Banco de México

Documentos de Investigación

Banco de México

Working Papers

N° 2015-12

The Perils of Peer Punishment: Evidence from a Common Pool Resource Experiment

Gioia de Melo
Banco de México y Universidad de la República del Uruguay

Matías Piaggio
Universidad de la República del Uruguay y Univesitat Autònoma de Barcelona

June 2015

Documento de Investigación
2015-12

Working Paper
2015-12

The Perils of Peer Punishment: Evidence from a Common Pool Resource Experiment*

Gioia de Melo†
Banco de México y Universidad de la República del Uruguay

Matías Piaggio‡
Universidad de la República del Uruguay y Univesitat Autònoma de Barcelona

Abstract: We provide experimental evidence on the effects of social disapproval by peers among communities of Uruguayan small-scale fishers exploiting a common pool resource (CPR). We combined this treatment with an in-group (groups from a single community) / mixed group (groups composed of fishers from different communities) treatment. We find that mixed groups, unlike in-groups, reduce their exploitation of the resource in response to the threat of punishment. Both in in-groups and mixed groups there is substantial antisocial punishment, which leads to increased extraction of the CPR by those who are unfairly punished. These findings indicate that effective peer punishment requires coordination to prevent antisocial targeting and to clarify the social signal conveyed by punishment.
Keywords: social disapproval, social preferences, common pool resource
JEL Classification: D03, O12, C93

Resumen: Se proporciona evidencia experimental de los efectos de la desaprobación social entre pares en comunidades de pescadores uruguayos de pequeña escala que explotan un recurso de uso común (RUC). Combinamos este tratamiento con un tratamiento intra-grupo (grupos de una misma comunidad) / grupo-mixto (grupos compuestos de pescadores de distintas comunidades). Se observa que los grupos mixtos, a diferencia de los intra-grupos, reducen su explotación del recurso en respuesta a la amenaza de castigo. Tanto en los intra-grupos como en los grupos mixtos hay castigo antisocial sustancial, lo cual lleva a una mayor extracción del RUC por parte de quienes fueron castigados injustamente. Estos resultados indican que el castigo efectivo entre pares requiere coordinación para evitar objetivos antisociales y clarificar la señal social que transmite el castigo.
Palabras Clave: desaprobación social, preferencias sociales, recurso de uso común

*Agradecemos particularmente los valiosos consejos de Sam Bowles, Francisco Alpizar y Fredik Carlsson. También agradecemos los comentarios recibidos por Gabriele Camera, Luigi Luini, Shachar Kariv, Jordi Brandts, Jorge Maldonado, Jeroen van der Bergh Josep Lluís Raymond y Andres Rius. Agradecemos el financiamiento de LACEEP y del Instituto de Economía (UdelaR). Este proyecto no habría sido posible sin el apoyo de varios investigadores del Instituto de Economía durante las sesiones experimentales.

† Banco de México y Universidad de la República del Uruguay. Email: gdemelo@banxico.org.mx.

‡ Universidad de la República del Uruguay y Univesitat Autònoma de Barcelona. Email: mpiaggio@iecon.ccee.edu.uy.

1. Introduction

The exploitation of a common pool resource (CPR) poses a typical social dilemma. Hardin (1968) proposes the establishment of either private or state property rights as a solution to avoid the so-called tragedy of the commons. However, since informational asymmetries often vitiate the attempts of government regulations or market contracts to prevent overexploitation, communal property regimes have become an attractive alternative for the conservation and sustainable use of CPRs.

Regarding coastal and inland fisheries, there are already more than thirty experiences of co-management in Latin America and the Caribbean. However, this practice is more widely spread in Brazil and Chile, while in the rest of the countries there are just isolated experiences. In Brazil co-management is practiced for multiple species, while in Chile co-management takes place only in benthic shellfisheries (Gutiérrez et al., 2011; Salas et al., 2011). Given their sedentary nature, benthic shellfisheries favor the establishment of spatially explicit management tools such as territorial user rights coupled with co-management, (Defeo and Castilla, 2005). Gutiérrez et al. (2011) argue that while the success in Brazilian co-management experiences is heterogeneous, all the Chilean cases are very successful.

Although much research has explored the determinants of successful communal property regimes, the issue is far from settled. It has been argued in many studies that, by enforcing social norms, communal property can fill the gaps of incomplete contracts (Feeny et al., 1990; Ostrom, 1990; Baland and Platteau, 1996; Ostrom et al., 1999; Ostrom, 2000; Bowles and Gintis, 2002). Ostrom (1990) identifies eight design principles that characterize long-enduring CPR institutions. She argues that monitoring, graduated sanctions (by other appropriators or by regulators) and conflict-resolution mechanisms are in the core of communal CPR management success. These sanctions can be formal or informal, implying or not the payment of a fine.

In this study, we evaluate whether social disapproval (in particular blaming and shaming mechanisms) is effective in promoting cooperation in a CPR dilemma: small-scale fisheries in coastal lagoons. We seek to compare the effectiveness of social disapproval (or nonmonetary punishment following Masclet et al. (2003)) when the exploiting individuals belong to different communities with its effectiveness when such individuals all belong to the same community. Indeed, different kinds of institutions may be effective depending on the context in which a CPR is exploited (Ostrom et al., 1999).

There is evidence that nonmonetary punishment or social disapproval (Barr 2001; Masclet et al., 2003; Cinyabuguma et al., 2005; Noussair and Tucker, 2005; Carpenter and Seki, 2009; Dugar, 2010) and social approval (Gächter and Fehr, 1999; Rege and Telle, 2004) under certain conditions can increase contributions in public good games, voluntary contribution mechanisms and minimum effort games. Falk et al. (2012) find that social enforcement in the form of face to face communication that allows subjects to send signals of approval or disapproval is effective in increasing cooperation in a common pool resource and a trust game with third party punishment games.

A number of studies suggest that individuals achieve greater levels of cooperation with members of their own group than with outsiders. Turner et al. (1979) define in-group bias as those instances of favoritism which are unfair or unjustifiable in the sense that they go beyond the objective requirements or evidence of the situation. In this way, individuals enhance their social identity by taking decisions that are more favorable to their in-group than their out-group members (Tajfel and Turner, 1979). This phenomenon has been observed not only in groups induced artificially (Charness et al., 2007; Chen and Xin, 2009; Hargreaves et al., 2009; Harris et al., 2012) but also in groups that occur naturally (Bandiera et al., 2005; Miguel and Gugerty, 2005; Bernhard et al., 2006; Ruffle and Sosis, 2006; Goette et al. 2012). These results are clearly relevant to any analysis of a CPR dilemma. Commons managed by one group versus individuals belonging to different groups may influence the social preferences of group members and thereby affect resource conservation.

Our study concentrates on small-scale artisanal fishers on the Uruguayan seacoast who ply their trade in two coastal lagoons (Laguna de Rocha and Laguna de Castillos) while living in nearby villages. We study coastal lagoons because they are exploited only by artisanal fishers—in contrast to open sea, where large-scale fishing is widespread. Laguna de Rocha was declared part of the national protected areas system in 2010, while Laguna de Castillos is in the process of being declared a protected area. In Uruguayan coastal lagoons there are no rules that grant privileges to local fishers, any person holding a fishing license for that specific zone (coastal lagoons) is allowed to fish. However, there are four pilot experiences currently designing community based mapping and zoning in small scale fisheries in other locations (DINARA, 2009; 2011). The government intends to extend this practice to other locations (including small scale fisheries located in the protected areas).

We perform a framed field experiment (Harrison and List, 2004) employing naturally occurring groups (i.e. communities or groups of people who live in the same settlement, all groups fish in two coastal lagoons about 50 kilometers apart on the Uruguayan seacoast). Naturally occurring groups provide an ideal environment for the study of how group affiliation affects social norms (Cardenas, 2003; Bernhard et al., 2006). We seek to establish whether (or not) fishers are more sensitive to NMP when interacting among individuals from the same community than when interacting with fishers from a different community. We also test whether their propensity to cooperate differs in these two scenarios. Fishers from different communities do not interact during their daily life, but they often encounter each other while fishing as they move from one lagoon to the other in pursuit of more available fish. Our experiment incorporates both an NMP and an in-group/mixed-group treatment. Individuals participate in a CPR game and, after five periods of this game, the NMP is implemented. This nonmonetary punishment enables individuals to express their disapproval of others' extraction decisions while facing a monetary cost themselves. Disapproval is registered by flags that vary in color to reflect the level of disapproval. For the in-group treatment, subjects interact only with members of their own community; for the mixed-group treatment, subjects interact also with members of another community.

Experiments do not directly measure social preferences, and inevitably there will be more than one possible interpretation of results. We will, where the experimental results allow, consider the hypothesis that social preferences are a plausible explanation of the behavior in our experiment. In line with Bowles and Gintis (2011) by “social preferences” we refer to a wide range of motives such as reciprocity, altruism, and conformism as well as such emotions as shame, guilt, and anger. Punishment is often viewed not only as a way to incentivize desired behavior but also as a “moral lesson” in condemning antisocial behavior (Bowles and Polanía-Reyes, 2012). We are interested in exploring whether or not, in the absence of monetary incentives, moral lessons can effectively guide behavior toward socially beneficial ends. The prosocial emotions of an individual being punished could potentially be better identified by nonmonetary (NMP) punishment than when she must endure monetary (costly) punishment.

We find that nonmonetary punishment has a positive effect on cooperation when individuals are interacting with fishers from other communities. That is, when individuals in the mixed-group treatment face the possibility of NMP, they reduce their average extraction level irrespective of whether they are actually punished. The effectiveness of these informal sanctions is compromised to the extent that some individuals are less sensitive than others to NMP (i.e. the reaction to social disapproval is heterogeneous) and also by the use of such sanctions to punish not only free riders but also cooperators (i.e. antisocial or perverse punishment). Furthermore, we find no in-group bias with respect to cooperation. That is, individuals do not behave differently when interacting with those from their own community than when mixed with subjects from other communities—except for being more sensitive in mixed groups to the threat of NMP. We observe that individuals adjust their extraction levels from one period to the next in order to converge to the previous period’s group average. Also, subjects whose partners were punished in the previous period then prefer behaving less cooperatively to running the risk of being disadvantaged by others’ decisions. Yet because social norms need not be shared by all individuals, we conclude that peer punishment must be coordinated in order to prevent antisocial targeting and to enhance the social signal conveyed by punishment.

The paper contributes to the literature in bringing the devices of social punishment from the lab to the field and replicating some of the usual findings found on the former. Instead of inducing artificial in-group/mixed-group differences, it is the first setup that involves individuals from actual separate communities meeting each other. Furthermore, in line with Carpenter and Seki (2009) but unlike Masclet et al. (2003), Noussair and Tucker (2005) and Dugar (2010), even though individuals who are socially punished incur no monetary cost, those who punish others *are* assessed a monetary cost; this protocol was implemented to reduce the likelihood of carelessly administered punishments and to reflect that in real life blaming and shaming also induces transaction costs for the blaming person. In general terms, the paper contributes to the current discussion with regard to the role of social information in the establishment of group norms.

The rest of the paper is organized as follows. In Section 2 we describe the experimental design. Section 3 reports our results regarding the effect of the treatments in general, the punishment behavior and the reaction to punishment. We conclude with a summary discussion in Section 4.

2. Experimental design

2.1. Subject pool

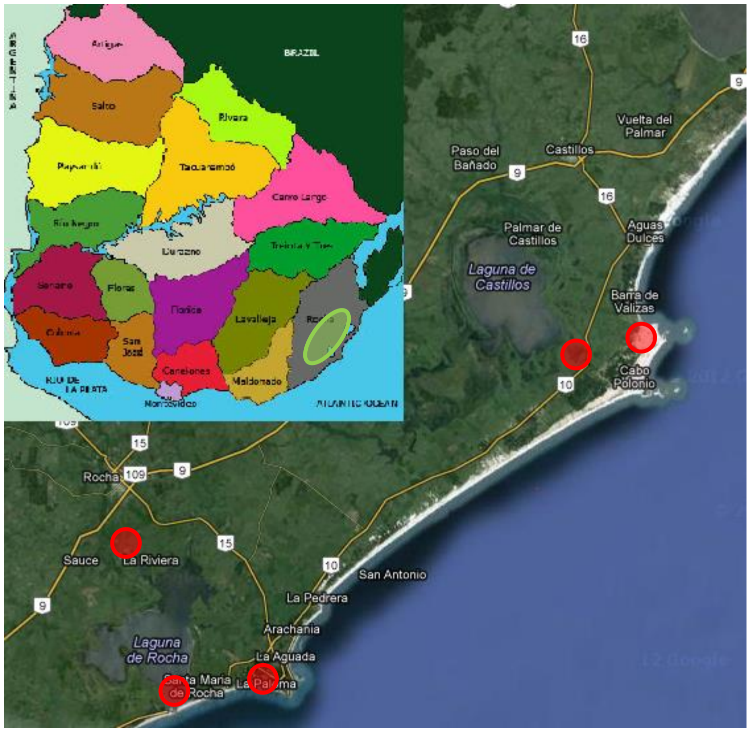
The Laguna de Rocha and Laguna de Castillos are located in the south-east coast of Uruguay (Figure 1). The former was declared part of the national protected areas system in 2010, while the latter is in the process of being declared a protected area. Small scale artisanal fishing activities are mostly developed by fishers from local communities, who move from one fishing site to the other depending on the season (CAEAPLR, 2006; Rodríguez-Gallego et al., 2008; and Defeo et al., 2009). This type of fishing not only implies that gross tonnage of the boat cannot exceed 10 tons (as in industrial fisheries), but also fishing activities are conducted with smaller boats than other cases of artisanal fisheries that fish in the open sea. Artisanal fishers have to get a specific license from the National Aquatic Resources Direction (DINARA), which must be renewed every four years and implies no monetary cost. A maximum of ten shrimp traps are allowed for this species when fishing in the coastal lagoons. In practice, licenses work more as an administrative register than as mechanism to regulate access. Monitoring activities are conducted by DINARA, and violations of regulations can be punished with sanctions that range from fines to gear confiscation. However inspections are ineffective because of institutional weaknesses.

There are no rules that grant privileges to local fishers, any person holding a permit for that specific zone (coastal lagoons, their tributaries and the Atlantic Ocean) is allowed to fish. However, co-management pilot experiences in artisanal fisheries are being developed in other locations and the government is evaluating whether to extend this practice to other locations (including those small scale fisheries located in the protected areas). Fish overexploitation is one of the most visible pressures that the Laguna de Rocha suffers, with some species exhibiting poor reproduction dynamics (Rodríguez-Gallego et al., 2008 and Defeo et al., 2009). This is a major concern, since fish are essential for both the conservation of local ecosystem and the preservation of the main source of income for the mostly low-income residents (Thompson, 2007).

We recruited individuals from five communities who fish in the Laguna de Rocha and/or in the Laguna de Castillos, two coastal lagoons about 50 kilometers apart on the Uruguayan seacoast; see Figure 1. We define community as a group of people who live in the same settlement and constantly interact with each other. Individuals from different communities are ethnically homogeneous but exhibit differences in socioeconomic characteristics. These subject communities differ in terms of how connected they are to relevant markets and also in terms of their exit options. The members of some communities (Laguna de Rocha, Puerto los Botes, and—to a lesser extent—El Puente) lead extremely isolated lives, and fishing is their main source of income; those in the other communities (Valizas and Barrio Parque) are more connected to densely populated areas and so have more varied options. Individuals with more exit options typically have more income and greater wealth (see Table A.1 in the Appendix). However, fishing gear among communities does not differ. They all fish in boats and use nets and shrimp traps.

Fishermen from different communities seldom meet in their daily lives, but they do so more frequently when moving across lagoons while fishing in seasonal peaks. Such movement is prevalent during the peak shrimp season, which usually occurs at least once annually in the Laguna de Castillos but rarely (for geographical reasons) in the Laguna de Rocha. According to PROBIDES (2002), fishermen have complained about fishers from other communities who arrive during the peak season to fish in the lagoon where the complainants fish year round. We believe that place of residence is the main factor dividing groups of fishermen.

Figure 1: Location of framed field experiment (the five communities marked by red circles)



2.2. The experiment

Our experiment consisted of a 20-period CPR game structured in four stages of 5 periods each. During 10 periods subjects interacted only with members of their own community (in-group treatment), while in the other 10 periods subjects interacted also with fishermen from another community (mixed-group treatment). This distinction was not explained to the participants. Before the game started, subjects were allocated to different groups based on the number that identified them. We did not explicitly explain the grouping criteria in order to minimize influencing subjects´ reaction to the treatment. However, subjects could tell by looking at their group partners whether they belonged to their community or to a different one. Communities are so small in the area of study that there is no chance that individuals within a community cannot determine whether an individual lives in his community or not. This is what the in-group and mixed-group treatments consisted of. In addition to these treatments, in periods 6-10 and 16-20 we added the possibility of expressing social disapproval or nonmonetary punishment. Thereby, the structure of the game could be described in four stages of 5 periods each in which subjects experienced (though in different order in Sessions 1 and 2) the four combinations of treatment described in Table 1.

Table 1: Characteristics of the experimental sessions

	Subjects		Treatments by period[a]			
Community name	**Included in analysis**	**Discarded[b]**	**1-5**	**6-10**	**11-15**	**16-20**
Session 1						
Laguna de Rocha	8	3	ingroup	ingroup punishment	mixed-group	mixed-group punishment
Valizas	8	3	ingroup	ingroup punishment	mixed-group	mixed-group punishment
Session 2						
El Puente	12		mixed-group	mixed-group punishment	ingroup	ingroup punishment
Puerto los Botes	8		mixed-group	mixed-group-punishment	ingroup	ingroup punishment
Barrio Parque	8		mixed-goup	mixed-group punishment	ingroup	ingroup punishment
Total	44	6				

[a]**In-group:** "Rooms and subgroups with individuals belonging to the same community".
Mixed-group: "Rooms and subgroups with subjects belonging to two communities".
NMP: "Expressing disapproval of others' extraction levels. Those punished receive flags".

[b] During session 1 the subjects who turned up from Laguna de Rocha and Valizas were not multiples of four so three subjects from each community were selected randomly to play in subgroups of three and were reshuffled solely among the six all the periods. They were not considered in the analysis.

The CPR game was used to frame the decision of how many nets to use when fishing. The explanation mentioned that the activity intended to reproduce a situation in which a group of persons must make decisions individually about how to exploit a fishery such as Rocha´s coastal lagoons. Subjects made their decision in subgroups of four participants. During periods 1-5 and 11-15, subjects participated in a regular CPR game in which they considered a common pool resource exploited by individuals who have the same maximum endowment (eight nets) of fishing rights. An individual's benefits were increasing in the number of nets he used and decreasing in the aggregate number of nets used (see Table A.2). Subject i's earnings in periods 1-5 and 11-15 are given by the payoff function $\pi_i =$

$18a_i + 12\sum_{j=1}^{4}(8 - a_j)$.[1] A selfish individual would always choose $a_i = 8$ so as to maximize his own material payoff.

During periods 6-10 and 16-20, a nonmonetary punishment or social disapproval treatment was introduced. During these periods, subjects were allowed to express disapproval of others' fishnet choices within their current subgroup. Once the punishment points administered to each subject were totaled, a flag whose color (yellow, orange, or red) indicated the extent (least to most, respectively) of their peers' disapproval was assigned in accordance with the ranges listed in Table A.4. No subject could receive a red flag unless more than one other participant disapproved of his fishnet choice. Those who received a flag had to exhibit it in the next period while playing in a different subgroup.

We employed a *hybrid* strategy method to implement social disapproval. In this method individuals made decisions in two stages. Firstly, individuals chose their individual extraction level, and were subsequently informed of the total number of nets used by other subgroup members (allowing each subject to calculate the average number of nets used). Secondly, knowing the group's extraction level, each participant was empowered to allocate 0 to 10 "punishment points" to the number of fishnets that others chose to use (see Table A.3) and could disapprove of the eight extraction alternatives (1 to 8 nets) at the same time.[2] In this way, punishment points were not assigned as in the pure strategy method whereby both decisions—namely, extraction and punishment—are made at the same time.

The reason why we chose a hybrid strategy method is that we wanted subjects to punish for reasons related to extraction levels and not for personal reasons between subjects,

[1] Unlike the quadratic model representing decreasing marginal returns common in CPR framed field experiments (e.g. Ostrom et al., 1994; Cárdenas, 2003), we specify a linear payoff function. The model in this article follows closely the model developed by Bowles (2004, pp 153-156) in which peer monitoring and forms of social disapproval enable individuals to achieve agreed levels of effort. We choose the payoff function to be linear in order to simplify the model given the greater complexity of considering motives for social disapproval. Thereby, the aim of the payoff function is to test for the existence of cooperation. The theoretical model is described in Appendix A.

[2] A subject was free to punish those choosing the same number of nets that he chose, although such punishment would not also be applied to himself (this aspect of the setup was explained only in response to a direct question).

especially in the in-group treatment where all subjects in a group knew each other. We discarded the alternative of disclosing actual individuals´ levels of extraction in a random order because it would have been extremely cumbersome to implement given that the game did not involve the use of computers. We preferred a hybrid strategy method to a pure strategy method because the former is closer in spirit to assigning punishment based on knowing the fishnet choices of each of the other subgroup members and also in order to attenuate the latter´s shortcomings listed in the literature. Indeed, Brandts and Charness (2010) argue that following a strategy method instead of a direct punishment treatment can lead to lower disapproval among individuals. Also, Blount and Bazerman (1996) argue that individuals are less concerned with fairness when simultaneously choosing between two outcomes than when considering each outcome separately.

Punishment points resulted in no monetary cost to the punished but did entail a monetary cost to the punisher: each punishment point cost the punisher one point in his "earnings account". Subjects were charged for the total number of punishment points they issued regardless of whether that number corresponded to the number of nets actually used by the targets.[3] Thus subject *i*'s payoff function during the *last* five periods of each stage is $\pi_i = 18a_i + 12\sum_{j=1}^{4}(8 - a_j) - \sum_{k=1}^{8}\mu_{i,k}$

The cost of punishing was set much lower than the points a subject could earn during a period. For instance, if all subjects chose the Nash equilibrium in one period then each would earn 144 points; if the social optimum was achieved, then each would earn 354 points. The cost to a subject who disapproved of all possible fishnet choices by administering the maximum punishment in one period would total 80 points (equivalent to about half a US dollar, hereafter denoted simply via "$"). The aim of this treatment was to re-create the experience of being socially punished in the field (via gossip, direct criticism, etc.) and to evaluate the effects of that punishment on extractive decisions in subsequent periods. We acknowledge that punishing others socially may entail also a social cost to the

[3] There are two reasons why the punisher was charged the total number of disapproval points and not merely for those corresponding to actual fishnet choices: the former (i) was much simpler to explain and (ii) enabled the subject to calculate the cost by himself. We believe that simplifying mechanisms of this type are especially useful in a framed field environment.

punisher, but because that is not the focus of this study it is sufficient for our purposes that there be *some* (monetary) cost to the punisher. Carpenter (2007) concludes that the demand for punishment is relatively inelastic with respect to price and income and argues that this is due to the fact that individuals punish primarily for social rather than economic reasons.

2.3. Structure of the experiment

Subjects were first contacted during a survey conducted in March 2011, which was almost a census of the population as fisher communities are very small. Indeed, according to the Acuatic Resources National Direction (DINARA), during the shrimp season (peak fishing time) approximately 120 - 200 persons went to Laguna de Rocha to fish in 2009 while we surveyed a total of 130 fishers. We implemented the survey in March because it is generally the peak fishing season when we expected to find more fishers in the lagoons. The aim of this survey was to gather data on socioeconomic characteristics and environmental perceptions among the resource users of artisanal fisher communities in Rocha and Castillos coastal lagoons. At the end of the questionnaire, each interviewee was asked whether he would like to participate in an activity where he could earn, on average, the equivalent of two days' wages (about $30). The experiment´s recruitment took place a week before the experiment. We revisited the five communities and hand-delivered flyers to residents, and we also made phone calls to those who had been surveyed but could not be located during our subsequent visit. To test for the existence of a self-selection bias between those individuals that participated in the experiment and those that were surveyed in March but did not participate in the experiment, we conducted Wilkoxon rank-sum tests considering the variables in Table A.1. Difference in the means was rejected for all the tested variables (Years of schooling, z= -1.48 p-value= 0.14; Wealth, z=0.059, p-value=0.95; Per capita income (US), z=0.471; p-value=0.95; Fishing as the main activity, z=-0.34, p-value=0.74).

The experiment was conducted in two sessions during November 2011. Both sessions took place at La Paloma, a town in the province of Rocha, Uruguay. Because the experimental design required mixing ate certain point fishers from different communities, we needed at least two communities to participate in each session. Two communities were invited to participate in the first session and other three in the second session (Table 1). This distribution was determined randomly. Unlike most framed field experiments, in this study subjects were transported from their place of residence to the town in which the experiment was conducted. This design was necessary so that subjects from different communities could meet, but it required that fishermen leave their community to participate. We had difficulty convincing subjects to travel, which explains why there were fewer participants than desired.[4]

When subjects arrived at the venue, they drew a number from a bag (one bag per community). This number represented an identifier that assigned each subject to a room for the first ten periods and to a different room in the last ten periods as well as a subgroup for each of the twenty periods. Within these rooms, participants switched subgroups before each round so as to take part in a CPR game in different subgroups of four persons. In session 1 there were two rooms of eight subjects, and individuals were constantly reshuffled within these rooms during every period and were assigned to a different room after 10 periods in order to begin the mixed-group treatment. In session 2, in which three communities participated with 12, 8 and 8 members each, there were three rooms: two of 8 and one of 12 subjects and individuals were reshuffled within these rooms for ten periods and then switched rooms to play the in-group treatment in the following ten periods, also being constantly reshuffled. We reshuffled subgroups after each period in order to try to minimize certain aspects of repeated game type of behavior (to completely avoid this type of behavior, a perfect strangers design would be required as in Fehr and Gächter (2000)). In the mixed-group treatment, each subgroup consisted of two individuals from each of two communities, while in the in-group treatment all the individuals belonged to the same community.[5] The subgroups that participated in the experiment's 20 periods were

[4] We were unable to expand the sample size by extending the experiment to other communities because the mixed-group fishing scenario that takes place in the Rocha and Castillos' coastal lagoons is almost unique in Uruguay.

[5] In session 2, there were twelve subjects from one community (El Puente) and only eight subjects from the other two communities (Puerto los Botes and Barrio Parque). Hence the mixed-group treatment in this session involved subgroups composed either of two subjects from El Puente and two from one of the other communities or of three subjects from El Puente and one from another community. In all cases, the mixed-group treatment involved mixing just two communities.

predetermined by identifier numbers. It was common knowledge that the matching procedure for all periods was random and was determined by the initial draw of participants' identifier numbers. Before each period, the experimenters indicated to the participants which subgroup of four they would take part. After the first 10 periods, participants in the mixed-group treatment were switched to the in-group treatment (and vice versa), although the subjects were not informed of these particulars. During session 1, the in-group treatment preceded the mixed-group treatment; in session 2 the order was reversed (see Table 1). This design enabled us to control for order effects.

Once divided into subgroups of four members, participants were asked to sit back-to-back so that they could not see the others' choices. Each session was conducted by a moderator who gave instructions throughout the game, and each also included a monitor for every subgroup of four. This protocol ensured that subjects did not interact during the game and that an experimenter was always available to explain how the materials should be used.

Subjects received a payoff table and an earnings sheet on which they kept a record of their decisions and points gained. The table summarized the payoff consequences of all combinations of subject's own nets used and the total number of nets used by the subgroup's other three members (see Table A.2). The exchange rate was set at $0.62 for 100 points. Subjects were asked to decide—while looking at the payoff table—how many nets to use (minimum one, maximum eight); this number they wrote on a slip of paper that was then handed to the experimenter. Once the four subjects had transcribed their decisions, the total number of nets used by the subgroup was announced so that each subject could calculate the number of points earned and write that figure on his earnings sheet. The explanation of the game followed that described in Cardenas (2003). The actual experiment began after the moderator had conducted three rehearsal periods and once all questions from participants had been answered. All decisions were made privately and individually, and only the total number of nets chosen (by the four subgroup members) was announced publicly.

Prior to beginning the experiment's punishment phase (i.e., before the last five periods of each stage), an illustrative example was described to the participants.[6] This example showed three subjects' disapproval cards: one punishing without any criteria, one punishing those who used many nets, and one not punishing at all. Upon resumption of the actual experiment, the subjects' chosen number of nets and number of assigned punishment points assigned were private information; the only public information was the flag received by subjects who received punishments from others of more than one point. Subjects had to display any flag received so that others could see it during the game's next period.

At the end of each experimental session, we conducted a post-experiment survey containing questions about reasons for punishment and about feelings in response to being punished. Each session of the experiment lasted about three hours, and participants earned, on average, nearly $30 (including a guaranteed $5 participation fee); this amount is equivalent to 10% of a subject's typical monthly wage.[7]

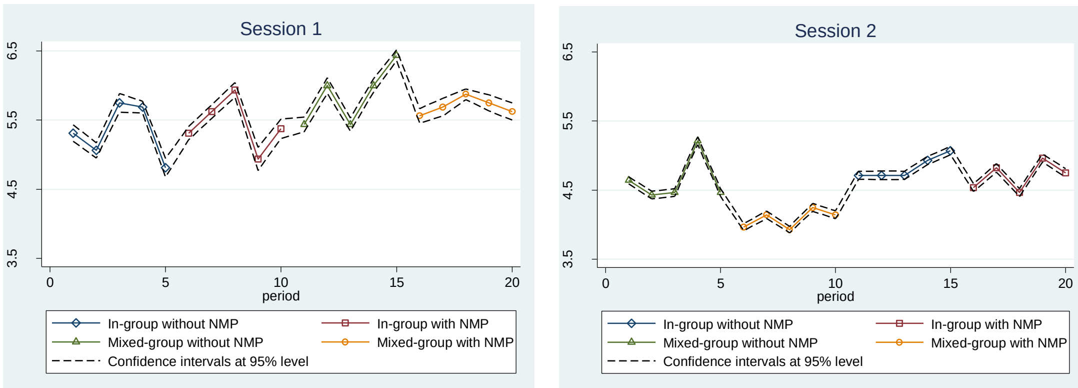
3. Results

The left and right panels of Figure 2 plot average extraction levels (number of nets chosen) by period and treatment for sessions 1 and 2, respectively. At first glance, the figure suggests that the change from in-group to mixed-group treatment does not lead to significant behavioral changes in the absence of nonmonetary punishment. Without NMP, the extraction levels chosen by subjects in session 1 were higher for the mixed-group than for the in-group treatment; however, no substantial change was observed for the subjects in session 2. The inclusion of NMP had a positive effect on cooperation, especially for the mixed-group treatment: it lowered average extraction levels in stage four of session 1 and in stage two and four in session 2. Extraction levels in session 2 were on average lower than those of session 1 along the whole game.

[6] Subjects were neither told that in rounds 6-10 and 16-20 they would be allowed to disapprove of others´ behavior nor that in rounds 11-20 they would change groups completely (groups of 8-12). They were told that they would switch groups of 4 every single round.

[7] A similar experimental design (which excluded the in-group and mixed-group treatments) was tested using 36 undergraduate students as participants.

Figure 2: Average extraction levels by treatment type and session



Source: own calculations.

3.1. Testing the treatment effects

To test the effects of our in-group/mixed-group and NMP treatments, we employed dynamic analysis to examine the extractive decisions of participating subjects. These treatments were tested in two ways. First, the model included a pair of indicator variables: *in-group*, which was set equal to 1 (respectively, to 0) for subjects when part of the in-group (respectively, mixed-group) treatment; and *NMP*, which was set equal to 1 for extraction decisions made during a round that allowed for nonmonetary punishment (i.e., rounds 6–10 and 16–20) and to 0 otherwise. Second, we tested for interaction between the treatments. For this purpose, three dummy variables were included: *mixed-group with NMP*, *in-group with NMP*, and *in-group without NMP* (recall that the base-case scenario is "mixed-group without NMP"); each of these dummies was set equal to 1 only for the scenario that it describes, and 0 otherwise.

A fixed-effects regression was performed that controls for individuals' time-invariant characteristics. The final model estimated (column [8] in Table 2) is

$$(1) \quad a_i^t = \alpha_i + \beta_1 mixed\_group\ w/NMP_i^t + \beta_2 in\_group\ w/\ NMP\ _i^t + \beta_3 in\_group\ w/out\ NMP\ _i^t + \beta_6 stage3\text{-}4_i^t + e_{it}$$

In this formula, a_{it} denotes i's extraction level in period t. Equation (1) also includes an indicator variable, *stage_3-4*, that is set equal to 1 only for rounds 11–20. We assume the last term in equation (1) to be a normally distributed random residual. Note that time fixed effects were omitted because they are strongly correlated with the treatment variables; in fact, our treatment dummies are themselves time.

Columns [1]–[3] of Table 2 show that, whereas the in-group treatment has no effect on subjects' choice of extraction level, lower levels are chosen under the NMP treatment. Column [4] documents that the treatment effect of NMP differ for in-group versus mixed-group settings. On the one hand, the number of nets chosen in the mixed-group setting without NMP is not statistically significantly different from the number chosen in the in-group setting—with or without nonmonetary punishment. On the other hand, subjects in the mixed-group setting choose fewer nets with NMP than without it (the −0.414 coefficient amounts to 20% of a standard deviation in the number of nets), yet the behavior of individuals in the in-group setting is not statistically significantly affected by NMP. Finally, the *stage_3-4* dummy variable (rounds 11–20) is positive and significant in all models. In other words, subjects increased their average extraction level during the second stage regardless of which treatment they experienced first. This finding—that cooperation decays throughout the game—is in line with previous research.

Table 2: Dynamic analysis of extraction decisions

	Dependent variable: *fishnets* $_{it}$			
	(1)	**(2)**	**(3)**	**(4)**
in-group	0.002		0.002	
	(0.139)		(0.139)	
nonmonetary punishment (NMP)		-0.225*	-0.225*	
		(0.113)	(0.113)	
mixed--group with NMP				-0.414**
				(0.160)
in-group without NMP				-0.187
				(0.199)
in-group with NMP				-0.223
				(0.172)
stage_3-4	0.402***	0.402**	0.402***	0.402***
	(0.139)	(0.161)	(0.139)	(0.139)
_cons	4.733***	4.847***	4.846***	4.940***
	(0.120)	(0.106)	(0.137)	(0.164)
Obs.	880	880	880	880
Subjects	44	44	44	44
r2 within	0.019	0.025	0.025	0.029
r2 overall	0.009	0.012	0.012	0.014
r2 between	.	.	0.108	0.069

*** p<0.01;** p<0.05; * p<0.1

Standard errors (in parentheses) are clustered at the individual level.

Source: own calculations

It is also relevant to look at the sociodemographic determinants of individual extraction decisions. Table A.5 in the Appendix shows the OLS results for two dependent variables of interest: number of nets chosen in the first period (columns [1] and [2]) and average number of nets chosen throughout the 20 periods (columns [3]–[5]). Wealth and age are the only observable individual determinants that are statistically significant; no other individual-level economic or demographic variable is able to explain extraction choices. The magnitude of the wealth coefficient is worth noting: an increase of one standard deviation in the wealth index increases by 44% the average number of nets chosen.[8] Community membership seems to be a significant determinant of fishnet choices. El Puente

[8] The wealth index, which is based on the durable goods owned by a household, was elaborated by means of factor analysis. This index includes variables for the following goods: water heater, refrigerator, television, radio, cable TV, DVD player, washing machine, microwave, computer, Internet connection, telephone, motorbike, automobile, and horse.

(the baseline in the regression) extracted significantly less than the other four communities. Also, the Wilcoxon–Mann–Whitney (WMW) ranksum test rejects the equality of median and mean extraction levels between places of residence, two-by-two, at the 10% confidence level.[9] These results—together with the non-significance of individual characteristics—support the hypothesis that group-level institutions and/or social norms affect the behavior of individuals.

3.3. Punishment behavior

In this section we analyze the behavior of punishers. On average, 71% of the subjects chose to punish during each period in which punishment was allowed. Disapproval was substantial throughout the game and surprisingly high in the last period, even though subjects knew the experiment would be over after that period.[10] Figure 3 graphs average punishment points administered, by period, for the two sessions. Because subjects were unaware of the individual extraction level of the other subgroup members, during the mixed group treatment they could not knowingly direct punishment to members of the other community. Higher levels of punishment were observed under the mixed-group treatment in session 1 but not in session 2. When both sessions are considered together, there is no statistically significant difference in the amount of punishment administered under mixed-group versus in-group treatments.[11] During the whole game subjects in session 2 assigned more punishing points than those in session 1.

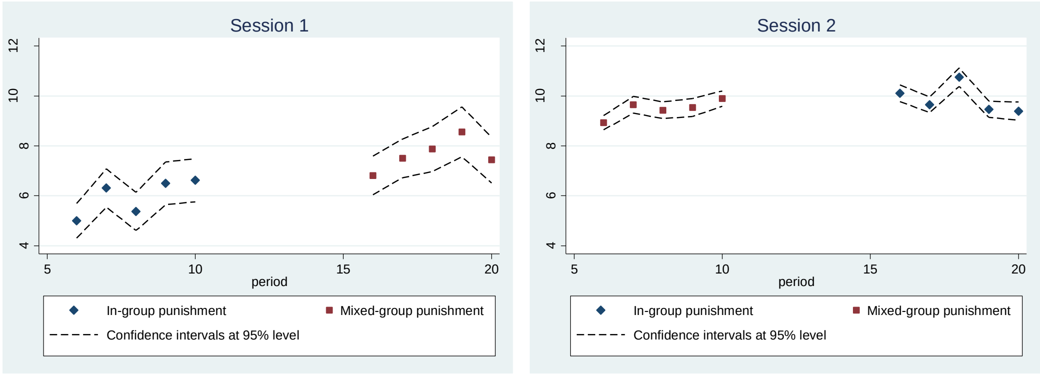
---

[9] There are only two cases in which this hypothesis is *not* rejected: (i) when comparing Barra de Valizas and Barrio Parque with respect to the average number of nets used; and (ii) when comparing Laguna de Rocha, Barra de Valizas, and Barrio Parque with respect to the average number of points earned during the experiment. However, equality between Barra de Valizas and Barrio Parque with respect to median average earnings is rejected by the WMW ranksum test. Tests are available upon request.

[10] The average number of disapproval points per subject is 8.6 while the average during the pretest with students was 4.2. Observing differences in behavior between both populations justifies the relevance of field experiments. However, we consider that results from the pretest and the actual experiment cannot be compared. First, the pre-test excluded the in-group and mixed-group treatments as the participants were all students. Second, the ranges of disapproval points for the three types of flags (yellow, orange and red) were modified after the pretest.

[11] The WMW ranksum test does not reject equality of punishment administered during mixed-group and in-group treatments for the two sessions together (p=0.54).

Figure 3: Average punishment points by period and session



Source: own calculations

Table 3 reports total and per-subject disapproval points in terms of how many nets both the punisher (rows) and the punished subject (columns) chose. Following Herrmann et al. (2008), we interpret punishment for extraction levels greater than punishment of free riding (cells in grey in Table 3) and punishment for extraction levels less than or equal to one's own as antisocial punishment (cells in white in Table 3). Punishment of free riding could be viewed as altruistic given that individuals incur material costs when punishing but reap no material benefits from doing so, since participants are reshuffled after each period. However, repeated game behavior cannot be perfectly ruled out (players could potentially meet again in the game). Punishment of free riding can also be interpreted as the provision of a second-order public good in order to contribute to the creation of social norm. We observe a substantial amount of antisocial punishment (i.e., administered to cooperators). According to the criterion established by Herrmann et al. (2008) 57% of punishing points assigned could be classified as punishment of free riding. In general terms, subjects who choose fewer than five nets assign more punishing points to those who choose six or more nets while those choosing five or more nets mainly disapprove of those choosing fewer than six. The lower panel of Table 3 displays average per-subject rather than total punishment points. Antisocial punishment is the consequence of a few subjects administering large amounts of punishment: there are only three subjects that used six or more nets, and they administered a large number of punishment points to those who used fewer nets. Nonmonetary punishment is actually more effective than indicated by Figure 2 when the subgroups in which these three subjects participated are excluded. Table 3 also shows that some subjects punish another who uses the *same* number of nets—especially when that number is large. This could be interpreted as an attempt to discourage others from free riding even as the punisher disregards the social norm (i.e., “do as I say, not as I do”). As with punishment overall, antisocial punishment does not differ significantly between the in-group and mixed-group treatments.

Table 3: Total and average per-subject punishing points by punisher and punished choice of nets

Total punishing points								
Punisher´s choice of nets	**Punished´s choice of nets**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1	0	0	0	0	4	14	14	20
2	0	0	18	91	110	157	295	273
3	22	0	0	7	24	45	105	147
4	38	8	0	2	19	52	123	163
5	37	28	4	7	16	44	86	123
6	87	79	61	60	48	31	81	104
7	132	126	125	112	83	25	14	44
8	105	90	99	49	31	46	25	45
Average per-subject-period punishing points								
1					1.3	2.8	3.5	2.2
2			1.8	7.6	6.5	5.6	6.4	7.0
3	4.4			3.5	1.4	2.0	2.8	3.9
4	3.5	1.6		1.0	1.5	2.4	2.8	3.9
5	3.4	3.1	4	1.8	1.6	2.2	2.7	4.0
6	5.4	4.9	5.5	4.3	3.7	1.7	2.3	3.7
7	8.8	8.4	7.4	8.6	6.9	2.8	2.0	3.4
8	8.1	5.6	5.5	4.9	3.9	5.1	3.1	3.5

Source: own calculations

Translating punishment points into flags reveals the actual intensity of NMP received. On average, 1.7 flags were displayed each period per subgroup (of four members). Table 4 reports the distribution of flags as a function of whether the focal subject chose an extraction level below or above his subgroup’s mean. Most flags were applied to subjects who deployed more nets than the mean number in their subgroup, but a full 40% of the flags were applied to individuals whose extraction levels were actually below the subgroup mean.

Table 4: Total flags by round

Period	Total flags	Negative deviation max{0;$\bar{a}_{t-1}$-$a_{i,t-1}$}				Positive deviation max{0;$a_{i,t-1}$-$\bar{a}_{t-1}$}			
		Total flags	Yellow	Orange	Red	Total flags	Yellow	Orange	Red
Total flags	190	76	42	32	2	114	75	28	11
%	100%	40.0%	22.1%	16.8%	1.1%	60.0%	39.5%	14.7%	5.8%

Source: own calculations

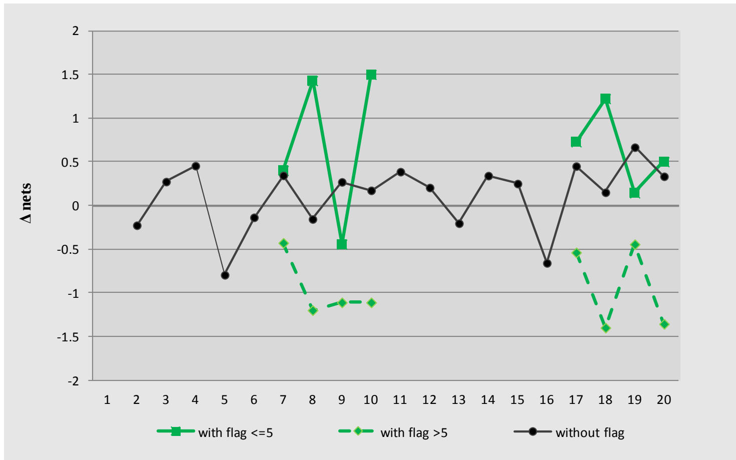
Among the post-experiment questions was one asking subjects to identify their reasons for punishment. Most respondents (55%) disapproved of subjects for using too many nets.[12]

3.4. Reaction to punishment

In this section we analyze whether punishment generates a change in behavior among those who are punished. At first glance, the descriptive analysis suggests that flags induce variations in the behavior of individuals. Subjects who receive a flag in one period reduce their extraction in the next period by 0.26 nets on average. This result does not always hold at the individual level, however, and one reason is that sometimes even those who choose a *low* number of nets are punished. Figure 5 shows that, whereas those who receive a flag after throwing more than five nets reduce that number (by 0.99 nets on average) in the next period, those who receive a flag after throwing five or fewer nets actually increase that number (by 0.61 nets on average) in the next period. In the periods during which NMP was implemented, the number of nets chosen by those who do not receive a flag in the previous period ranges around zero.

[12] The other reasons given for punishment were "without any criteria" (14%), "did not disapprove" (11%), "those who threw few nets" (7%), "those who play differently" (5%), "because it was part of the game" (5%), and "did not understand" (5%).

Figure 5: Fishnet variations



Source: own calculations

A significant percentage (33%) of the individuals who received a flag did not change their behavior in the next round. The modes of the distribution of extraction choices were two and eight nets, and nearly half (55% and 48%, respectively) of subjects who chose those values did not change their choice—that is, irrespective of how many flags they received.

Not all the flag colors yielded the same reaction. Subjects were more indifferent to yellow than to other flags: in 42% of the cases where a subject received a yellow flag, he did not change his decision in the next period. When analyzing subjects' reactions in view of their feelings (as described in the post-experiment survey) after receiving a flag, we find that—of those subjects who declared indifference to a flag—70% either maintained or increased their extraction level after receiving one. In contrast, those subjects who admitted to feeling uncomfortable when flagged either maintained (in 28% of the cases) or reduced (in 52%) their extraction level during the next period after being flagged. All subjects who responded that they experienced anger when punished increased their extraction level in the following period.[13]

[13] To save space, we have omitted tables reporting extraction level variations as a function of flag color received and of subjects' self-reported feelings in response to punishment. These tables are available from the authors upon request.

The next step is to devise a formal test for the behavior just described. We first test for whether subject i's decision changes from period t−1 to period t as a function of punishment received in the previous period. Then we adapt the reaction function employed by Masclet et al. (2003) and Noussair and Tucker (2005) and test for whether—once the subject's deviation (from his subgroup average) is included in the regression—any such decision changes are still related to punishment received in the previous period. The model estimated is:

(2) $$a_i^t - a_i^{t-1} = \beta_0 + \beta_1 * Flag_i^{t-1} + \beta_2 * OthersFlag_i^{t-1} + \beta_3 * (\max\{0, a_i^{t-1} - \bar{a}^{t-1}\}) + \beta_4 * (\max\{0, \bar{a}^{t-1} - a_i^{t-1}\}) + e_i^t$$

Here $Flag_i^{t-1}$ is a dummy variable that indicates whether or not the individual received a flag in a previous period, and $OthersFlag_i^{t-1}$ denotes how many of i's partners in period t received a flag in period t−1 (this variable ranges in value from 0 to 3). The terms $max\{0, a_i^{t-1} - \bar{a}^{t-1}\}$ and $max\{0, \bar{a}^{t-1} - a_i^{t-1}\}$ capture whether the subject extracted (respectively) more or less than his subgroup's average in the previous period and also indicate the magnitude of any deviation. Once again, the equation's last term is assumed to be a normally distributed random residual. Regression results for this model are reported in column [3] of Table 5. We test this model only for those periods during which reactions to flagging could occur (i.e., periods 7–10 and 17–20) and separately for subjects who chose five or fewer nets and for subjects who chose more than five nets. All specifications include individual fixed effects to control for non-observable factors that may affect a subject's decisions.

Table 5: Reaction to punishment

	Dependent variable: $Fishnets_{i,t}$ -$fishnets_{i,t-1}$											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Periods	**NMP**	**NMP**	**NMP**	**nets <=5 NMP**	**nets >5 NMP**	**NMP**	**NMP**	**NMP**	**nets <=5 NMP**	**nets >5 NMP**	**No-NMP**	**NMP**
Positive deviation from group average in previous round; max{0;$a_{i,t-1}$ -$\bar{a}_{t-1}$ }			-0.912***	0.186	-0.691***			-0.953***	0.172	-0.663***	-0.554***	-0.967***
			(0.173)	(0.527)	(0.175)			(0.163)	(0.530)	(0.161)	(0.119)	(0.179)
Negative deviation from group average in previous round; max{0;$\bar{a}_{t-1}$ -$a_{i,t-1}$ }			0.855***	0.700***	0.103			0.836***	0.664***	0.170	0.917***	0.832***
			(0.147)	(0.157)	(0.501)			(0.144)	(0.161)	(0.476)	(0.152)	(0.144)
Flag in previous round	-0.61*	-0.637*	-0.289	-0.117	-0.127							
	(0.32)	(0.333)	(0.223)	(0.266)	(0.308)							
Yellow flag in previous round						-0.471	-0.521	-0.302	-0.083	-0.005		
						(0.328)	(0.340)	(0.253)	(0.366)	(0.326)		
Orange flag in previous round						-0.793*	-0.778	-0.324	-0.270	-0.622		
						(0.467)	(0.467)	(0.325)	(0.375)	(0.502)		
Red flag in previous round						-1.105	-1.074	0.340	2.055*	0.510		
						(1.205)	(1.203)	(0.661)	(1.052)	(0.669)		
Flag in rest of the group members in previous round		0.229*	0.196	0.388**	-0.126		0.218*	0.197	0.411**	-0.166		
		(0.115)	(0.120)	(0.157)	(0.099)		(0.115)	(0.125)	(0.160)	(0.121)		
_constant	0.29**	0.016	-0.048	-0.677*	0.517	0.300**	0.035	-0.018	-0.677*	0.515	-0.178	0.132
	(0.14)	(0.166)	(0.253)	(0.348)	(0.363)	(0.138)	(0.172)	(0.243)	(0.352)	(0.358)	(0.163)	(0.172)
Nº observations	352	352	352	213	139	352	352	352	213	139	396	352
Nº individuals	44	44	44	39	32	44	44	44	39	32	44	44
r2 within	0.020	0.029	0.360	0.182	0.164	0.023	0.032	0.363	0.204	0.186	0.291	0.350
r2 overall	0.018	0.030	0.202	0.111	0.096	0.018	0.029	0.205	0.119	0.105	0.185	0.196
r2 between	0.013	0.073	0.047	0.001	0.024	0.001	0.035	0.049	0.000	0.008	0.021	0.038

*** p<0.01;** p<0.05; * p<0.1

Standard errors (in parentheses) are clustered at the individual level.

All the regresions correspond to periods where individuals could show a reaction to NMP in previous period, except col. (11), that refers to the ones where punishment in previous period was not available.

Flag rest of the group members in *t-1* is variable that ranges from 0 to 3 depending on how many current group members received a flag in the previous period.

Col. (4) and (9) only consider individuals with extraction levels lower or equal to 5, while col. (5) and (10) refer only to individual with extraction levels higher than 5

Source: own calculations.

The values reported in column [1] of Table 5 indicate with a 10% significance level that being punished results in a downward adjustment during subsequent periods. We also estimated alternative specifications in which flag colors were distinguished; the results from these estimations are substantially similar (columns [6]–[10]). Columns [2]–[5] and [7]–[10] present results when the model includes a count variable for how many of the three other members in a subject’s group during period t received a flag during period $t-1$. Having partners who were punished in the previous period tends to increase own extraction, an effect that is more pronounced for subjects who chose to deploy five or fewer nets in the previous period (columns [4] and [9]). However, such subgroup partners have no effect on an individual who used more than five nets in the previous period (columns [5] and [10]).

If we control for the deviation of individuals from the average of their subgroup in the previous period in order to capture conformity effects, then receiving a flag is no longer followed by reduced extraction levels (columns [3]–[5] and [8]–[10] of Table 5). As in Velez et al. (2009), we interpret conformity as a psychological propensity to match common behavior in order to avoid appearing deviant. Those who used fewer (more) nets than the average of their previous period's subgroup will significantly increase (decrease) their extraction in the next period. As might be expected, the number of nets does not decrease when we consider only the reaction of those who received a flag after choosing five or fewer nets and, conversely, the number of nets does not increase when we consider only the reaction of those who received a flag after choosing more than five nets. The magnitude of the conformity effect is greater during the NMP periods (especially for positive deviations in subjects' extraction levels relative to their subgroup's mean), which could suggest that nonmonetary punishment is inducing convergence to the social norm. However, Table 5 includes (as column [11]) results for a control model that applies to periods during which flag reactions were not possible; this allows us to compare conformity effects. Confidence intervals for the effects described here, in periods with and without NMP, overlap at the 95% level (columns [11] and [12]). Interactions between previous-period deviating behavior and being flagged are not significant, which confirms that the high significance of conformity effects is not a consequence of being punished. Note also that these conformity effects do not differ for in-group versus mixed-group treatments (see Table A.6).

When flags are distinguished by their colors (column [6] in Table 5), we observe that receiving an orange flag has a modest reducing effect on extraction levels, but this effect is diminished when we split the sample between subjects who were flagged after choosing five or fewer versus more than five nets (columns [9] and [10]). Note the large increase in number of fishnets deployed during period *t* when a red flag was received after deploying five or fewer nets during period $t-1$ (column [9]). In other words, subjects react strongly—and non-cooperatively—in response to what they perceive as unfair punishment.

4. Discussion

In this study we performed a framed field experiment to test the effectiveness of nonmonetary punishment (NMP) in the context of a common pool resource game. We combined this treatment with an in-group/mixed-group treatment requiring fishers from different communities to interact solely with members of their own community in one of the stages of the experiment and mixed with subjects from another community in the other stage.

First, our findings suggest that NMP has the effect of diminishing extraction levels, but only in the mixed-group treatment. That is, at least when interacting with subjects who are not of their own community, subjects achieve greater cooperation levels upon the threat of being punished. In contexts where individuals do not know each other (or hardly know each other) but are aware that there is some chance of seeing each other again, public punishment might constitute the only information others have about oneself. In this sense, it is important to avoid being socially disapproved. Such social sanction may not be perceived as meaningful when administered by workmates or neighbors, and neither would it matter much when individuals are certain that they will never meet again. In short, the relationship between sensitivity to peer punishment and social context—i.e. in-group versus mixed-group interactions—may not be a monotonic one. Gächter and Fehr (1999) conclude that if social distance between subjects is reduced by forming weak social ties, approval incentives give rise to a large and significant reduction in free-riding. Our findings for mixed groups could point to the presence of weak social ties as in our setting it is likely that subjects have seen each other sometime in the past or will see each other again in the future. Also, the fact that the threat of social disapproval does not seem to have an effect when subjects are only interacting with members of their own community could be due to internalized norms being crowded out (Cardenas et al. 2000, Vollan, 2008, Bowles and Polanía-Reyes, 2012) by the social disapproval treatment. Previous literature addressing contributions in public good games has found that nonmonetary punishment increases cooperation (López et al., 2012), but it has less of an effect than monetary sanctions (Masclet et al., 2003) and is more effective in increasing cooperation when *combined* with monetary sanctions (Noussair and Tucker, 2005). This paper is consistent with those studies in finding that nonmonetary punishment can enhance cooperation simply by affecting prosocial emotions, yet this result holds only when the subjects belong to different groups.

Second, once we control for the deviation of individuals from the average of their subgroup in the previous period, reactions to punishment (i.e., reducing extraction levels after receiving a flag) are no longer significant. One reason for this failure of punishment may be the presence of substantial antisocial or perverse punishment. Such punishment is also observed by Falk et al. (2000), Masclet et al. (2003), Cinyabuguma et al. (2006) and Gächter and Herrmann (2011). Cooperation (here, choosing to use fewer nets) may not be perceived as a social norm enforceable by punishment (Casari and Luini, 2009); thus, there may be other norms—for example, "try to catch as many fish as possible"—that may prevail (Noussair et al., 2014). Hence some punished subjects may view as inappropriate such disapproval for using many nets and respond by increasing their number of nets (or maintaining their choice of the maximum number). Also, there are aspects of the subjects' daily lives that may influence game outcomes (Cardenas and Ostrom, 2004). For instance, individuals may believe that the intensity of their own fishing has far fewer consequences on the future availability of fish than do, say, climate factors or other industries. Punishment may fail to increase cooperation also because there is insufficient coordination or no venue for discussing the reasons for punishment. Janssen et al. (2010) argue that, when participants can "punish back" but cannot discuss why they are punished, being sanctioned does not carry a clear message. Also, Putterman (2010) argues that uncoordinated punishment is often counterproductive. In our experiment, the occurrence of antisocial or perverse punishment may be attributable not only to the lack of a unique social norm but also to the lack of discussion about sanctions. Hence punishment may have failed to transmit the moral lesson that high extraction levels should be sanctioned. Furthermore, those who were punished for extracting *low* levels reacted by increasing their extraction levels. Beckenkamp and Ostmann (1999) and Masclet et al. (2003) argue that punishment will likely reduce cooperation if subjects perceive the sanctions to be unfair (antisocial). It is interesting that subjects were willing to incur a monetary cost in order to administer nonmonetary punishment, a finding that accords with many previous studies on monetary punishment. More generally, the subjects themselves may not expect punishment to induce more cooperative behavior. Carpenter et al. (2004), Carpenter (2007), Casari and Luini (2009), Fudenberg and Pathak (2010), and Noussair et al. (2011) conclude that punishment need not be applied instrumentally to increase cooperation and that subjects have preferences for punishing.

Third, individuals adjust their period-by-period decisions in order to more nearly match their peers' average in the previous period. In line with Masclet et al. (2003), Velez et al. (2009) and Hayo and Vollan (2012), this could reflect conformity effects. These results could also suggest that social comparisons may serve as a nonpecuniary way for policy to encourage changes in behavior (Ferraro and Price, 2013). Also, cooperative individuals increase their own extraction levels after observing that their current game partners were punished in the previous period. This could reflect that they are conditionally cooperative and refuse to cooperate if they suspect others do not cooperate The role of social information on influencing behavior either driven by the desire to conform to the social norm or influencing prosocial emotions (such as shame) has been noted by several studies (Soetevent, 2005; Croson and Shang, 2008; Panagopoulos, 2010; Lopez et al., 2012). Croson and Shang (2008) observe that the effect of observing that others are less cooperative is stronger in determining a decrease in own cooperation than the effect of observing high levels of cooperation. In this way, a subject who sees himself among noncooperative partners may react by increasing his own extraction level to avoid being disadvantaged. That is, individuals behave as if expecting that punished subjects will not react favorably (i.e., by reducing their level of extraction) to that punishment. Participants may also interpret that they are less likely to be punished for using many nets when their subgroup partners are accustomed to extracting high levels of the resource.

Fourth, and contrary to most previous research on this topic, we find no in-group bias with respect to cooperation. That is, individuals do not behave differently when interacting with those from their own community than when mixed with subjects from other communities—except for being more sensitive in mixed groups to the threat of NMP. Many fishermen who were surveyed complained about fishers from other communities who arrive during the peak season to fish in the lagoon where the complainants fish year round. Yet fishers from all communities fish also in other locations during seasonal peaks. That our experiment revealed no in-group bias might therefore reflect fishers acknowledging that all of them are sometimes “outsiders”. It could also reflect the lack of any meaningful differences among our focal communities in terms of ethnicity or religion, differences that other studies have identified as determinants of negative feelings about out-group members (Hewstone et al., 2002).

Overall our results show that, in response to the threat being socially disapproved, individuals cooperate (here, by limiting their resource exploitation) when they are mixed with individuals from other communities. Our findings also indicate that coordination is required to render peer punishment effective, to prevent antisocial targeting, and to enhance the social signal conveyed by such punishment. Finally, we establish that previous interactions with other subjects—even if only in a series of one-shot games—exert substantial influence on behavior.

References

Baland, J.M., Platteau, J.P. (1996) "Halting degradation of natural resources. Is there a role for rural communities?". *Clarendon Press Oxford*.

Bandiera, O.; Barankay, I. and Rasul, I. (2005). "Social Preferences and the Response to Incentives: Evidence from Personnel Data". *Quarterly Journal of Economics*, 120(3): 917–62.

Barr A. (2001) "Social Dilemmas and Shame-based Sanctions: Experimental results from rural Zimbabwe". Working Paper 2001.11, Centre for the Study of African Economies University of Oxford.

Beckenkamp, M., and Ostman, A. (1999) "Missing the target? Sanctioning as an ambiguous structural solution". in Foddy, M., Smithson, M., Scheneider, S. and Hogg, M. (eds.) *"Resolving social dilemmas: dynamic, structural, and intergroup aspects"*. London: Psychology Press, 165-180.

Bernhard H., Fehr, E. and Fischbacher, U. (2006) "Group affiliation and altruistic norm enforcement". *American Economic Review*, 96(2): 217–21.

Blount, S. and Bazerman, M. (1996), "The inconsistent evaluation of absolute versus comparative payoffs in labor supply and bargaining". *Journal of Economic Behavior and Organization*, 30, 227-240.

Bowles, S. and Gintis, H. (2002) "Social capital and community governance". *The Economic Journal* Vol. 112 N. 483: 419-436.

Bowles, S. (2004) Microeconomics: behavior, institutions and evolution. Russell Sage Foundation.

Bowles, S. and Gintis, H. (2011) *"A cooperative species"*. Princeton University Press.

Bowles, S. and Polanía-Reyes, S. (2012) "Economic Incentives and Social Preferences: Substitutes or Complements?". *Journal of Economic Literature*, 50:2, 368-425.

Brandts, J. and Charness, G. (2011) "The strategy versus the direct-response method: a survey of experimental comparisons". *Experimental Economics*, Vol. 14, pp. 375 – 398.

CAEPALR (2006) “Propuesta de ingreso del área protegida laguna de Rocha al sistema nacional de áreas protegidas”, Comisión Asesora Específica Provisoria del Área Protegida Laguna de Rocha.

Cardenas, J.C. (2003) “Real wealth and experimental cooperation: experiments in the field lab”. *Journal of Development Economics* 70 (2003) 263– 289.

Cardenas, J.C., and Ostrom, E. (2004) “What do people bring into the game? Experiments in the field about cooperation in the commons”. *Agricultural Systems*, Vol. 82, pp. 307–326.

Cárdenas, J. C. and Ramos, P. A. (2006) “Manual de juegos económicos para el uso colectivo de los recursos naturales.*”*

Cárdenas, J.C. and Stranlund, J. (2000) “Local Environmental Control and Institutional Crowding-Out”. *World Development*, 28 N10, pp. 1719-1733.

Carpenter J. and Seki E. (2009) “Do Social Preferences Increase Productivity? Field Experimental Evidence from Fishermen in Toyama Bay”, *Economic Inquiry*, 49(2): 612-630.

Casari, M. and Luini, L. (2009) “Cooperation under alternative punishment institutions: An experiment”. *Journal of Economic Behavior & Organization*, 71: 273-282.

Carpenter, J., Matthews, P., Ong’ong’a, O. (2004) “Why punish? Social reciprocity and the enforcement of prosocial norms”. *Journal of Evolutionary Economics*, 14: 407-429.

Carpenter, J. (2007) “The demand for punishment”. *Journal of Economic Behavior and Organization*, Vol. 62: 522-542.

Carpenter, J. and Seki, E. (2009) “Do Social Preferences Increase Productivity? Field Experimental Evidence from Fishermen in Toyama Bay”. *Economic Inquiry*, Vol 49, No 2: 612-630

Charness, G., Rigotti, L. and Rustichini, A. (2007) “Individual Behavior and Group Membership”. *American Economic Review*, Vol. 97, Nº 4, pp. 1340 – 1352.

Chen, Y and Xin S. L. (2009) “Group identity and social preferences”. *American Economic Review*, 99(1): 431–57.

Cinyabuguma, M., Page, T. and Putterman L. (2005) "Cooperation under the threat of expulsion in a public goods experiment". *Journal of Public Economics*, 89: 1421-1435

Croson, R., and Shang, J. (2008) "The Impact of Downward Social Information on Contribution Decisions". Experimental Economics, 11(3): 221-33.

Defeo, O. y Castilla, J. (2005) "More than one bag for the world fishery crisis and keys for co-manangement in selected artisanal Latin American shellfisheries". *Review in Fish biology and Fisheries,* 00:1-19.

Defeo, O., Horta, S., Carranza, A., Lercari, D., de Álava, A., Gómez, J., Martínez, G., Lozoya, J.P. and Celenano, E. (2009) "Hacia un manejo ecosistémico de pesquerías: Áreas Marinas Protegidas en Uruguay". DINARA and Facultad de Ciencias – UdelaR.

Denant-Boemont, L., Masclet, D. and Noussair, C. (2011) "Announcement, observation and honesty in the voluntary contributions game". *Pacific Economic Review*, Vol. 16, Nº 2, pp. 207 – 228.

DINARA (2009) *Boletín informativo Abril 2009*, Dirección Nacional de Recursos Acuáticos, Uruguay.

DINARA (2011) *Boletín informativo Abril 2011*, Dirección Nacional de Recursos Acuáticos, Uruguay.

Dugar, S. (2010) "Nonmonetary sanctions and rewards in an experimental coordination game". *Journal of Economic Behavior & Organization*, 73: 377 – 386.

Falk, A., Fehr, E. and Fischbacher, U. (2000) "Informal sanctions". Working paper, University of Zurich.

Falk, T., B. Vollan and M. Kirk (2012) "Analysis of material, social, and moral governance in natural resource management in southern Namibia". *International Journal of the Commons* 6: 271-301.

Feeny, D., Berkes, F., McCay, B. and Acheson, J. (1990) "The tragedy of the commons, twenty-two years laters". *Human Ecology,* Vol. 18, Nº 1.

Fehr, E. and Gächter, S. (2000) "Cooperation and punishment in public good experiments". *American Economic Review*, Vol. 90, Nº 4, pp. 980 – 994.

Ferraro, P and Price, M. (2013) "Using non-pecuniary strategies to influence behavior: evidence from a large scale field experiment". *Review of Economics and Statistics*, 95(1): 64-73.

Fudenberg, D. and Pathak, P. (2010) "Unobserved punishment supports cooperation". *Journal of Public Economics,* 94: 78-86.

Gächter, S. and Fehr, E. (1999) "Collective action as a social exchange". *Journal of Economic Behavior & Organization*, Vol. 39, pp. 341–369.

Gächter, S. and Herrmann, B. (2011) "The limits of self-governance when cooperators get punished: Experimental evidence from urban and rural Russia". *European Economic Review,* 55, pp. 193 – 210.

Goette, L., Huffman, D. and Meier, S. (2012) "The impact of group membership on cooperation and norm enforcement: evidence using random assignment to real social groups". *American Economic Journal: Microeconomics,* 4:101-115.

Gutiérrez, N.L., Hilborn, R. and Defeo, O. (2011) "Leadership, social capital and incentives promote successful fisheries". *Nature*, Vol. 470, Nº 7334, pp. 386 - 389.

Hardin, G. (1968) "The tragedy of commons", in Stavins (2000) *"Economics of the environment. Selected Readings"*, W. W. Norton.

Hargreaves Heap, S. P., and Zizzo, D.J. (2009) "The Value of Groups". *American Economic Review*, Vol. 99, Nº 1, pp. 295–323.

Harris, D., Herrmann, B. and Kontoleonx, A. (2012) "When to Favour Your Own group? The Threats of Costly Punishments and In-group Favouritism", Discussion Paper Series, Nº 628, Department of Economics, University of Oxford.

Harrison, G. and List, J. (2004) "Field experiments". *Journal of Economic Literature*, Vol. 42, Nº 4. (Dec., 2004), pp. 1009-1055.

Hayo, B., Vollan, B. (2012) “Group interaction, heterogeneity, rules, and co-operative behaviour: Evidence from a common-pool resource experiment in South Africa and Namibia”. *Journal of Economic Behavior & Organization*, Vol. 81, pp. 9– 28.

Herrmann, B; Thoni, C.; and Gächter, S. (2008) “Antisocial punishment across societies”. *Science* 319 (5868), 1345-6.

Hewstone, M., Rubin, M. and Willis, H. (2002) “Intergroup bias”. *Annual Review of Psychology*, Vol. 53, pp. 575 – 604.

Janssen, M., Holahan R., Lee, A. and Ostrom, E. (2010) “Lab experiments for the study of socio-ecological systems”. *Science* 328: 613-617.

López M.; Murphy, J.; Spraggon, J. and Stranlund, J. (2012) “Comparing the effectiveness of regulation and pro-social emotions to enhance cooperation: experimental evidence from fishing communities in Colombia”. *Economic Inquiry*, Vol. 50 (1): 131-142.

Masclet, D., Noussair, C., Tucker, S. and Villeval, M.C. (2003) “Monetary and nonmonetary punishment in the voluntary contributions mechanism”. *American Economic Review*, Vol. 93, Nº 1, pp. 366 – 380.

Miguel, E. and Gugerty, M.K. (2005) “Ethnic diversity, social sanctions and public goods in Kenya”. *Journal of Public Economics*, Nº 89, pp. 2325 – 2368.

Noussair, C. and Tucker, S. (2005) “Combining monetary and social sanctions to promote cooperation”. *Economic Inquiry*, Vol. 43, No. 3 649-660.

Noussair, C. and Tucker, S. (2007) “Public observability of decisions and voluntary contributions in a multiperiod context”. *Public Finance Review* Vol. 35 Number 2 176-198.

Noussair, C., van Soest, D. and Stoop, J. (2014) “Punishment, reward, and cooperation in a framed field experiment”. *Social Choice and Welfare*, forthcoming.

Ostrom, E. (1990) *“Governing the Commons: The Evolution of Institutions for Collective Action*”- New York: Cambridge University Press.

Ostrom, E. (2000) “Collective action and the evolution of social norms”. *The Journal of Economic Perspectives*, Vol. 14, Nº 3.

Ostrom, E., Burger, J., Field, C., Norgaard, R., and Policansky, D. (1999) “Revisiting the commons: local lessons, global challenges”. *Science* Nº 284, 278 – 282.

Panagopoulos, C. (2010) “Affect, social pressure and prosocial motivation: Field experimental evidence of the mobilizing effects of pride, shame and publicizing voting behavior”. *Political Behavior*, 32: 369-386.

PROBIDES (2002) “Proyecto de Desarrollo de la Areas Protegidas Lagunas de Garzon y Rocha”. Documentos de Trabajo Nº 44.

Putterman, L. (2010) “Cooperation and Punishment”. *Science*, Vol 328: 578-579

Rege, M. and Telle K., (2004) “The impact of social approval and framing on cooperation in public good situations”. *Journal of Public Economics* 88: 1625– 1644.

Rodríguez-Gallego, L., Santos, C., Amado S., Gorfinkel, D., González, M.N., Gómez, J., Neme, C., Tommasino, H. y Conde D. (2008) “Costos y beneficios socioeconómicos y ambientales del uso actual de la Laguna de Rocha y su Cuenca. Insumos para la Gestión Integrada de un Área Protegida Costera”, Informe Programa de Desarrollo Tecnológico, UdelaR.

Ruffle, B. and Sosis, R. (2006) “Cooperation and the in-group-out-group bias: A field test on Israeli kibbutz members and city residents”. *Journal of Economic Behavior & Organization*, Vol. 60, pp 147–163.

Salas, S., R. Chuenpagdee, A. Charles, J. C. Seijo, (2011) “Coastal fisheries of Latin America and the Caribbean”, FAO Fisheries and Aquaculture Technical Paper Nº 544, Food and Agriculture Organization, Rome, Italy.

Soetevent, AR. (2005) “Anonymity in Giving in a Natural Context - A Field Experiment in Thirty Chruches”. *Journal of Public Economics*, 89(11-12): 2301-2323.

Tajfel, H.; Turner, J. (1979). "An Integrative Theory of Intergroup Conflict", in Austin, W. G.; Worchel, S. The Social Psychology of Intergroup Relations. Monterey, CA.

Turner, J. C., Brown, R. J., and Tajfel, H. "Social comparison and group interest in ingroup favouritism". *European Journal of Social Psychology*, Vol. 9, pp. 187-204.

Velez, M.A., Stranlund, J.K., and Murphy, J.J. (2009) "What motivates common pool resource users? Experimental evidence from the field". *Journal of Economic Behavior & Organization*, Vol. 70, pp. 485–497.

Vollan, B. (2008) "Socio-ecological explanations for crowding-out effects from economic field experiments in southern Africa". *Ecological Economics,* 67:560-573.

Appendix A

We suggest a model that disentangles different motives of behavior that individuals may face when interacting in the context of a common pool resource dilemma. The model follows closely a model developed by Bowles (2004, pp 153-156), in which peer monitoring and forms of social disapproval enable individuals to achieve agreed levels of effort.

In this model individuals not only care about their own payoffs but also value (either positively or negatively) the material payoffs of their peers. Individuals may experience spite or altruism (which are independent of the others' actions), as well as reciprocity (the value they place on others' payoffs depends on the others´ past behavior or in their beliefs about the others' types). Individuals share a social norm regarding how much extraction is admitted and may experience shame if they are publically sanctioned for violating it. Besides, they face motives for punishing others socially when the others deviate from the social norm. However, punishing others may be costly, as it can deteriorate the relationship with ones' peers.

Consider a common pool resource exploited by two individuals i and j (the model can easily be generalized to *n* members). We define individual *i*'s utility function as:

$$(\mathrm{A.1}) \qquad u_i = \Pi_i + \beta_{ij}\Pi_j - s_i + d_i$$

Utility is the sum of the individual's own material payoffs (Π_i) plus the valuation of the others' material payoffs ($\beta_{ij}\Pi_j$), minus the subjective valuation of shame (s_i), and subjective utility or relief experienced from expressing NMP (d_i).

Let *i*´s material payoff be:

$$(\mathrm{A.2}) \qquad \Pi_i = p_1 a_i + p_2 \left[\sum_{k=i}^{k=j} (a^{Max} - a_k)\right] \;\; \forall\, k = i, j \; and \; i \neq j$$

where both *i* and *j* have the same maximum endowment of a^{Max} to use for extracting a particular resource (i.e. fishnets). As in Cardenas (2004), the aggregate extraction by the two players $\left[\sum_{k=i}^{k=j} a_k\right] \forall\ k = i, j\ and\ i \neq j$ reduces *i*'s material payoffs. Alternatively, the externality can also be described as a public good benefit from conservation, i.e. lack of extraction.

Individuals have preferences as to the other's payoffs. This is reflected in *i*'s utility by the coefficient β, which depends on both unconditional preferences (altruism or spite) and on reciprocity. Member *i*'s degree of other regarding preferences towards *j* is:

$$(\mathrm{A.3}) \qquad \beta_{ij} = \alpha_i + \lambda_i\left(b - \mathrm{a}_j\right)$$

where $\alpha_i \in (-1,1)$ is *i*'s unconditional spite or altruism, and $\lambda_i \in (0,1)$ is her degree of reciprocity. The level of reciprocal motivation therefore depends on the extent to which *j* has deviated from the social extraction norm (*b*): If *j* has extracted less than b, and $\lambda_i > 0$ then *i* experiences good will toward *j* and positively values his payoffs. But if *j* extracted more than the social extraction norm or if *i* feels spite towards *j*, then *i* may experience malevolence toward *j* ($\beta_{ij} < 0$) and enhance his utility by disapproving of *j*'s performance.

Punishment for deviating from the social norm is expressed through nonmonetary mechanisms. Socially punishing defectors enhances one's utility through the relief of expressing emotions.[14] But it does not come without cost. Individuals who express their disapproval in relation to others' actions face a cost of $c(\mu) = \frac{\gamma_i}{2}\mu_{ij}^2$ due to the deterioration in the relationship with their peers. Therefore, disapproval motives (d_i) are a function of the benefits that punishing provides ($-\beta_{ij}\mu_{ij}$), which is a function of the punishment provided as well as altruism (spite), reciprocity, how the other deviates from the social norm, and the cost of punishing:

[14] We are ruling out dynamic effects of punishment, that is, punishing *j* in order to get him to cooperate in the future.

$$(\text{A.}4) \qquad d_i = \mu_{ij}\left[-\beta_{ij} - \frac{\gamma_i}{2}\mu_{ij}\right]$$

Finally, being publicly punished by others may cause shame,

$$(\text{A.}5) \qquad s_i = \sigma_i(a_i - b)\mu_{ji}$$

where σ_i is a measure of one´s susceptibility to social punishment. The level of disutility experienced from being socially punished depends on one's susceptibility to punishment, the degree of divergence of the individual's extraction relative to the social norm (how fair the individual evaluates the punishment as being) and the severity of the punishment received.

The individual chooses an extraction level a_i and a level of NMP μ_{ij} toward his peer in order to maximize equation (A.1). The first order condition indicates that the utility-maximizing level of punishment is:

$$(\text{A.}6)\ \mu_{ij} = -\frac{\beta_{ij}}{\gamma_i} = -\frac{1}{\gamma_i}\left[\alpha_i + \lambda_i(b - a_j)\right]$$

In other words, *i* chooses the level of disapproval that equates the marginal cost of punishment ($\gamma_i\mu_{ij}$) with the marginal benefit of punishment, $-\beta_{ij}$, the negative of the valuation placed on the payoff of the other (as long as $\beta_{ij} < 0$, and chooses zero punishment otherwise). Where punishment is positive, it is clearly increasing in λ_i and decreasing in α_i, as one would expect.

The extraction level of *i* will be a function of *j*´s level of extraction, as well as of the parameters related to the other regarding preferences.

$$(\text{A.}7)\ a_i = \frac{\gamma_j\left(p_1 - p_2(1 + \beta_{ij})\right)}{2\lambda_j\sigma_i} + b + \frac{\alpha_j}{2\lambda_j}$$

Eq. A.7 suggests that *i*’s extraction level varies positively the more altruist *j* is, the higher *j*’s marginal cost of disapproving is and the higher *j*’s extraction levels are. In turn, *i*’s level of extraction will diminish if he is very sensitive to shame, or if *j* is a reciprocator. In this way, social preferences (other than spite) may induce individuals to behave in ways that diverge from the Nash equilibrium in a social dilemma. That is, by valuing other players’ payoffs, altruism and reciprocity can make individuals behave closer to the social optimum. Reciprocity motives may also induce an individual to express NMP to norm violators. If individuals feel shame when punished by others, this may also help avert coordination failures in terms of resource extraction.

Appendix B

Table A.1: Average socioeconomic characteristics by community

Community	Years of schooling	Electricity at home	Wealth[a]	Per capita income (US)	Fishing main activity
Laguna de Rocha	6.0	13%	1.85	149	75%
Valizas Puente	6.7	75%	3.06	175	67%
Barra de Valizas	7.6	38%	1.68	373	63%
Puerto los Botes	6.0	100%	2.52	246	100%
Barrio Parque	8.0	100%	4.32	320	38%

[a]The wealth index, which is based on the durable goods owned by a household, was elaborated by means of factor analysis. This index includes variables for the following goods: water heater, refrigerator, television, radio, cable TV, DVD player, washing machine, microwave, computer, Internet connection, telephone, motorbike, automobile, and horse.

Source: own calculations

Table A.2: Payoff table

	My fishnets								
Others' total	1	2	3	4	5	6	7	8	Others' average
3	354	360	366	372	378	384	390	396	1
4	342	348	354	360	366	372	378	384	1
5	330	336	342	348	354	360	366	372	2
6	318	324	330	336	342	348	354	360	2
7	306	312	318	324	330	336	342	348	2
8	294	300	306	312	318	324	330	336	3
9	282	288	294	300	306	312	318	324	3
10	270	276	282	288	294	300	306	312	3
11	258	264	270	276	282	288	294	300	4
12	246	252	258	264	270	276	282	288	4
13	234	240	246	252	258	264	270	276	4
14	222	228	234	240	246	252	258	264	5
15	210	216	222	228	234	240	246	252	5
16	198	204	210	216	222	228	234	240	5
17	186	192	198	204	210	216	222	228	6
18	174	180	186	192	198	204	210	216	6
19	162	168	174	180	186	192	198	204	6
20	150	156	162	168	174	180	186	192	7
21	138	144	150	156	162	168	174	180	7
22	126	132	138	144	150	156	162	168	7
23	114	120	126	132	138	144	150	156	8
24	102	108	114	120	126	132	138	144	8

Table A.3: Punishing card

If the other throws:	I disapprove (0 to 10 points)
1 net	
2 nets	
3 nets	
4 nets	
5 nets	
6 nets	
7 nets	
8 nets	
Total	

Table A.4: Flag range

Flag	Total punishment points received
Yellow	2 - 5
Orange	6 - 10
Red	11 - 30

Table A.5: Determinants of subjects' extraction decisions

	Dependent variable				
	Nets first period		Average nets		
	(1)	(2)	(3)	(4)	(5)
Laguna de Rocha[a]	0.84	1.79**	1.55**	2.02***	2.00***
	(1.13)	(0.87)	(0.70)	(0.46)	(0.49)
Valizas[a]	2.53**	1.17	2.65***	2.59***	2.51***
	(0.93)	(0.85)	(0.77)	(0.59)	(0.65)
Botes[a]	2.97**	1.42*	1.25	1.21**	1.26**
	(1.09)	(0.76)	(0.76)	(0.50)	(0.49)
Barrio Parque[a]	3.23**	1.42	1.92**	1.49**	1.56**
	(131)	(0.94)	(0.93)	(0.67)	(0.69)
female	0.64		-0.27		
	(0.90)		(0.38)		
age	-0.02		-0.05***	-0.03**	-0.03**
	(0.03)		(0.02)	(0.01)	(0.01)
years of schooling	-0.02		-0.17*		
	(0.17)		(0.09)		
drinkable water[b]	-1.80*		-0.32		
	(1.01)		(0.72)		
electricity[b]	-1.04		-0.85		
	(1.03)		(0.71)		
wealth[c]	0.49**		0.60***	0.40***	
	(0.23)		(0.14)	(0.10)	
per capita income (logs)	-0.99**		0.07		
	(0.43)		(0.30)		
fishing is main activity[b]	1.11*		-0.11		
	(0.65)		(0.39)		
perception[d]	-0.28		-0.19		
	(0.72)		(0.43)		
trust[e]	-0.16		-0.66		
	(1.20)		(0.56)		
second quartile (wealth)					0.35
					(0.59)
third quartile (wealth)					1.27**
					(0.56)
fourth quartile (wealth)					1.35**
					(0.59)
Constant	11.85***	3.83***	5.73*	3.63***	4.08***
	(3.61)	(0.55)	(2.93)	(0.58)	(0.69)
Obs.	43	44	43	44	44
R-squared	0.34	0.12	0.61	0.46	0.45

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

[a] Community names.

[b] Dummy variables that equal 1 if the subject has access to electricity, drinkable water and if fishing is his/her main activity, respectively.

[c] The wealth index considers different durable goods a household may own.

[d] Dummy that equals 1 if the subject believes that preserving the environment in coastal lagoons is mainly a responsibility of the people rather than the government.

[e] Dummy that equals to 1 if the subject believes one can trust most people.

Source: own calculations.

Table A.6: Net variations, flags, and deviations from group's average in previous round including interactions terms

	Dependent variable: $fishnets_t$ - $fishnets_{t-1}$	
Sample	**7-10 & 17-20**	**7-10 & 17-20**
Positive deviation from average ($a_{i,t-1}$-$ã_{t-1}$)	-0.952***	-0.940***
	(0.183)	(0.201)
Negative deviation from average ($ã_{t-1}$-ai,$_{t-1}$)	0.876***	0.934***
	(0.166)	(0.162)
Positive deviation from average ($a_{i,t-1}$-$ã_{t-1}$)*$flag_{t-1}$	-0.010	
	(0.204)	
Negative deviation from average ($ã_{t-1}$-$a_{i,t-1}$)*flagt-1	-0.095	
	(0.168)	
Positive deviation from average ($a_{i,t-1}$-$ã_{t-1}$)*mixed-group		-0.076
		(0.166)
Negative deviation from average ($ã_{t-1}$-$a_{i,t-1}$)*mixed-group		-0.235
		(0.156)
_cons	0.120	0.144
	(0.165)	(0.169)
N	352	352
N_g	44	44
r2_w	0.351	0.356
r2_o	0.197	0.201
r2_b	0.038	0.040
*** p<0.01;** p<0.05; * p<0.1		
standard errors in parenthesis		

Source: own calculations

Appendix C

This is a summary of the protocol given to moderators and monitors during their training. The instructions and in particular the examples that explain the dynamics of the baseline CPR game follow closely the *Manual de juegos económicos para el uso colectivo de los recursos naturales* (Cárdenas, J. C. and Ramos, P. A., 2006). The extended version has three more sections referring to contingent measures in case a participant feels uncomfortable during the game, confidentiality is violated, as well as the role of moderators and monitors.

1) WELCOME

Once participants have arrived to the venue and are gathered in the same room:

1. We will first welcome them and thank them for agreeing to participate in the activity. Next, we will explain:
- The aim of the study (see paragraph below which should be repeated once they are divided into groups).
- Characteristics of the activity:
  - ➢ They will participate in groups but they will make decisions individually and privately.
  - ➢ They will be divided into groupings of eight or twelve.
  - ➢ In each grouping there will be subgroups of four that will switch after each period. That is, their subgroup partners will change after every period.

2. Identifier: After the general explanation, participants will be requested to draw a number from a bag. This number represents an identifier that assigns a subject to a subroup for each of the twenty periods.

In the event that the number of participants from a community is not a multiple of four, there will be extra numbers in red. Those participants that draw a number in red will play in a subgroup with the all those who get red numbers in all communities and will not be considered in the analysis. This extra subgroup will play in order not to make distinctions with the other participants in what refers to time spent in the activity and average earnings.

Aim of the study:

The aim of the activity you will take part of is to study how individuals make decisions. Interacting with you is very important for us because in this way we can understand how individuals make decisions in situations similar to those they face in their work.

Along the activity you will make decisions and in this way will earn points. These points will accumulate and at the end of the activity they will be transformed into money. For this reason, it is very important that you pay attention to the instructions given by the experimenter in your group.

It is important to take into account that in this type of activities, money is used so that individuals are not indifferent to the decisions they make and just like the decisions you make at work they impact on your earnings. However, we do not expect that earning money is the sole reason why you decided to participate.

<u>1.2) THE GAME:</u>

Participants will be divided into groups of eight (or twelve) and will be conducted by a moderator who will give the instructions throughout the game. Within each group there will be two (or three) subgroups of four: green and blue (and red if it is a group of twelve). There will be a monitor for each subgroup of four.

The main difference between the responsibilities of moderators and monitors is that the moderator is the one in charge of explaining the game for the whole group.

1.2.1) MATERIALS

Subjects will receive:

- A payoff table (yellow)
- An earnings sheet (white)
- Before each period a card in which they will write down how many nets to use when fishing (blue, green or red depending on the subgroup they were assigned).

During the last five periods of each stage:

- The former earnings sheet will be retrieved and a new one will be provided including an additional column in order to keep track of punishment points directed to other participants. Participants will copy the total number of points accumulated so far in the game.
- Once subjects are informed of the total number of nets used by the subgroup. A punishing card will be delivered.

In addition, each moderator and monitor will receive:

- A sequence that indicates for each period of the game, the identifier number of the subjects that will play in the subgroup that he/she is in charge.
- A flag range that assigns yellow, orange and red flags in accordance to total punishment points a subject received. This flag range will be displayed in cardboard, so that it is visible to all participants.

IMPORTANT: it is extremely important that participants are unable to see either the number of nets used by others or the punishment points others assign.

Moderators and monitors are in charge of explaining the characteristics of each stage of the game and answering doubts. It is crucial that they remain neutral and make sure they do not influence the decisions subjects make.

A frequent question in this type of games is: *"Can I choose always the same number of nets?."* The moderator should reply that in each period each participant must choose the number of nets he prefers and insist that this choice should be made *individually and privately*.

1.2.2) INSTRUCTIONS

Sentences in italics explain in detail how the game should be explained to participants. They can be either read or paraphrased.

Once participants have understood the aim of the game and are organized in groups, they must learn the game's dynamics. There will be enlarged cardboard samples of the cards hanging on the walls. Examples will be written on the enlarged cards to facilitate the explanation.

Introduction

This activity intends to recreate (reproduce) a situation in which a group of persons must make decisions individually about how to exploit a natural resource such as a fishery, a wood or any other resource a community may use. In this case, it represents Rocha's coastal lagoons.

You will play several periods equivalent to a fishing day. At the end of the activity you will have accumulated a certain number of points that will be converted into money.

You cannot comment on the decisions you have made or will make as then the activity will be invalidated. In the event this happened the activity would be finalized and players would be paid according to the points earned up to that moment.

Materials are handed-in to participants

You have drawn a number from a bag. This number is an identifier that assigns you to a subgroup at each period. Now you will receive:

- *The payoff table (yellow) in which you can determine the points you can earn in each period depending on the decisions you and the rest of the subgroup take. 100 points are equivalent to 12 pesos.*
- *The earnings sheet (white) where you will keep record of the points earned.*
- *Before the beginning of each period you will receive a card in which you will write down your decision for that period.*

The activity consists of imagining you go fishing and the other three subjects in the subgroup go fishing as well and each of you sells what he catches (that is, you are NOT a team).[15] *Each of you must decide how many nets to use. Each can use a minimum of one net and a maximum of eight. What you earn depends on what you fish and this is reflected in the yellow payoff table.*

Explanation of payoff table

In the yellow payoff table you can find the points you can earn per period depending on how many nets you and the rest of the group decide to use. In the first row you can see the number of nets you can decide to use. The first column shows the total number of nets the other three members of the subgroup can decide to use. The last column indicates the average number of nets the other three members of the subgroup would then be using. So the number of points you can earn in each period depends on the choice of nets you and the other three members of the subgroup choose individually.

We will have three practice periods. In these periods you will not earn points. The aim is to learn how to use all the materials and make sure all participants understood the activity before it starts.

During the practice periods the moderator will reshuffle participants randomly.

[15] We included this clarification to prevent that they would get confused thinking that the more they all fished (4 members), the more they would earn. The goal was to help them understand the payoff table (i.e. the common pool resource dilemma).

Practice period number 1

Imagine that you are fishing in a lagoon where there are also three other people. Each fisher must decide how many nets to use (1 to 8). The amount you will fish (indicated by the points you will earn) will depend on the number of nets you and the other three fishers throw.

Participants will be handed a card in order to write their identifier number and the number of nets chosen. In the practice period number 1 the moderator will instruct participants to each choose 3 nets. The monitors will pick up the cards and type the choices and will then communicate the total number of nets chosen by the subgroup (12 in this case). Every participant must write down this number in column B of the earnings sheet. Then, they should subtract the number of nets chosen by himself (3) to the total announced and write down the result in column C of the earnings sheet. The participants should look at the payoff table and determine the points earned (294) and finally write down this number in column D of the earnings sheet.

		My fishnets								
	Others' total	1	2	3	4	5	6	7	8	Others' average nets
Others' fishnets	3	354	360	366	372	378	384	390	396	1
	4	342	348	354	360	366	372	378	384	1
	5	330	336	342	348	354	360	366	372	2
	6	318	324	330	336	342	348	354	360	2
	7	306	312	318	324	330	336	342	348	2
	8	294	300	306	312	318	324	330	336	3
	9	282	288	294	300	306	312	318	324	3
	10	270	276	282	288	294	300	306	312	3
	11	258	264	270	276	282	288	294	300	4
	12	246	252	258	264	270	276	282	288	4
	13	234	240	246	252	258	264	270	276	4
	14	222	228	234	240	246	252	258	264	5
	15	210	216	222	228	234	240	246	252	5
	16	198	204	210	216	222	228	234	240	5
	17	186	192	198	204	210	216	222	228	6
	18	174	180	186	192	198	204	210	216	6
	19	162	168	174	180	186	192	198	204	6
	20	150	156	162	168	174	180	186	192	7
	21	138	144	150	156	162	168	174	180	7
	22	126	132	138	144	150	156	162	168	7
	23	114	120	126	132	138	144	150	156	8
	24	102	108	114	120	126	132	138	144	8

Practice period number 2

In the second practice period each participant should choose 5 nets. The total number of nets used will then be 20. The participant should be able to identify the number of points earned (234).

Practice period number 3

The third practice period resembles the actual game. Participants will make a decision individually and privately, the total number of nets used will be announced and they will have to calculate the number of points earned. Monitors should supervise earning sheets in order to make sure the procedure has been understood. Participants will be reshuffled randomly in subgroups and will sit back-to-back with the other subgroup members.

After the third practice, period the moderator will answer questions and afterwards will read aloud the informed consent that individuals should sign if they agree to continue participating.

After the first five periods of the game, the new treatment will be explained.

Nonmonetary punishment

Participants will receive:

- A new earnings sheet that includes an additional column in order to subtract disapproval points they decide to send.
- A trial card where they will write down the number of nets they choose to use.
- A trial punishing card that will be completed following the example below.

The moderator will explain to the group that in the next periods they will not only choose how many nets to use but also will be able to disapprove of the behavior of the other subgroup members.

Up to now you have decided how many fishnets to use. In the next periods you will be able to express disapproval to others' fishnet choices. As a consequence, those participants punished by the rest of the subgroup will receive a flag whose color indicates the extent of peers' disapproval.

Once you have decided how many nets to use and the total number of nets used by the subgroup has been announced you will complete the punishing card, and will be able to allocate 0 to 10 points to others' fishnet choices. Punishment points will be added and individuals will be issued a yellow, orange or red flag depending on the extent of peers' disapproval.

Flag range	
Flag	Total punishment points received
Yellow	2 - 5
Orange	6 - 10
Red	11 - 30

The number of fishnets used by each participant and punishment points assigned to other's choices will never be public. The sole public information will be the flag issued to the punished participant.

Expressing disapproval is not for free. The total number of disapproval points you assign each period will be subtracted from the points you earned.

A subject could disapprove of eight extraction alternatives (1 to 8 nets) at the same time. A participant is free to punish those choosing the same number of nets that he chose, although such punishment would not also be applied to himself (this aspect of the setup was explained only in response to a direct question).

Nonmonetary punishment practice period

In this practice period we will all pretend we are participant number 3. This participant chose 6 nets. This number will be written down in the practice card and in column A of the earnings sheet.

Once the cards have been picked up by the monitor and added up, the total number of nets will be announced. Suppose the total number of nets used is 19, participants should write down this number in column B of the earnings sheet. Then, they should subtract column A to column B (13). As player 3 used 6 nets and the rest of the group used 13 nets, the number of points earned by player 3 is 264 (this should be written down in column D of the earnings sheet).

Player 3 can now express disapproval to others' fishnet choices. Let's suppose player 3 grants: 1 point to those who used 7 nets and 2 points to those who used 8 nets and 0 to the other options. Player's 3 punishing card will look like this:

Punishment card	
If the other throws:	I disapprove (0 to 10 points)
1 net	
2 nets	
3 nets	
4 nets	
5 nets	
6 nets	
7 nets	1
8 nets	2
Total	3

Player's 3 cost of punishing will then be 3 points (1+2). This cost must be written down in column E of the earnings account, and in column F calculate net earnings by subtracting column E to column (earnings – cost of punishing).

Player's 3 fishnet choice is also disapproved by other subgroup members. If other subgroup member punishing cards are as follows (show cardboard):

Participant: 1		Participant: 2		Participant: 4	
Punishment card		**Punishment card**		**Punishment card**	
If the other throws:	I disapprove (0 to 10 points)	If the other throws:	I disapprove (0 to 10 points)	If the other throws:	I disapprove (0 to 10 points)
1 net		1 net	9	1 net	0
2 nets		2 nets	3	2 nets	0
3 nets	1	3 nets	0	3 nets	0
4 nets	1	4 nets	3	4 nets	0
5 nets	2	5 nets	4	5 nets	0
6 nets	3	6 nets	5	6 nets	0
7 nets	8	7 nets	8	7 nets	0
8 nets	10	8 nets	9	8 nets	0
Total	25	Total	41	Total	0

Player's 3 fishnet choice was punished by a total of 8 points (3 points from player 1 and 5 points from player 2 as player 4 did not assign disapproval points). Player 3 will be issued an orange flag in accordance with the ranges shown in the cardboard. Player 3 will display the flag received in the game's next period.