

Punishment and reward in multi-group resource appropriations: an experimental approach

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1. Introduction

A commons dilemma arises in situations in which groups of individuals jointly rely on a resource and individuals' rational decisions to use the resource are sub-optimal from the perspective of the group. Furthermore, many resources are used by more than one group, leading to particularly convoluted situations in which one group's use unilaterally affects the use of the other groups. For example, it is common for multiple groups to share the water resources of a river. In that case, a decision by a user potentially affects all users downstream but does not affect users upstream. International rivers have often induced political tensions among riparian states such as the ones between India and Bangladesh, between Arab countries and Israel, or among ten riparian countries of the Nile river (Elhance, 1999; Wolf, 1998). Fish stocks are another source of similar disputes. While fish species migrate across different fishing grounds, fishers may not move correspondingly due to territorial restrictions or a gear type. This could put some fishers at a disadvantaged position and others at a dominant place like river resource appropriators (e.g. Tokunaga et al. (2019)). The greater the variety of user groups, the more complex the dilemma. New models are needed to resolve these multi-group conflicts.

In this paper, we develop a model to analyze cooperation in unilateral externality resource appropriations and test it using a laboratory experiment. We are interested in understanding an effective mechanism to foster cooperation among advantaged appropriators, and in particular how such a mechanism can be exerted by disadvantaged appropriators. Building on the literature showing the efficiency of punishment in a public goods game, we examine how empowering disadvantaged appropriators to punish and/or reward advantaged appropriators affects cooperation in a multi-group environment.

2. Materials and methods

We use laboratory experiments to separately identify the effect of punishment and reward in a

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commons dilemma of a multi-group environment. This study modifies a standard CPR game relied on in previous studies (Hackett et al., 1994; Ostrom et al., 1992; Walker et al., 1990). We adopt a model of spatially linked groups of users of a CPR to represent multi-group appropriations in which a privileged (advantaged) group’s appropriations reduce a disadvantaged group’s use of the resource (Libecap & Wiggins, 1984; Sanchirico & Wilen, 1999, 2005; Schnier, 2009). Our multi-group setting restricts one group of users to appropriations from a single patch, which could affect the other group of users of a different patch. Although we structure the base model in the context of spatial connectedness, our conclusions apply equally to temporal constraints and differences in usage as previously discussed.

Each session of the experiment involved 16 subjects who were randomly assigned to groups of 8 members in the multi-group setting (four advantaged and four disadvantaged members). In the first half of the experiment, participants made eight decisions about whether to invest some or all of an endowment of 14 tokens in a group account (CPR) or in a private account. The subjects in each group were also randomly assigned a type – advantaged (group 1) or disadvantaged (group 2) – and those characteristics were maintained throughout the session. In this second half of the experiment, participants were provided with new instructions that specified what option was allowed after they made their investment decisions. Under the punishment (reward) treatment, with trivial costs disadvantaged members were allowed to send punishment (reward) points to advantaged members, whose earnings are reduced (increased) proportionately by the number of points received.

3. Preliminary Results

Although the figures below do not show an obvious difference between treated and control subjects, the estimates from regression do reveal treatment effects. Consistent with the literature, both punishment and reward sent by disadvantaged appropriators was effective in fostering a cooperative behavior among advantaged appropriators in our multi-group environment.

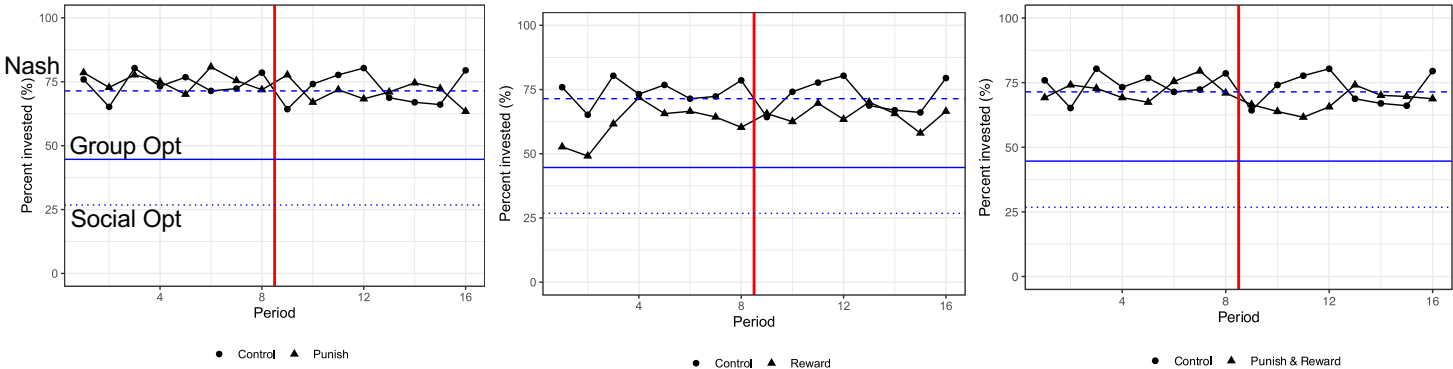


Fig. 1 Mean appropriation rate by treatment (%) over time (regular appropriators)