or delay) the decline in contributions, rather than induce higher contributions – **conditional cooperation exhibits a self-serving bias**
- Both the composition and configuration of types in the group affect the pattern of contributions in the NPGG

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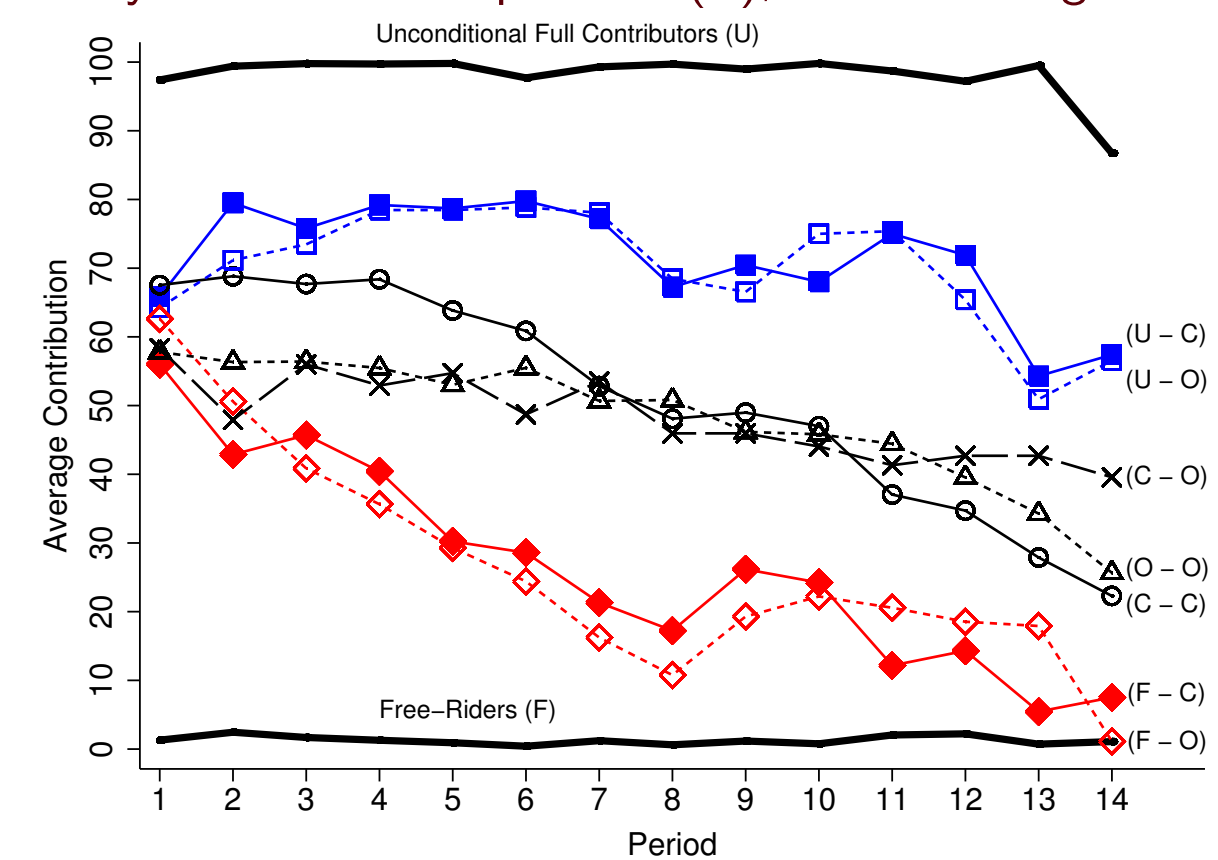
Neighborhood Contagion in the NPGG

Subject Classifications

Classification	Treatment			
	P-N	P-G	C-N	C-G
Unconditional Full Contributors (U)	16	5	16	13
Free-Riders (F)	7	8	6	9
Conditional Cooperators (C)	29	41	37	28
Other	20	18	13	22
Total	72	72	72	72

- Subjects are classified based on their decisions in the experiment
- We find significant neighborhood influences on conditional cooperators, consistent with the idea that conditional cooperation has a self-serving bias.**
- Players with a free-riding neighbor (F) converge quickly toward free-riding behavior
- Players with a full contributor neighbor (U) exhibit almost no decay until the end, but do not converge toward full contributions

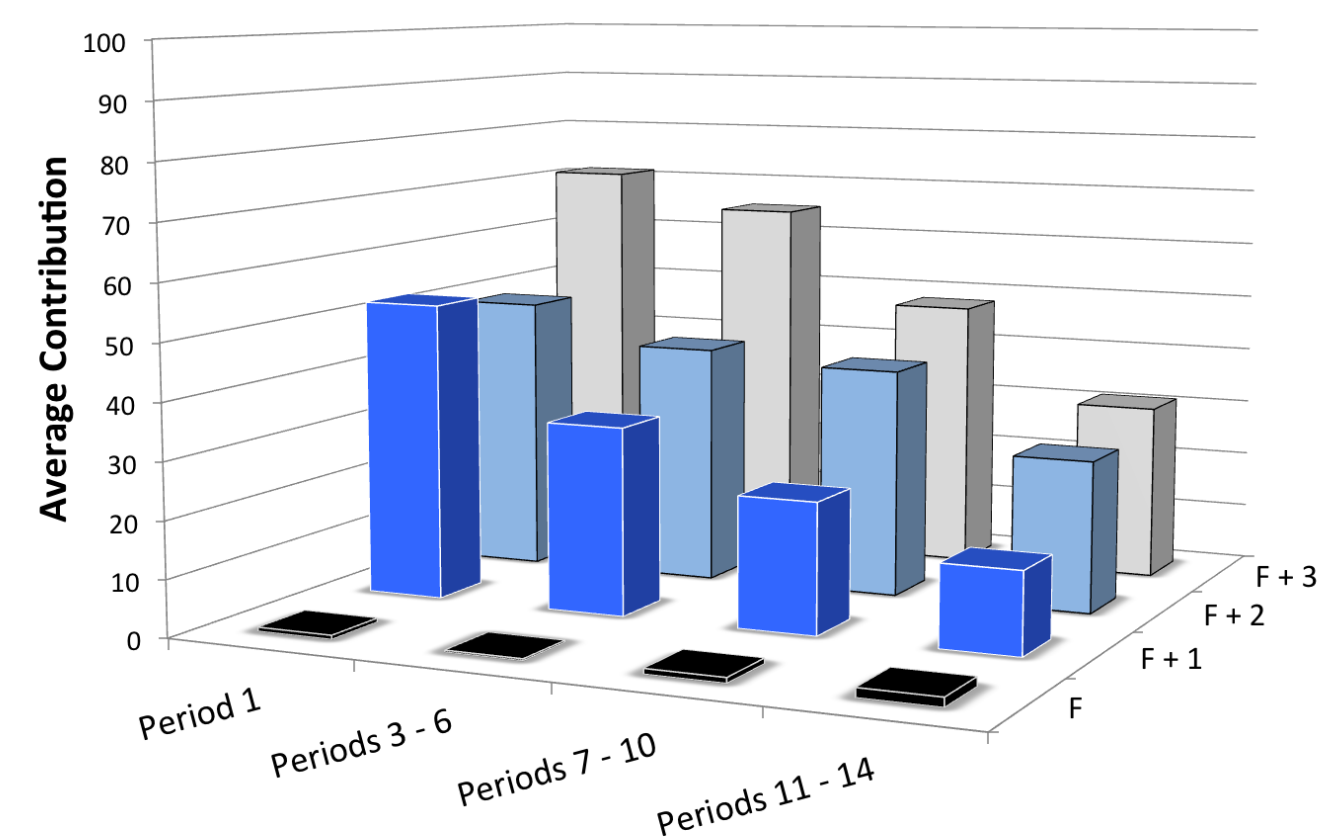
Ave. contribution by conditional cooperators (C), based on neighbors' classifications



Group Composition and Contagion

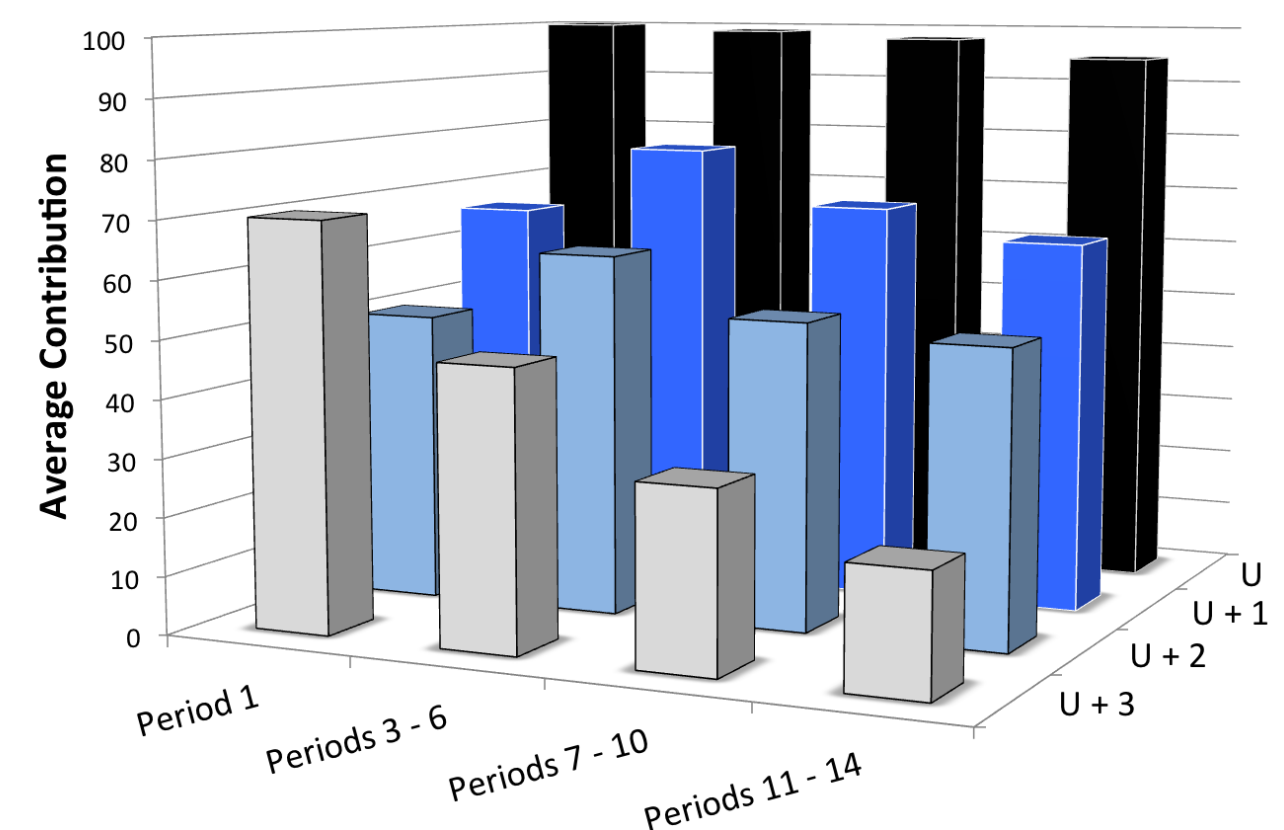
- Stable contributions by unconditional types spread contagiously across the network.

Groups with 1 free-rider (F) and 5 conditional cooperators (C)
 F = free-rider; F + n = players who are n steps from the free-rider.



- Unconditional full contributors can slow down or postpone the decay in contributions, but do not induce convergence towards full cooperation.

Groups with 1 (or 2) full contributors (U) and 5 (or 4) conditional cooperators (C)
 U = free-rider; U + n = players who are n steps from the unconditional full contributor.



Conclusions

- the dynamics of conditional cooperation are particularly salient in the NPGG
- unconditional types (full contributors and free-riders) can either **speed up** or **delay** the breakdown of cooperation
- evidence in support of the **self-serving bias**