Pro-social behavior, Heterogeneity and Incentives: Experimental evidence from the local commons in Colombia

Sandra Polania-Reyes[1]
Department of Economics
University of Siena

Abstract

Promotion of pro-social behavior in social dilemmas has been subject to an increased interest among social scientists and policy makers due to the relevance of Common Pool Resources (CPR) in long-run human well-being. Although economists know a lot about the effect of incentives on pro-social behavior, we understand very little about how to promote pro-social behavior efficiently. For example, we accept that monetary incentives sometimes are less effective than would be predicted for entirely self-regarding individuals but we are unable to identify the mechanisms by which these crowding effects may occur.

This study examines a unique experimental data set of a CPR game with 1095 individuals (79% are CPR users that are closely related to a real resource). Our purpose is twofold. On one hand, it goes ahead on the experimental analysis by accounting for unobserved heterogeneity of individuals' social preferences and group composition of types within each group. On the other hand, it explores the role of heterogeneity of pro-social preferences on achieving the most efficient economic incentive.

First, we drop the assumption that all individuals are all self-regarding and develop several models of pure Nash strategies for our CPR game when individuals are motivated by a combination of self-interest and preferences for altruism, reciprocity or inequity aversion. Second, we estimate individual heterogeneity by using a random coefficients model approach and classify individual social preferences (according to their behavior in the baseline phase) by assigning a type to every participant. Third, we compare the role of heterogeneity of preferences in social efficiency across incentives and confirm the existence of different effects of incentives on each type; the subsidy is found to be the most socially efficient incentive. Finally, we obtain *exogenous* determinants of individual type such as level of education, perceptions on the CPR, perceived interest in cooperation among the community, whether the participant does volunteer work and whether the CPR is the household main economic activity of the household; we also obtain *endogenous* determinants such as the composition of types in the group and their demographic characteristics.

JEL classification: A13 (Relation of Economics to Social Values), C23 (Random effects models), C51 (Model Construction and Estimation), D64 (Altruism), H39 (Fiscal Policies and Behavior of Economic Agents), Q20 (Renewable Resources and Conservation), Q28 (Renewable Resources and Conservation, Government Policy).
Keywords: Common-pool resources, social preferences, laboratory and field experiments, explicit incentives, inequity aversion, altruism, random coefficients model

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1. Introduction

Promotion of pro-social behavior in social dilemmas has been subject to an increased interest among social scientists and policy makers due to the relevance of Common Pool Resources (henceforth CPR) in long-run human well-being (Janssen et al. (2010)). The motivation for this study is that researchers in economics know a lot about the existence of pro-social behavior. An individual behaves pro-socially in order to help others -including himself, to achieve a common good. Social preferences are those concerns for the well-being of others and desires to uphold ethical norms. They reduce social inefficiency in the absence of complete contracts (Arrow (1971); Becker (1976); Akerlof (1984)) and thus are the key to solve social dilemmas (Ostrom (1990)), in which the uncoordinated actions of individuals result in an outcome that is Pareto inefficient[2].

Although economists know a lot about the effect of incentives on pro-social behavior, we understand very little about how to promote pro-social behavior efficiently. Most of Mechanism Design and Public Economics models assume that individuals are self-regarding, that is, they face own-material-payoff-maximizing motives. Although it has been found that economic incentives[3] may be less effective than predicted (Sobel (2005); Bowles (2008)). We remain unable to identify the mechanisms by which these crowding effects may occur[4].

It is also acknowledged that allowing for heterogeneity is key to achieve more efficiency in public policies (Kreps (1997)). This approach implies that the design and evaluation of public policies must consider the composition of social preference types in the target group and the effect of incentives on each type. However, how incentives interact with heterogeneous social preferences remains mostly unexplored; existing experimental evidence and economic theory do not complement each other when trying to solve this puzzle. This study presents evidence on the role of heterogeneity in social preferences on efficiency of incentives.

The aim of the paper is twofold. First, introduces a structural approach to examine which types of social preferences individuals exhibit in a CPR environment, in which the CPR is collectively owned or shared among populations (e.g. natural resources, land, software) and foregoing the overexploitation of the jointly used resource leads to a Pareto superior outcome. Second, it examines the effect of heterogeneity of social preferences in achieving social efficiency of incentives. This is especially important for policy makers who look for not only effective but also efficient incentives. Understanding heterogeneity of individual preferences in this environment is the first step to design Pareto efficient incentives.

We address these questions, first by using a CPR experimental game in the field to find empirical evidence of heterogeneity of social preferences types and explaining these types of social preferences within an economic model. Second, we use this structural model to have a robust estimation of the theoretical parameters and the distribution of types in our sample.

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[2] The individual optimization problem is to maximize i's payoff, i.e. $\max_{x_i} \pi_i\left(x_i, \sum_j x_j\right)$. Given that $\frac{\partial \pi_i}{\partial x_i} > 0$ and $\frac{\partial \pi_i}{\partial \sum_j x_j} < 0$, the Pareto optimal allocation does not coincide with the individually rational strategy.

[3] Which I will call simply "incentives" without the adjectives, meaning interventions to influence behavior by altering the economic costs or benefits of some targeted activity.

[4] See Bowles and Polania-Reyes (2012) for a review and Holmes et al. (2010) for empirical attempts.

Second, we assess the impact of incentives on social efficiency via their effect on the different types of behavior. We find that individual pro-social behavior is consistently different across types and the composition of types in the group significantly determines the initial average level of extraction for the group, the path of extraction and the outcomes. Besides, different incentives have a different effect on behavior, which is determined, in part, by the composition of types in the group.

Finally, we examine the possible determinants of being classified as a certain type by taking into account socio-economic characteristics and the composition of types in the group.

The paper goes as follows: next session highlights this paper's contribution. Section 3 introduces the CPR framework and the experimental design for this study. We also compare the models' predictions with and without an incentive (i.e. low subsidy, low fine, medium fine, high fine and very high fine). In Section 4, we drop the assumption that all individuals are all self-regarding and develop several models of pure Nash strategies for our CPR game when individuals are motivated by a combination of self-interest and preferences for altruism (Levine (1998)), reciprocity (Bowles and Gintis (2003)) or inequity aversion (Fehr and Schmidt (1999)). Section 5 describes the data and our experimental procedures. In section 6, we classify individual social preferences according to their behavior in the baseline (no incentive) phase. We estimate individual heterogeneity by using a random coefficients model and examine incentives' performance in the light of efficiency and efficacy. We also compare the role of different preferences in the social efficiency of incentives, and confirm the existence of different effects of incentives on each type and the best efficient incentive. In Section 7 we relate the probability of being type q and the theoretical parameters of altruism and reciprocity to both *exogenous* variables (such as socio-economic characteristics, perceptions on the CPR and the community and social capital measures) and *endogenous* ones such as the composition of the group in terms of types and observable characteristics. The last section concludes and suggests points of future research.

2. Heterogeneity of social preferences

While there is a vast literature that show a substantial fraction of the players are motivated by motives different from self-interest, there has been little evidence on the coexistence of different social preferences present among individuals. Theoretical and empirical advances over the intervening years provide the basis for a reconsideration of the simultaneous presence of different social preferences (Rabin (1998); Kreps (1997); Elster (1998), Leider et al. (2009)) and the effectiveness of incentives to promote pro-social behavior not only in the lab, but also in the field (Bowles and Polania-Reyes (2012)). On the other side, the role of economic incentives and pro-social behavior has been studied mostly in Principal-Agent settings (Kessler (2008); Falk et al. (2005); Falk and Kosfeld (2006)) with few exceptions (see for example Rodriguez-Sickert et al. (2008)).

This paper contributes to provide additional implications for policy design and mechanism design theory. First, we drop the assumption that when individuals exhibit social preferences, they also show the same type (Hwang and Bowles (2014); Dufwenberg et al. (2011); Charness and Rabin (2002)). Second, we improve the type classification method, which is the most used currently in the literature of social preferences (i.e. random coefficients model) and

explain these types of social preferences within an economic model[5]. Finally, we assess the role of heterogeneous social preferences on the efficiency of incentives.

We contribute to the literature of Common Pool Resource games that have been implemented by assuming homogeneous preferences mostly with only students (Falk et al. (2002)) based on (Walker et al. (1990)) and only real users (Margreiter et al. (2005); Velez et al. (2009)). Our sample is unique since which has both students and real users of the CPR and different CPR environments (water, firewood and fish) under a rich set of (economic and non-economic) incentive schemes. This dataset has been used before to show that users deviate more from self-regarding NE than students (Cárdenas (2004, 2011) and Cárdenas and Carpenter (2005)) and the effect of incentives at the average level (Cardenas et al (2004) and Cardenas (2005)). In addition, among real users of the CPR, those whose main resource of income is extraction from the CPR deviate more from self-regarding NE (Molina (2011)). All these studies explain these findings with the existence of social preference but do not explore the role of heterogeneity of social preference among the participants.

This paper is closely related to Velez et al. (2009). Our aim too, is to understand better the behavior of small-scale common pool resource users in developing countries. We also include different models of social preferences. However, we merge preferences for fairness and reciprocity as in Ledyard (1995) and Rabin (1993) but introducing a social norm measured as participants' initial belief in the practice rounds. Another difference with respect to Velez, et al.'s specification is that that we look at consistency of behavior to categorize an individual instead of characterizing aggregate behavior. Finally, we examine the role of incentives in social preferences and the effect of having different types in a group on efficiency.

Finally, this paper contributes to the literature on structural models of pro-social behavior (Falk and Heckman (2009); Manski (2011)) since we use the random coefficient model approach to estimate theoretical parameters. One of our strengths is that we have more than one observation per individual, which allows us to examine certain types of consistent behavior among individuals, contrary to other studies that use one-shot decision-classification. On the other hand, our results suggest the need to estimate a distribution for the –unobservable- categorization of social preference types and the parameters of such preferences, which is possible thanks to new advances in econometrics such as finite mixtures models (Echeverry and Polania-Reyes (2015)).

3. Common Pool Resource framework

i. Static Common Pool Resource game

This model was first presented in Cárdenas (2004) and Cárdenas et al. (2004). First, we are going to define the game $\Gamma = \{X^n, f\}$. An individual i is endowed with e units of effort (i.e. hours of extraction, investment in equipment, etc.) which he can use to extract $x_i \in X = \{1, \dots, e\}$ units from the CPR.

[5] In applied microeconomics, social preferences types have been studied in the context of public goods games based on Walker et al (1988) and risk preferences (see Andersen, et al. (2010)) and predominantly with only students (Fischbacher et al. (2001); Kurzban and Houser (2001); Burlando and Guala (2005); Bardsley and Moffat (2007); Carpenter et al. (2009)) or with only real users (see evidence in forest management by Rustagi et al., (2010)). For a good commentary, see Velez, et al. (2009) and Rustagi et al., (2010).

(1) $$f: \quad X^n \to \Pi^n \qquad (x_1, \dots, x_n) \mapsto (\pi_1, \dots, \pi_n)$$

The payoff function π_i is defined as

(2) $$\pi_i = ax_i - \frac{1}{2}bx_i^2 + \varphi\big(ne - (x_i + x_{-i})\big)$$

whose components are the direct benefits from extraction $ax_i - \frac{1}{2}bx_i^2$ and the indirect costs from depletion $\varphi\big(ne - (x_i + x_{-i})\big)$ by i's decision and other's decision, x_{-i} of extraction.

In this particular case, we assign to the fixed parameter the values $(a, b, \varphi, e) = (60, 5, 20, 8)$ and the number of players in the group g is $n = 5$, thus, they face a payoff function $\pi_i = 60x_i - \frac{5}{2}x_i^2 + 800 - (x_i + x_{-i})$, the set of possible choices of individual i are $X = \{1, \dots, 8\}$ and the possible aggregate level of extraction is given by $(x_i + x_{-i}) \in \{5, \dots, 40\}$.

The unique socially (Pareto) efficient allocation or social optimum (SO), which also maximizes the aggregate payoffs of the group $\sum_i \pi_i$ s.t. $x_i \in X$ and it is given by $(x_1^{SO}, \dots, x_n^{SO}) = argmax_{(x_1,\dots,x_n)} \sum_{i=1}^{n} \pi_i$. The optimization conditions yield the optimal decision of extraction $\hat{x}_i^{SO} = \frac{a - \varphi n}{b} < 0$ and our feasible socially optimal decision of extraction is a corner solution $x_i^{SO} = 1$ of extracting the minimum level possible of the resource[6].

The Social Efficiency Index (SEI) according to the number of individuals in the group g is defined as the ratio between the actual aggregate payoff, or the sum of the individual payoffs, $\sum_i \pi_i$ and the maximum aggregate payoff possible, the sum of the individual payoffs when all the individuals in the group play the social optimal strategy, $\pi_i^{SO} = \pi\big(x_i^{SO}\big) = 758 \; \forall i$. Under the social optimum, all players extract one unit and $SEI_g = \frac{\sum_i^5 \pi_i}{\sum_i^5 \pi_i^{SO}} = 1$.

There is a conflict between the self-regarding Nash equilibrium and the socially efficient strategies (See table A1 in the appendix). As we explain in detail below, the Unique Nash Equilibrium (SNE) for a self-regarding individual is given by $x_i^{SNE} = argmax_{x_i} \pi_i \; \forall i$ that is $x_i^{SNE} = \frac{a - \varphi}{b} = e = 8$, given the chosen parameters (a, b, φ, e). If there are only self-regarding individuals the social efficiency index is $SEI_g^S(x^{SNE}) = 0.42$.

ii. Dynamics of the CPR game: experimental design

Participants played a finitely repeated partner matching game, ($T = 10$ periods with $t = \{1, \dots, T\}$) with common knowledge of the payoff function. At the beginning of period t each individual decides simultaneously her level of extraction, x_{it}. At the end of period t, the experimenter announces aggregate extraction$(x_{it} + x_{-it})$ and players are informed about

[6] Since x_{it} takes only non-negative values, for framing the experimental design we have a corner solution at $\hat{x}_i^{SO} = 0$, that is players should not allocate labor into extraction to produce the socially efficient outcome. We have eliminated in the payoffs table that option to avoid possible conflicts in conducting these experiments in the field. Previous experiments and pre-testing exercises in the field suggest that there is a strong aversion towards prohibition of resource use that could create problems with the participants when conducting the experiments this way. Interior solutions with non-dominant strategies, such as used in Ostrom, Gardner and Walker (1994) and Cardenas et al. (2000), are another alternative, but here we also have decided to maintain corner solutions in order to have a design with a dominant strategy (Cárdenas (2005):250).

other players' aggregate behavior. That is i does not know individual extraction by the other players, x_{-it}. She only knows the average extraction by them, $\bar{x}_{-it} = \frac{\sum_{j\neq i}^{n-1} x_{jt}}{n-1}$.

Before round 11 the experimenter announces an incentive is implemented (see Figure A1 and the Appendix section for instructions and procedures). The groups remain unchanged during the following T rounds $t = \{11, \dots, 20\}$ (i.e. partner matching). The incentive could be a non-monetary incentive (i.e. the incentive does not affect individual payoffs) or a monetary incentive (fine or subsidy).

Some sessions did not face any incentive as we needed control groups, that is, during the remaining ten rounds individuals had the same baseline instructions.

iii. Monetary incentives to promote prosocial behaviour

In order to prevent over exploitation of the CPR, an economic incentive s is introduced, which is proportional to the level of extraction[7]. For each round, one player is chosen randomly with an exogenous probability of inspection $p = \{0.1, 0.2\}$ and face one monetary incentive. When the monetary incentive is a fine, s is the monetary cost of violating the rule of the socially optimum solution. If violating the rule, that is if has a level of effort that is greater than 1, $x_i > x^{SO} = 1$, the player pays a fine $s < 0$ and $s \in \{-350, -175, -100, -50\}$ per unit of extraction above 1. In particular, equation (3) now includes the new expected payoff function for a player i, which is as follows:

$$\pi_i^{s<0} = \pi_i + ps(x_i - x^{SO}) \quad (3)$$

The new Self-regarding Nash Equilibrium is $x_i^{SNE\_s<0} = \frac{a-\varphi+ps}{b} = \{1,6\}$ for $x_i \in [1,8]$. When the monetary incentive is a subsidy, s is the monetary reward for extracting less than the Self-regarding Nash strategy. If the chosen player's level of extraction such a level, $x_i < x^{SNE} = 8$, the player receives a subsidy, $s = 50$ per unit of extraction below 8. The expected payoff function for a player i, is now as follows:

$$\pi_i^{s>0} = \pi_i + ps(x^{SNE} - x_i) \quad (4)$$

The new Self-regarding Nash Equilibrium is $x_i^{SNE\_s>0} = \frac{a-\varphi-ps}{b} = 6$, for $x_i \in [1,8]$. The Social Efficiency Index, SEI, for a self-regarding individual is 62% for $s \in \{-100, -50, 50\}$ and 100% for $s \in \{-350, -175\}$. Table 1 summarizes the different monetary incentive schemes.

Table 1. Incentive scheme and new Self-regarding NE for each incentive

Incentive s (addition to π_i)		*Acronym*	**Individual level of extraction x_i** 1	2	…	7	8	$x_i^{SNE\_s}$	**Probability of inspection p**
Subsidy $+s(8-x_i)$	**Low**	**SL**	350	300	. . .	**50**	0	6	0.2
Fine $-s(x_i-1)$	**Low**	**FL**	0	**-50**	. . .	-300	-350	6	0.2
	Medium	**FM**	0	**-100**	. . .	-600	-700	6	0.1
	High	**FH**	0	**-175**	. . .	-1,050	-1,225	1	0.2
	Very high	**FVH**	0	**-350**	. . .	-2,100	-2,450	1	0.1

[7] The data set also contains additional treatments in which the monetary incentive is not exogenous. Players could decide whether to implement a monetary incentive such as i) and ii) at round 11 voting on whether to implement a low fine (or subsidy) and players decide who should be inspected, iii) and iv) a low fine (or subsidy) at each round, v) voting for a low subsidy at each round, and vi) and vii) voting a high (or low) fine at round 11.

iv. Non-monetary incentives to promote prosocial behavior

In order to prevent over exploitation of the CPR, individuals face one exogenous non-monetary incentive. These are *one-shot communication* (OC) in which the group has a single five min face-to-face communication only once prior to making all ten decisions (corresponding to rounds 11 to 20); *repeated communication* (RC) in which the group has a single five min conversation before each round; or *public announcement* (PA), in which the rule of extracting the social optimum level is announced. For the last treatment, in each round, one player is chosen randomly with $p = 0.2$; if violating the rule ($x^{SO} = 1$), the player pays no fine but must show the experimenter his or her extraction level, which is then announced publicly to the group. None of these non-monetary incentives alter the self-regarding Nash prediction (SNE).

v. Adaptive dynamics with heterogeneous types

Note that the one-shot static model doesn't correspond to the experimental design with T periods and we have to introduce time dynamics to the model in the estimation. Thus, it is necessary to set up the primitives of the adaptive dynamics of the individuals. For ease of computation we assume individuals have adaptive expectations[8]. Each type has a belief about others' decision x_{-i} in period t

$$B_t(x_{-it}) = \bar{x}^e_{-it} = \bar{x}_{-it-1} \ \forall i \tag{5}$$

where $\bar{x}_{-it-1} = \frac{\sum_{j\neq i}^{n-1} x_{jt-1}}{n-1}$ is other players' average level of extraction in the previous period. Although we are aware this is an extreme assumption, it is still useful for this study since we are focus on the classification procedures. The dynamics of the process of belief formation will be considered in further research. In addition, the initial condition $\bar{x}_{-i1} = \bar{x}_{-i0}$ we assume this one to be equal to the average of the individual level of extraction in the practice round; which is equal to 4.51 in our data.

4. Models of individual social preferences

In this section we present a structural approximation of individual prosocial behavior and consider the most popular types of individuals in the behavioral economics literature: Self-regarding, altruist, reciprocator and inequity averse. A risk neutral individual i maximizes a utility function U_i defined as[9]

$$\begin{gathered} X^n \xrightarrow{g} \Pi^n \xrightarrow{U_i} \mathbb{R}_+ \\ (x_1, \dots, x_n) \mapsto (\pi_1, \dots, \pi_n) \mapsto U_i(\pi_1, \dots, \pi_n) \end{gathered} \tag{6}$$

[8] This is relevant to the analysis of repeated games and relies on reinforcement or other forms of real-time learning. See Rabin (1993), Dufwenberg and Kirchsteiger (2004), and Falk and Fischbacher (2006).

[9] For simplicity, we are assuming that the individual utility function is linear in the players' payoffs. For example, in the case of a self-regarding individual, $U_i^S = U_i(\pi_i) = \varrho\pi_i$ with $\varrho = 1$. However, neutrality is an important matter measuring social preferences. It is necessary to perform the same analysis with other functional forms of the utility function. For example, when $U_i(\pi_i) = \frac{(\pi_i + c_i)^{1-\varrho}}{1-\varrho}$ where c_i is individual consumption of goods and $U_i(\pi_i) = \frac{(\pi_i + bw_i)^{1-\varrho}}{1-\varrho}$ where w_i is individual wealth and $b > 0$. This issue can be explored with the data set we have and is part of our current research.

The decision process for each individual is to maximize the expected individual utility function:

$$\max_{x_i} \mathrm{E}_{B_t} U(\pi_{it}, \bar{\pi}_{-it-1}; \Theta) \tag{7}$$

where $\bar{\pi}_{-i} = \frac{\sum_{j\neq i}^{n-1} \pi_j}{n-1}$ is other players' average payoff and $\Theta = \{\rho_i, \mu_i, \beta_i\}$ is a vector of individual parameters for the individual utility function, $U(.)$. We will now describe different models of social preferences and the maximizing strategies for every type q of social preferences from their respective utility function, U_i^q.

i. Baseline: self-regarding preferences

Individuals that exhibit self-regarding preferences care only about their own monetary cost and benefits and are usually called in the literature as free riders, selfish and defectors. A *Self-regarding individual* i has a utility function given by $U_i^S = \pi_i$. The Self-regarding best-reply (from the first order conditions) is $x_i^S = \frac{a-\varphi}{b} = 8$ and the Self-regarding Nash equilibrium is given by the maximum individual level of extraction or $x_i^{SNE} = 8$ units in our CPR framework $\forall i$.

Result 1. *Individuals that play the self-regarding NE strategy are a small proportion of the sample.*

This result is not new in the literature of social preferences. The first generation of experimental evidence reveals the existence of social preferences in which people may consistently deviate from the self-regarding Nash prediction and that social preferences are important influences on economic behavior (Fehr et al. (1997); Bewley (1999); Fehr and Schmidt (1999); Fehr and Gächter (2000)). When looking at individual behavior over rounds we find that the first result to motivate this study is that individuals that play the self-regarding NE strategy are a small proportion of the sample. Figure 1 presents the distribution of times that individuals extract 8 units among the first ten rounds. There are 35 percent of the players who never played the NE strategy, a quarter of the players chose the NE strategy only once and we observe that only 2 percent of 1000 individuals played the NE consistently during all periods.

We have to consider that there are identification issues between reputation and learning. For example, individuals may behave pro-socially in the presence of reputation effects (Kreps et al. (1982); Bohnet and Huck (2004); Mailath and Samuelson (2006)) (see Figure B1 in the appendix). We affirm this is not the case since the players have complete information on the payoffs and know that the game is finitely repeated. Thus, the sub-perfect SNE of this finite game is the same for all the rounds. This is consistent with models with incomplete information about other's preferences and/or that allow for reputation in games (Mailath and Samuelson (2006))[10]. In addition, although the fraction of players that extract 8 units is small at the beginning and increases at the last period, it never reaches 25% of the sample.

[10] This is also confirmed by the assumption that there is no Social multiplier in the game.

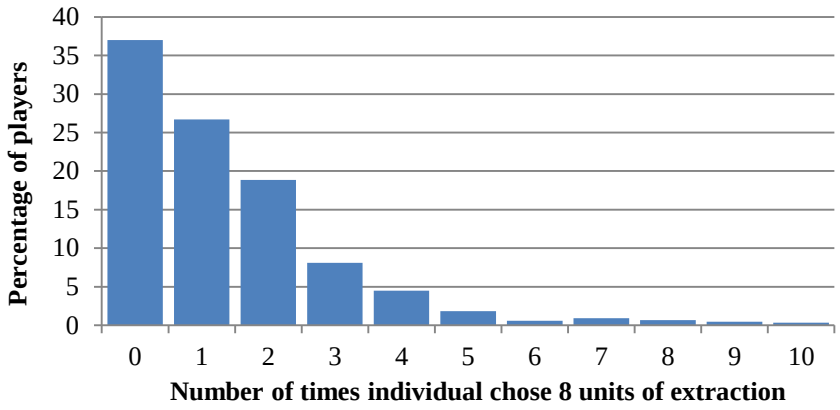

Figure 1. Percentage of individuals that behave as Self-regarding. N=1095 (CPR users and students). In the x-axis we observe the number of extractions $x_i = 8$ for during the first ten rounds. In total, only 0.35% chose the NE strategy consistently during the first ten rounds.

We also observe that individuals deviate from the NE strategy most of the time. We have a glimpse on heterogeneous behavior in our sample since we are called to explore what the 70% of the sample did choose. Then we need to go to a higher level of cognition in order to explain this behavior and use our definition in section 3. This approach and the individual preferences framework are key in order to answer our research question. Now we will present an individual preferences framework in a static setting for different types of social preferences.

ii. Altruistic preferences

We adapt our CPR framework to the models proposed by Levine (1998) and Casari and Plott (2003). Individuals that exhibit these preferences are those who care about other's utility (such as altruism (Andreoni and Miller (2002); Carpenter et al. (2009)), unconditional cooperator (Fischbacher et al. (2001)) or pure cooperators (Rabin (1993)). An Altruist has a utility given by

(8) $$U_i^A = \pi_i + \rho_i \bar{\pi}_{-i} \text{ with } \rho_i \in (0,4]\ \forall i$$

where ρ is the parameter of altruism, the positive weight an altruist puts on other's payoff. Note that this is equivalent to $\rho_i \in (0,1]$ if $\pi_{-i}$is used instead of $\bar{\pi}_{-i}$. The altruistic best reply (from the first order conditions) is[11]

(9) $$x_i^A = \begin{cases} x_i^S - \frac{\rho_i \varphi}{b} = 8 - 4\rho_i & if\ 0 < \rho_i < 1.75 \\ 1 & if\ 1.75 \leq \rho_i \leq 4 \end{cases}$$

If there are only pure cooperators, that is individuals with a very high ρ, we will have $\rho_i \geq 1.75\ \forall i$ and we obtain the Pareto efficient outcome, $x^{SO} = 1$.

iii. Reciprocal preferences and a social norm

Reciprocators cooperate only if others cooperate and present a similar behavior to conformism (Rabin (1993); Bowles (2004); Levine (1998)). When individuals do not have complete information about other's behavior, they use the current social norms which stem

[11] These are boundary conditions given $X = \{1, \ldots, 8\}$: $0 \leq \rho_i/4 \leq 0.44$.

from beliefs about others' behavior. A social norm is a pattern of behavior such that individuals prefer to conform to it on the condition that they believe that most people in their reference network i) conform to it (i.e. empirical expectations) and ii) think they ought conform to the norm (i.e. normative expectations) (Bicchieri (2006, 2014)) . Given that decisions are private and individual in the CPR game, the game is able to capture empirical expectations the first time they play (i.e. the practice rounds). Empirical expectations are key for social norms to evolve and they are mostly based on observations of what individuals in the reference group have done in the past (Bicchieri (2014)). In addition, in repeated encounters, people have an opportunity to learn from each other's behavior, and to secure a pattern of reciprocity that minimizes the likelihood of misperception (Bicchieri and Moldoon, (2014)). We then define x_i^* is an ethical prescription governing actions towards others, a social norm determined by culture, reference points or the context of individual behavior. In order to examine reciprocity, we use as social norm $x_i^* = \overline{x_0} = 4.51\ \forall i$, the average number of extracted units in the last practice round among CPR users in the first visit since at that stage subjects had not formed their expectations on which types they were interacting with in their group.

A nonaltruistic *Reciprocator* individual i (exhibits neither good will nor spite unconditionally but conditions her behavior on the goodness or spitefulness of others) has a utility given by

$$U_i^R = \pi_i + \mu_i(x_i^* - \bar{x}_{-i}^e)\bar{\pi}_{-i}\ \forall i \tag{10}$$

where the weight the reciprocator puts others' payoffs, μ_i, is positive and based on which i rates extractions from others deriving more utility if others' expected average extraction, $\bar{x}_{-i}^e$, is below this norm and less otherwise. The reciprocal best reply (from the first order conditions) is given by

$$x_i^R = \begin{cases} 8 & if\ x_i^* \le \bar{x}_{-i}^e \\ 8 - 4\mu_i(x_i^* - \bar{x}_{-i}^e) & if\ x_i^* > \bar{x}_{-i}^e \text{ and } \mu_i \in \left[0, min\left(1, \frac{1.75}{x_i^* - \bar{x}_{-i}^e}\right)\right] \end{cases} \tag{11}$$

An individual with preferences for *altruism* and *reciprocity* (Bowles, 2004) has a best reply function given by

$$x_i^{AR} = \delta_{1i} + \delta_{2i}\bar{x}_{-i}^e\ \forall i \tag{12}$$

where $\delta_{1i} = 8 - 4\mu_i x_i^* - 4\rho_i$ and $\delta_{2i} = 4\mu_i$. In the empirical section we are going to estimate the structural parameters ρ and μ by using the Random Coefficients model.

iv. Preferences for fairness and inequity aversion

The model of fairness and inequity aversion is based on Fehr and Schmidt (1999) and Bolton and Ockenfels (2000). We use the adaptation to a CPR model by Falk, et al. (2002). An *inequity averse* individual i has a utility given by

$$U_i^I = \pi_i - \alpha_i \max(\bar{\pi}_{-i} - \pi_i, 0) + \beta_i \max(\pi_i - \bar{\pi}_{-i}, 0)\ \forall i \tag{13}$$

The second term in Equation (13) measures the utility loss from disadvantageous inequality, and the third term measures the loss from advantageous inequality. It is assumed that the utility gain from *i*'s payoff is higher than her utility loss for advantageous inequality and her utility loss from disadvantageous inequality is larger than the utility loss if player i is better off than other players, $0 \le \beta_i < 1$. In addition, i is loss averse in social comparisons: i

suffers more from inequality that is to his disadvantage (Loewenstein et al. (1989)), $\alpha_i \geq \beta_i$[12].

There are two cases to study when comparing individual payoffs. First, if $\pi_i \leq \bar{\pi}_{-i}$ there is *disadvantageous inequality*. The critical condition is that $x_i^- \leq \frac{a(1+\alpha_i)-\varphi}{b(1+\alpha_i)} \leq 8$ that yields a parameter $\alpha_i = 0\ \forall i$. This is common when the Self-regarding NE is the upper bound of the feasible set: in this case when there is disadvantageous inequality, i will want to extract more units up to the maximum possible.

The second case is when there is *advantageous inequality* or $\pi_i > \bar{\pi}_{-i}$. The critical condition is $x_i^+ \geq \frac{a(1+\beta_i)-\varphi}{b(1+\beta_i)} \geq 1$ which yields a set of symmetric equilibria with individual's best reply (from the first order conditions)

$$(14) \qquad x_i^I = \begin{cases} (8 - \frac{4\min\beta_i}{1-\min\beta_i}, 8] & if\ 0 \leq \beta_i < 0.63 \\ 1 & if\ 0.63 \leq \beta_i < 1 \end{cases}$$

and $\min\beta_i$ is the smallest β_i among all n players in the group. Table 2 presents a summary of this section. In the next section we estimate the structural parameters for an individual that may exhibit altruistic or reciprocal preferences.

Table 2. Defining Θ: Individual's utility functions and best responses in a static setting

Individual type label $U_i^q(\pi_i, \bar{\pi}_{-i}; \theta_i^q)$	*i*'s Best response	Restriction	Parameter $\Theta = \{\theta_i^q\}$
Self-regarding $U_i^S = \pi_i$	$x_i^S = 8$		$\{0\}$
Altruist $U_i^A = \pi_i + \rho_i \bar{\pi}_{-i}$	$x_i^A \in [8 - 4\rho_i, 8)$ $= 1$	$0 < \rho_i < 1.75$ $1.75 \leq \rho_i \leq 4$	$\{\rho_i\}$
Reciprocator $U_i^R = \pi_i + \mu_i(x_i^* - \bar{x}_{-i}^e)\bar{\pi}_{-i}$	$x_i^R = \mathrm{h}(\mu_i, x_i^*, \bar{x}_{-i}^e)$ $= 8$	$x_i^* > \bar{x}_{-i}^e$ $x_i^* \leq \bar{x}_{-i}^e$	$\{\mu_i\}$
Inequity averse $U_i^I = \pi_i - \alpha_i \max(\bar{\pi}_{-i} - \pi_i, 0) + \beta_i \max(\pi_i - \bar{\pi}_{-i}, 0)$	$x_i^I \in (8 - \frac{4\min\beta_i}{1-\min\beta_i}, 8]$ $= 1$	$0 \leq \beta_i < 0.63$ $0.63 \leq \beta_i < 1$ and $\alpha_i = 0$	$\{\beta_i\}$ only if $\pi_i > \bar{\pi}_{-i}$

Note: We have chosen a functional form $U_i^q(\pi_i, \bar{\pi}_{-i}; \theta_i^q) = \pi_i + \theta_i^q \bar{\pi}_{-i}$ with $\bar{\pi}_{-i} = \frac{\sum_{j \neq i}^{n-1} \pi_j}{n-1}$. In our experimental setting the n-player game thus becomes a **2-player** game, though each of the n = 5 players is playing a different game. Given $\pi_i = 60x_i - \frac{5}{2}x_i^2 + 800 - (x_i + x_{-i})$, the individual's best response does not depend on $\bar{x}_{-i}^e = \frac{\sum_{j \neq i}^{n-1} x_j^e}{n-1}$, except for reciprocators. This will help for identification purposes in the analysis. For an example, see Appendix C.

5. The Data and experimental design

The experiments were conducted in 8 Colombian rural villages (see Table B1 in the appendix) between 2000 and 2002 and a university in Bogotá. A total of 1095 participants attended the sessions, 230 undergraduate students and 865 real users of a CPR. Participants in the sessions in the field were not only familiar with the use of common-pool resources – such as fisheries, water or firewood – but also knew each other and had a prior history of

[12] However, given our parameters, this is never the case in our game. Since the Nash equilibrium is a corner solution, there is no possibility of disadvantageous inequality.

reputation building before the experimental sessions. Every village depended on a different CPR[13].

In a session of twenty rounds, each of five players in a group has to decide a level of extraction between 1 and 8 units of a resource during two stages of ten rounds each. The game was framed as a one situation in which individual households have to decide about the extraction level of a resource such as fish, firewood or water. In each round, a monitor collected decisions and recorded them privately and confidentially. The monitor added the individual extraction levels and announced the total extraction for the group in that round. By knowing the group extraction and their own individual extraction, players were asked to calculate their individual earnings according to the payoff table (see Appendix A). However, players did not know the individual decisions of the others in the group, just their aggregate extraction. This procedure was repeated for twenty rounds. At the end of all the rounds, earnings were added for each participant, and each was privately paid in cash[14].

All data were collected using standard procedures in experimental economics in the laboratory: no deception, no field referents, and fully salient choices. See Cárdenas (2004) and Cárdenas et al., (2004) for the details on this experimental design and its modeling, Cárdenas et al. (2000) for the first field experiment with an external regulation tested experimentally in the field, and Cárdenas (2011) for experimental procedures on the field experiment data set used in this paper[15]. We collected information on individual characteristics of CPR users only. Table 3 summarizes the individual characteristics of CPR users that participated in the games.

On average the household size was 6 people, the average age of the participants was 34 years old and nearly half of the participants were women. We also collected information on the CPR, which are shown in the appendix. To our knowledge this is the richest dataset on CPR in a developing country[16].

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[13] This would make the use of type-detection and reading of intentions by players during the experiment more salient (Cárdenas et al., 2004).

[14] Each experimental session in the field was conducted with five people who lived in the same village. Groups were randomly formed, but we avoided members of the same household participating in the same session. All sessions in the field and the university were hand-run, using pencil and paper. Each session took about three hours. This included the time taken for reading the protocols (see Appendix A), running two or three practice rounds, undertaking two stages of 20 rounds, and calculating the earnings by subject while they filled out a short exit survey and other demographic details (for the villagers only). During the first stage of ten rounds, all sessions were run under the same set of rules. The subjects were notified that the experiment would last at least ten rounds, and that during these rounds no communication among themselves would be allowed. The villagers were seated in a circle facing outwards so that the privacy of the decisions could be maintained. Once the ten rounds were over, the monitor announced that a second stage was about to start, under a new set of rules, for another ten rounds. None of the groups knew in advance during the first ten rounds the type of new rules for the second stage of the game (for more details on the experimental procedures see Appendix A and Cárdenas, et al. (2004) and Cárdenas (2005)).

[15] Individuals did not know how many rounds they would play. There were two example rounds and one practice round and the game started once the experimenter ensured the participants understood the procedure.

[16] There is a caveat to take into account when analyzing CPR users' decisions. In 2002, three of the villages that participated in 2001 were visited for a second time. Individuals that participated in the experiments in this second visit, i.e. 160, although not all had participated before showed a significantly different behavior compared to the overall sample of individuals who participated before, i.e. 705. We did not want to exclude the sample of the second visit since it contains also valuable information about group behavior. For now on, we will describe in the text individual behavior of the overall sample unless we state otherwise. All the information and comparison between the first and second visits is examined in Cárdenas and Carpenter (2005). See Cárdenas et al. (2015) for a novel proposal to explain heterogeneous behavior with this sample.

Table 3. Real Users' Socio-economic Characteristics (N=865)

Variable		Mean	Median	Min.	Max.	Standard deviation	Obs.
Household Size		5.02	5	1	19	2.75	773
Age		34.03	32	7	85	13.91	765
=1 if Woman		46.86	0	0	1	0.50	764
Years of education		5.98	5	0	18	3.73	703
=1 if Landowner		75.03	1	0	1	0.43	749
Number of children		2.28	2	0	6	1.93	359
=1 if membership in associations		44.42	0	0	1	0.50	824
=1 if attends at least to one meeting		62.01	1	0	1	0.49	824
Number of associations meetings		19.82	8.5	1	720	56.20	360
=1 if individual has done any volunteer work in the past year		65.58	1	0	1	0.48	738
Number of days of volunteer work per year		18.91	1	0	365	62.86	738
Percentage Households whose one of two main economic activities is	Agriculture	40.17	0	0	1	0.49	824
	Cattle	11.77	0	0	1	0.32	824
	Fishing	35.32	0	0	1	0.48	824
	Wood	6.01	0	0	1	0.24	815
	Hunting	2.21	0	0	1	0.15	815
Fraction of households with CPR extraction as main economic activity	100%	7.04					824
	50%	31.31					
	0%	61.65					
Time spent by households on CPR extraction	100%	6.19					
	50%	31.07					
	0%	62.74					

Table 4 summarizes the sample allocated according to the treatments and phases of an experimental session.

Table 4. Sample and treatments

Phase	Treatment	Individuals	Groups		
			Total	CPR users	Students
Round 1-10	Control	1095	219	173	46
Round 11-20	Low Subsidy	105	21	18	3
	Low Fine	125	25	20	5
	Medium Fine	50	10	5	5
	High Fine	80	16	12	4
	Very High Fine	25	5	3	2
	Total Pure Economic Incentive	*385*	*77*	*58*	*19*
	Communication one shot	80	16	13	3
	Communication each round	75	15	13	2
	No FINE- public announcement	60	12	9	3
	Total Non-Economic Incentive	*215*	*43*	*35*	*8*

6. Identification of social preferences types: the Random Coefficients model approach

The Random Coefficients model (RCM) is a classification method based on Swamy (1970); Kurzban and Houser (2005); Carpenter and Seki (2011) and Carpenter et al., (2009). A backward looking individual i who has a maximum level of extraction of $e = 8$ units and decides her level of extraction $x_i \in [1,8]$ may have a characteristic behavioral attribute. The parameter heterogeneity is treated as stochastic variation In order to obtain individual measures of social preferences exhibited in the game, we use a random coefficient estimation,

which assumes the coefficient vector is the outcome of a random process and the parameters are drawn from a population of possible coefficients and allows the estimates to vary by individuals. The output of the model is an intercept and slope for each subject.

i. Estimation

In the baseline (i.e. no treatment) the level of extraction of individual i depends on the average of the level of extraction by the other members in the group in the previous round $(t-1)$ such that:

$$x_{it} = \delta_{1i} + \delta_{2i}\bar{x}_{-it-1} + \epsilon_{it} \quad \forall t = 1,..10 \tag{15}$$

where individual behavior has two dimensions: δ_{1i} is a measure of Altruism or unconditional cooperation, δ_{2i} is a measure of Reciprocity or conditional cooperation, ϵ_{it} is iid $N(0, \sigma^2_{\epsilon_i})$ and the coefficient vector for the ith individual such that $\delta_i = \delta + \nu_i$ with $\nu_i \sim N(0, \Sigma_\nu)$[17].

The estimation of the structural parameters of reciprocity and altruism is given by equation (15), $\hat{\rho}_i = 2 - \hat{\mu}_i x_i^* - \hat{\delta}_{1i}/4$ and $\hat{\mu}_i = \hat{\delta}_{2i}/4$.

ii. Classification of types

There are four types of social preferences in this model and each one must satisfy different conditions, shown in Figure 2 and summarized in Table 5. First, a Self-regarding individual presents a high level of 'unconditional' extraction $\hat{\delta}_1 \geq 6$ for all the rounds $t = 1,..,10$ and a low coefficient of reciprocity $|\hat{\delta}_2| \leq 1/4$. Second, a reciprocator or "If others extract less, I will extract less"- individual exhibits a positive slope $\hat{\delta}_2 > 1/4$. Third, a "*Counter*" or "If others extract less, I will extract more" individual exhibits a negative $\hat{\delta}_2 < -1/4$[18]. Finally, an Altruist individual presents a low level of 'unconditional' extraction $\hat{\delta}_1 \leq 3$ for all rounds $t = 1,..,10$ and a low coefficient of reciprocity $|\hat{\delta}_2| \leq 1/4$.

Table 5. Type classification conditions using the RCM approach

	Social preferences' type q			
Parameters' conditions	Altruist	Self-regarding	Reciprocator	Counter
Unconditional extraction, $\hat{\delta}_1$	$\hat{\delta}_1 \leq 3$	$\hat{\delta}_1 \geq 6$	$\hat{\delta}_1 \leq 6$	$\hat{\delta}_1 \geq 3$
Reciprocity, $\hat{\delta}_2$	$\lvert\hat{\delta}_2\rvert \leq 0.25$	$\lvert\hat{\delta}_2\rvert \leq 0.25$	$\hat{\delta}_2 > 0.25$	$\hat{\delta}_2 < -0.25$

Our best algorithm that maximizes the number of individuals allocated to a certain type does not consider test of significance since the number observations per individual is ten[19]. Note that altruists are also non-reciprocators. It is possible to find reciprocators whose decision was to extract less but conditioned on whether others extracted less. Figure 2 presents the zones where the individuals should be allocated given this classification method procedure. Right in the middle of the space, there are those individuals that do not meet any of the cases, called the '*unidentified*' individuals.

[17] In addition, $(\delta_1, \delta_2)_i = (\delta_1, \delta_2) + \nu_i, E(\nu_i) = 0, E(\nu_i \nu_i') = \Sigma$.

[18] Duffy and Munoz-Garcia (2013) show the existence of a 'backstabber' player type who is unconcerned about fairness initially cooperates in order to disguise himself as a player type who is concerned about fairness and inducing the uninformed player to cooperate in all periods of the repeated game until the 'backstabber' takes the opportunity to defect, i.e., he "backstabs" the uninformed player.

[19] However, when using a restriction of level of significance for $\hat{\delta}_2$ significantly different from zero at 90%, the proportion of individuals allocated as a reciprocator and a counter falls 33.19% for first time - CPR users and 30.86% for students.

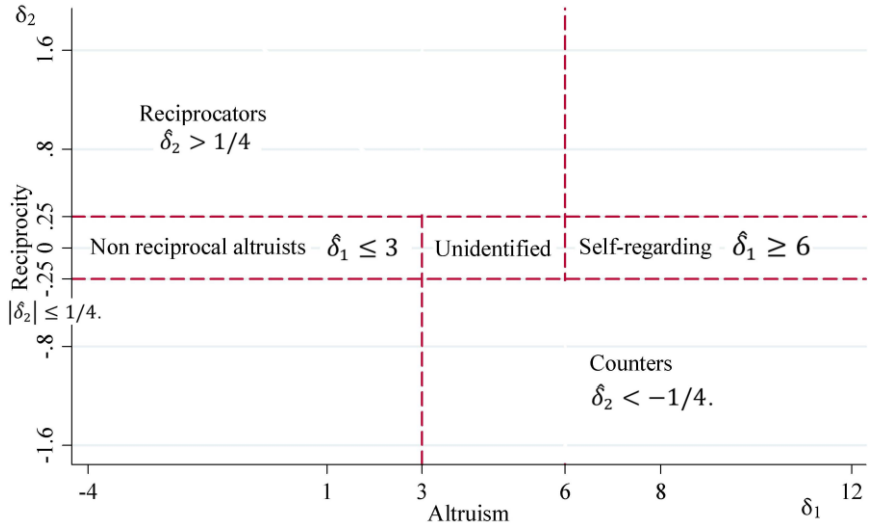

Figure 2. Heterogeneity with the RCM

Result 2. *Using the RCM classification method, we find there is heterogeneity of social preferences.*

Figure 3 shows the distribution of observed heterogeneity among CPR users. In our classification we did not consider the complete sample since students and CPR users show significantly different behaviors (See Appendix, Figure D1 and Figure D2). Every dot is an individual lying in the $(\hat{\delta}_1, \hat{\delta}_2)$ space. Among the first visit-CPR users, 29.22 percent (229 individuals) where found to be the reciprocator type, 10.35 percent are the altruistic type, 6.95 percent the self-regarding type and 21 percent the counter type. Although the number of counters seems large, we observe their behavior as a common one; when some 'super' free riders or even spiteful, wait to build trust among other players in order to extract more and obtain a higher payoff in one round (see figure B1a in the appendix). Unfortunately, this specification approach does not allow us to include an advantageous inequality averse type (i.e. the β parameter)[20]. Individuals that could not be categorized are called type "unidentified" are 32.5 percent of the individuals.

Table 6 shows the estimates for a random coefficient regression model for CPR users in the first visit[21]. The values and signs are the expected. Individuals that are considered the altruist type have in average a $\hat{\rho}_i$= 1.40 whereas those considered self-regarding would have face a $\hat{\rho}_i$= 0.37. Note that this value is not zero because Self-regarding individuals are those who would consistently extract 6 or more units. On the other hand, reciprocators have the highest value of $\hat{\mu}_i$, 0.13 and those we call Counter have the opposite value, -0.13.

[20] When implementing a model that allows for preferences for reciprocity, altruism and inequity aversion, we do not obtain enough exclusion restrictions in order to identify β_i. However, we conducted an RCM classification estimation by using only the cases when $\pi_i > \bar{\pi}_{-i}$. Our results (available upon request) are similar to the model with reciprocity, confirming evidence by Falk et al (2002) which demonstrate that self-interest combined with inequity aversion generates a best-response function with the same form as the self-interest and reciprocity best response function.

[21] For the same table with students and CPR users in the second visit see table D1 and D2 in the appendix. The coefficient size is substantially larger for CPR users than for the students, which shows a much stronger shift towards cooperative choices for the former.

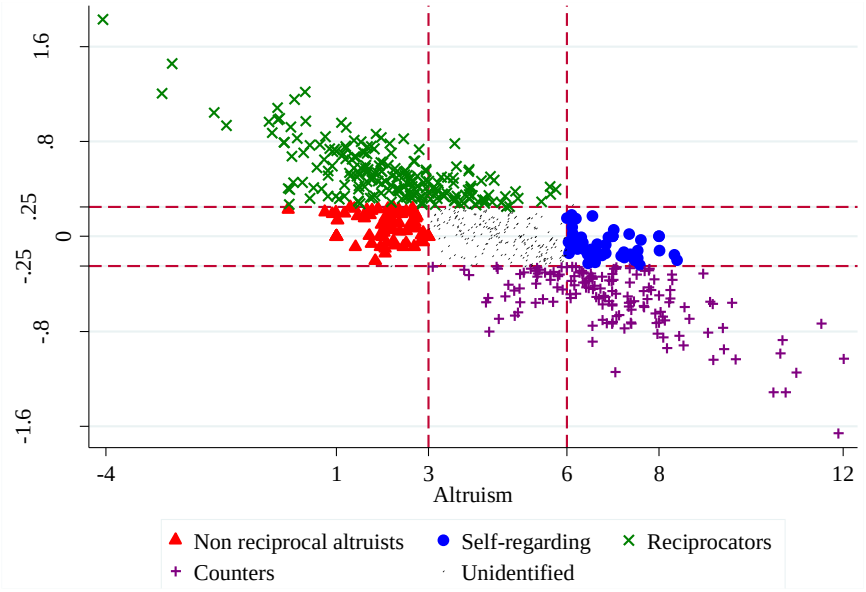

Figure 3. The distribution of observed heterogeneity of social preferences in the game with the RCM – First time visit - CPR users (N=705)

Table 6. Individual structural parameters estimators of Altruism and Reciprocity for each type – First visit CPR users

Structural parameter		Non reciprocal Altruists	Reciprocator	Self-regarding	Counter	Unidentified
Altruism, $\hat{\rho}_i$	Mean	1.40	0.86	0.37	0.85	0.84
	Standard Dev.	0.19	0.27	0.17	0.32	0.20
	Minimum	1.07	0.11	0.00	-0.06	0.16
	Maximum	1.77	1.70	0.65	1.83	1.73
Reciprocity, $\hat{\mu}_i$	Mean	0.02	0.13	-0.02	-0.13	0.00
	Standard Dev.	0.03	0.06	0.03	0.06	0.03
	Minimum	-0.05	0.06	-0.06	-0.41	-0.06
	Maximum	0.06	0.46	0.05	-0.06	0.07
N		73	206	49	148	229

Notes: For CPR users in the first visit, we set $x_i^* = 4.51$, the average number of extracted units in the last practice round.

iii. Examining efficiency

The RCM procedure gives us '*rough*' social preference parameters, given the assumptions we have to make. However, we are able to validate this modeling approach by showing with a sensitive analysis how our assigned types behave in terms of efficiency in their groups. Consistently, among students, the average SEI was 0.67 whereas among CPR users in the first visit the average social efficiency index was 0.73[22]. Now, we examine how the type of neighborhood affects social efficiency.

Result 3. *Social preferences composition affects efficiency.*

This effect is different from what we would expect by simple aggregation. In Table 7, we observe the Social Efficiency Index SEI_g^q according to the number of type q individuals in the group g and the fraction of individuals type q in the group of $n = 5$ players[23]. In the first column there is the number of individuals in the group of 5 players that were categorized by

[22] Among CPR users in the second visit the average social efficiency index was 0.78.
[23] For this table with the student and 2nd visit CPR users samples, see Tables D3 and D4 in the appendix.

the RCM of type q. A dot denotes absence of observations when there was no group with a certain composition. When there is a dot For example, we may have groups with no altruist and all reciprocators. Among the 141 groups of CPR users in the first visit, there were never 4 altruists in a group and there were no groups with 4 or 5 self-regarding individuals. When the fraction of altruists predominates in the group the SEI yields the highest (92.27 percent) value over all groups. We compared efficiency between groups with the same number of individuals being type q by doing a t-test of means (Altruist vs. Self-regarding, self-regarding vs. positive reciprocator, positive vs. negative reciprocator, negative reciprocator vs. counter and counter vs. unidentified). Column two in Table 6 shows that when the number of altruists increases in the group, social efficiency is significantly higher than efficiency when the number of self-regarding individuals increases, that is, when there are many predicted self-regarding in the group, the average payoff and social efficiency in the group are the lowest. The fifth column presents a decreasing SEI from 69.3 to 63.14 when the number of self-regarding individuals in the group increases up to 3 people. Another highlight is that when there were no altruists in the group efficiency was comparable to having mostly self-regarding in the group.

As we defined above, we use as social norm $x_i^* = \overline{x_0} = 4.51\ \forall i$, the average number of extracted units in the last practice round among CPR users in the first visit. The second and third columns of table 6 show that the reciprocators respond to the social norm: efficiency decreases with the number of reciprocators in the group where extraction is higher than the norm and increasing where extraction is lower than the norm. Among reciprocators, the SEI reaches to the maximum when there are three reciprocal individuals and it is higher when the average level of extraction by others is lower than the benchmark, x_i^*. The initial level of extraction matters in order to respond positively when this level is high or negatively when it is low according to the amount of reciprocators in the group.

Finally, although the 'counter' type is a high fraction of the sample, having a high number of 'counters' in the group is not significantly different for those who could not be categorized, i.e. unidentified[24].

Table 7. Social efficiency and group heterogeneity with the RCM- CPR users first visit

No. individuals in group g that are type q	Individual Type q label					
	Altruist	Reciprocator		Self-regarding	Counter	Unidentified
		$x_i^* > \bar{x}_{-i}^e$	$x_i^* \leq \bar{x}_{-i}^e$			
0	69.81***	75.44	68.96	75.02	73.20	74.90
1	76.35**	76.51	69.59*	69.30**	72.92	74.58
2	83.81***	78.79	68.25**	64.87**	73.83	72.61
3	85.80	80.37	65.48**	63.14	71.25	69.78
4	.	68.78	63.26	.	73.56	70.56
5	92.27	77.15	69.05	.	.	71.78

Unpaired t-test of difference in means between consecutive types (i.e. altruist vs. self-regarding, reciprocator when $x_i^* > \bar{x}_{-i}^e$ vs. reciprocator when $x_i^* \leq \bar{x}_{-i}^e$, reciprocator when $x_i^* > \bar{x}_{-i}^e$ vs. self-regarding, reciprocator when $x_i^* \leq \bar{x}_{-i}^e$ vs. counter and counter vs. unidentified) having the same number of players type q. ***, ** and * respectively represent significance at 1%, 5% and 10% confidence level. The number of groups is 141.

Result 4. *Incentives have heterogeneous effects on social efficiency across groups. Social preferences composition affects incentives performance.*

[24] Although we would like to examine whether it matters who else is in the group, it is not possible to compare the SEI across the different type composition and vary the type the majority is playing with since we lack of enough observations.

Incentives affect individual and group behavior differently from what is predicted by the model of Self-regarding individuals. We look at group's efficiency according to the group's composition of types and the growth rate of efficiency for each incentive[25]. First, we performed the same analysis in table 6 in the presence of every incentive. For example, in Table 8a we observe how social efficiency for each group composition was affected by communication. Among the different types the highest impact of the incentive is when most individuals in the group were reciprocators (65.48 vs. 88.84).

Table 8a. Social efficiency and group heterogeneity in the presence of communication at each round- CPR users first time visit

No. individuals in group g that are type q	Individual Type q label					
	Altruist	Reciprocator		Self-regarding	Counter	Unidentified
		$x_i^* > \bar{x}_{-i}^e$	$x_i^* \leq \bar{x}_{-i}^e$			
0	85.39	.	.	89.07	89.68	90.78
1	93.18	89.28	78.20	86.26	88.99	87.27
2	93.58	88.70	87.75	.	86.95	92.30
3	.	91.07	88.84	.	.	83.19

In Table 8b we observe how a low fine affected social efficiency for each group composition. The performance of the incentive is very poor, since there are small improvements in efficiency. Among the different types the highest impact of the incentive is when there was one self-regarding individual in the group (89) and when there were no altruist in the group (85.38) and the lowest when most individuals in the group were reciprocators (65.48 vs. 88.84).

In addition, under the High fine (not shown), negative reciprocators, i.e. $x_i^* \leq \bar{x}_{-i}^e$ respond prosocially with an increase of 30% in efficiency. Self-regarding individuals cooperate more only with the low subsidy: when there are three (and two) self-regarding individuals with an increase of 37% (and 39%) increase in efficiency. The lower growth rates of efficiency are those by positive reciprocators, i.e. $x_i^* > \bar{x}_{-i}^e$ under the very high fine with a decrease of 15% in efficiency and altruists with an increase of 8% in efficiency under a fine. Overall negative reciprocators' behavior improves.

Table 8b. Social efficiency and group heterogeneity in the presence of a low fine- CPR users first visit

No. individuals in group g that are type q	Individual Type q label					
	Altruist	Reciprocator		Self-regarding	Counter	Unidentified
		$x_i^* > \bar{x}_{-i}^e$	$x_i^* \leq \bar{x}_{-i}^e$			
0	85.38	82.73	72.95	85.91	83.33	87.19
1	77.89	84.67	73.86	89.00	88.72	88.96
2	97.25	89.73	82.57	75.58	82.35	85.48
3	.	83.56	68.34	.	.	72.25

We calculate the growth rate in efficiency for each different group composition and define the SEI growth rate as the ratio $SEI_{g\ t>10}^{q\ s} / SEI_{g\ t\leq 10}^{q} - 1$ for every incentive s, number of individuals q in group g. In Table 8c we observe the average of SEI growth rates by incentive across groups; thus observing efficiency by taking account heterogeneity. The control group presents a natural average decrease by 0.88%, a result consistent with the worsening of cooperation across time when there is no regulation. All groups are better off

[25] In order to obtain a comparable measure of efficiency for the low subsidy, we extracted from the earnings the prize the inspected individual obtained by deviating from the SNE.

with communication every round. Efficiency rates grew up to 35.67% and 20.29% on average.

Result 5. *Non-economic incentives perform better than economic incentives. Communication increases efficiency.*

Among the monetary incentives, the low subsidy had the best performance, and the high fine is the second best, with a efficiency growth rate up to 41% and 15.89% on average, despite of the decrease in efficiency among altruist with a -1%. Efficiency reaches the highest efficiency among self-regarding with the low subsidy with an average increase of 19.38%. The least effective incentive is the very high fine.

Table 8c. Incentives and Social Efficiency Growth rate across groups

Treatments	Efficiency Growth rate		
	Average	Maximum	Minimum
Control	-0.88	6.64	-10.18
Low Subsidy	*19.38*	*39.25*	*4.81*
Low Fine	13.30	28.43	2.02
Medium Fine	11.38	24.38	-4.61
High Fine	15.89	40.99	-1.03
Very High Fine	3.20	25.03	-19.29
Total Fine Incentive	*13.32*	*27.20*	*0.02*
Communication one shot	14.68	39.91	0.83
Communication each round	20.29	35.67	11.65
Total Non-monetary incentive	*17.92*	*39.91*	*5.00*

The following three institutions evaluate the impact of imposing a sanction on non-compliance with a probability of 1/5 of being inspected. The heavier sanction comes with the high fine, which shows an impact similar to that of the communication in one shot. On average, the fine as an incentive increases efficiency 13.32% lower that the improvement by non-monetary incentives 17.92%. As the empirical experimental evidence on CPR games suggests (Ostrom et al., 1994, Hackett et al. 1994, Ahn et al., 2011, Zhosan and Gardner, 2013), the most efficient incentive is communication each round with an average increase of 20.29%.

iv. State-dependent social preferences

We proceed to implement the random coefficient model estimation for the second stage of the experiment, rounds 11 to 20 and compared the differences in type classification according to the incentive.

Result 6. *Exposure to treatment affect individual's type*

In table 9a and Table 9b we present the effect of the incentive on individual behavior by types for CPR users in the first visit. In the second column we show the classification generated with the first ten rounds. From column 3 to 7, we show for each type assigned in the baseline the distribution of the individuals among different types in the treatment phase. Table 9a shows the shifts in social preferences after the implementation of communication one shot and communication before each round. For both treatments, self-regarding individuals disappeared. Altruist did not change their behavior when communication occurred at every round but when communication occurred only once, 44% of altruist became reciprocators and 11% were unidentified. The highest percentage of individuals who

changed their type were those of counter: 50% and 36% became altruist in the second stage. These findings are consistent with the hypothesis that communication helps players to detect the types of players the hypothesis that communication helps players to detect the types of players with whom they are interaction or the actions that others are more likely to take (Frank (1988), Brosig (2002) and Cárdenas et al., (2004))[26]

Table 9a. Percentage of individuals who change their type under the non-monetary incentive – CPR users first visit only

Incentive	Type classification in Baseline	Type classification from behavior in rounds 11-20				
		Altruist	Self-regarding	Reciprocator	Counter	Unidentified
Communication one shot	Altruist	44	0	44	0	11
	Self-regarding	0	0	100	0	0
	Reciprocator	26	0	37	0	37
	Counter	50	0	21	14	14
	Unidentified	24	0	29	5	43
Communication each round	Altruist	100	0	0	0	0
	Self-regarding	33	0	33	0	33
	Reciprocator	43	0	38	10	10
	Counter	36	0	29	7	29
	Unidentified	43	0	24	10	24

In table 9b, a Medium fine, those who were categorized as altruist in the baseline did not change their type with the fine introduction. In Table 9a, we observe that self-regarding individuals disappeared with the use of non-monetary incentives. Only the low fine, medium fine and high fine, 25%, 20%, 50% of those who were classified as self-regarding, kept their title, respectively. Individuals who were classified as counters migrated to other types, mainly altruist and unidentified. In the case of the Low subsidy, those who were categorized as Counter in the baseline, 50% became altruist in treatment phase, 7 % became reciprocator, 29% was unidentified and 14% remained as counter. We observe a change of preferences to altruist. In most treatments, those were classified as Altruist kept their title, although we observe that under communication one shot and the very high fine some who were altruist change their type to reciprocators.

Table 9b. Percentage of individuals who change their type under the monetary incentive s – CPR users first visit only

Incentive	Type classification in Baseline	Type classification from behavior in rounds 11-20				
		Altruist	Self-regarding	Reciprocator	Counter	Unidentified
Low subsidy	Altruist	100	0	0	0	0
	Self-regarding	44	0	11	22	22
	Reciprocator	60	0	13	7	20
	Counter	50	0	7	14	29
	Unidentified	36	0	29	4	32
Low Fine	Altruist	82	0	18	0	0
	Self-regarding	42	25	0	17	17
	Reciprocator	41	0	30	11	19
	Counter	56	6	13	13	13
	Unidentified	41	0	21	9	29
Medium Fine	Altruist	100	0	0	0	0
	Self-regarding	20	20	60	0	0
	Reciprocator	33	0	33	0	33
	Counter	50	0	0	0	50
	Unidentified	30	10	30	10	20

[26] Among other reasons that communication enhances cooperation are: i) it allows players to commit; ii) it allows a process of moralization among players; iii) it can reinforce group identity (Messick and Brewer (1983), Kollock (1998))

High Fine	Altruist	100	0	0	0	0
	Self-regarding	50	50	0	0	0
	Reciprocator	50	0	15	10	25
	Counter	50	8	8	25	8
	Unidentified	61	0	13	9	17
Very High Fine	Altruist	50	0	50	0	0
	Self-regarding	0	0	0	0	0
	Reciprocator	67	0	0	0	33
	Counter	43	14	0	29	14
	Unidentified	67	0	0	33	0

7. Determinants of social preference type

A key feature of heterogeneity is the role of individual socio-economic background and it is relevant to complement the analysis with a comparison between behavior inside and outside the lab, for example, the use of CPR in real life by the participants. Figure 4 shows the fraction of players that extract 8 units according to their economic dependence to the CPR. Those CPR users whose income depends 100% on the CPR extract significantly less whereas those users whose income depends 0% on the CPR extract significantly more[27].

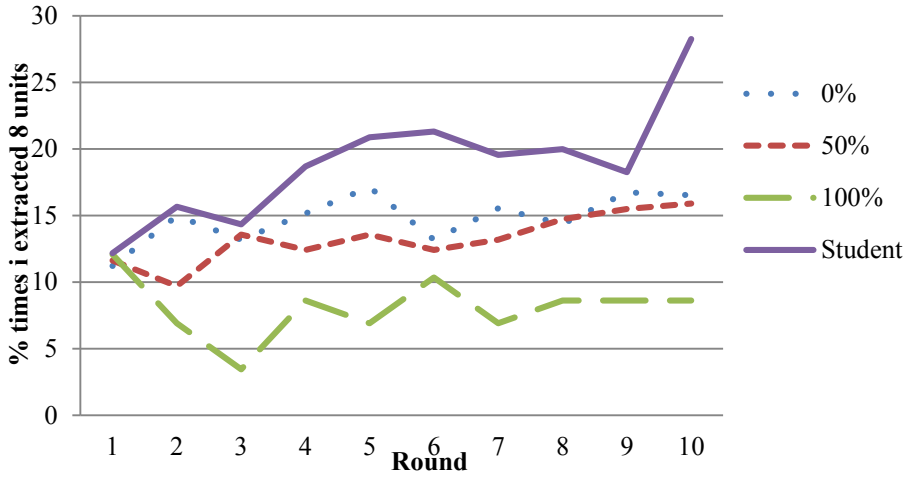

Figure 4. Heterogeneity of real level extraction of the CPR in the game all CPR users vs. students (N=1095). The solid line shows the % time that the Self-regarding NE was chosen in the game by the Students sample. The round-dot line shows the case with individuals who use 0% of the real CPR. The square-dot line shows the average level of extraction in the game by individuals who use 50% of the real CPR. The long-dashed line the average level of extraction in the game by individuals who use 100% of the real CPR. The difference in means in the last round is significant at 10%.

We define $\theta_{zq} = \Theta(Z\phi)$, the vector of conditional preference parameters as a function of some exogenous socio-economic characteristics Z vector[28] and analyze the determinants of being type q in our sample of CPR users in the first visit. In table 10 and 11 we show the role of individual socio-economic characteristics and group composition on the probability of being altruist, self-regarding, reciprocator, and counter, after controlling for a variety of observable variables and using the sample of first visit CPR users only. In Table 10, all eight columns show results obtained from a probit regression with the Index of CPR extraction as main economic activity and in Table 11, all eight columns show results obtained from a probit regression with the Index of time spent by the household on CPR extraction[29].

[27] This table shows a similar pattern to Molina (2011) with 665 CPR users.
[28] The vector of unconditional preference parameters is simply θ_q.
[29] We report the main results in table 10, table 11 and their additional controls in the appendix.

In order to check whether some variables are near perfect linear combinations of one another, we examine the variance inflation factor (VIF) and the degree of collinearity. The VIF values of these variables are very high, which indicates that these variables are possibly redundant. We exclude these variables on use of the CPR, social capital measures and perceptions from the analysis in Tables 10, 11 and 12. Table E1 in the appendix shows the coefficients obtained in a number of probit regressions that relate the probability that an individual is type q to each of the measures that presents multicollinearity. The purpose of these table is simply to illustrate the association between the behavior in the game we observe and other forms of behavior that have been used in the literature as indicators for pro-social behavior in CPR.

Result 7. *Individual and group level of education increases the likelihood of being an Altruist.*

Result 8. *Perception of lack of willingness to cooperate in the community increases the likelihood of being a reciprocator.*

In tables 10 and 11 in Columns I (1), II (1), III (1) and IV (1) we include socio economic characteristics, such as the age and the education level of the participant (the complete set of results can be found in the Appendix); individual perceptions on the CPR and social capital in the community and an individual measure of social capital, i.e. volunteer work in the previous year. In Columns I (2), II (2), III (2) and IV (2) we add variables on group composition such as the percentage of altruist, reciprocators, self-regarding and counters among the rest of the members in the group, the average sex, years of education and index of economic dependence of the CPR among the rest of the group. Table 11 presents the same analysis but uses an index of time spent by CPR extraction.

Household size, years of education and volunteering increase probability of being categorized as type Altruist; those who in real life depend economically more on the CPR have a lower probability of being allocated to the self-regarding type, confirming our observation from Figure 4. If the participant thinks that the amount of the CPR has remained the same in the past years, the probability of being an altruist decreases 3%, which consistent with anecdotal evidence on people who believe that the resource is not scarce extracting more than the social optimum in order to maximize individual gains. On the other hand, if the participant perceives that there is an interest in the community to cooperate, the probability of this participant being type reciprocator decreases and that of counter increases. Counter individuals would take a higher advantage in a community where people cooperate, as counters will spitefully free-ride in order to obtain a higher benefit. Finally, a participant who thinks the community should be the main vigilant will have a less chance to be self-regarding.

When introducing variables on group composition, we observe that a participant's behavior is conditioned on the types of others in the group (see columns I (2) and I (4). For example, counters were those who extracted a small amount in the first rounds and then extracted a high amount in order to obtain the gain of free riding when the rest of the members were thinking they had mostly altruists in the group. The effect of belonging to a group with a high number of years of education also has a positive effect of behaving as an altruist. In addition, the average index of CPR extraction as main economic activity among the rest of the group increases the likelihood of behaving as altruist and decreases that of behaving as self-regarding. The result that the percentage of reciprocators in the group lowers the probability of behaving as a self-regarding is consistent: a self-regarding individual who knows she is

among reciprocators is more likely to internalize the retaliation costs without further considerations about social preferences. Although being a woman increases the chance to be categorized as self-regarding, the presence of other women in the group reduces it, suggesting a same-sex solidarity that is stronger than self-interest. When we conduct the analysis with the index of time spent on CPR extraction in table 11, the effect of this index with the probability of behaving as self-regarding is no longer significant when controlling for group composition.

Result 9. *Estimated structural parameters confirm results 7 and 8.*

Table 12 presents a linear estimation of the determinants for the individual parameters of altruism and reciprocity, $\hat{\rho}$ and $\hat{\mu}$ respectively, for the first time CPR users. We find a robust positive relation between $\hat{\rho}$ and years of education. Without adding controls on group composition, there is a positive relation between the perception of cooperation in the community and $\hat{\rho}$. We find a robust negative relation between $\hat{\mu}$ and whether the participant perceives there is an interest in the community to cooperate. If the individual perceives her community has an interest for cooperation there is no motivation for including in her utility a component that seeks to enforce a social norm.

Although there is a positive relation between household size, age, the index of time spent on CPR, the index of CPR extraction as main economic activity, these coefficients are no longer significant when including group composition variables. The coefficient for altruism also has a positive relation with the average $\hat{\rho}$, average index of CPR as main economic activity and average index of time spent by CPR extraction among the rest of the group. However, there is no relation between measures of group composition and the coefficient of reciprocity, which may suggest that reciprocity is a behavior that is already embedded before the individual enters the lab, regardless of the composition of the group and how cooperation evolves over time during the game. In contrast, behaving as an altruist or self-regarding is highly related not only to exogenous individual characteristics but also to how other group members behave and how cooperation evolves.

Table 10. Probit estimation of determinants of being type q including the Index of CPR extraction as main economic activity

Dependent variable: 1 if player is type q		*Altruist*		*Self-regarding*		*Reciprocator*		*Counter*	
	Independent Variables	I (1)	I (2)	II (1)	II (2)	III (1)	III (2)	IV (1)	IV (2)
Participant's characteristics	Household Size	0.009*	0.006**	0.002	0.002	-0.004	-0.002	-0.007	-0.009
		[0.005]	[0.003]	[0.003]	[0.003]	[0.010]	[0.010]	[0.009]	[0.009]
	Age	0.000	0.001	-0.001	-0.001*	0.000	0.000	0.001	0.001
		[0.001]	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
	Sex	0.002	-0.007	0.034*	0.040**	0.052	0.020	-0.059	-0.035
		[0.024]	[0.020]	[0.019]	[0.017]	[0.044]	[0.048]	[0.048]	[0.051]
	Years of education	0.008**	0.004*	-0.004	-0.004	-0.007	-0.003	-0.004	-0.002
		[0.004]	[0.003]	[0.003]	[0.003]	[0.007]	[0.007]	[0.007]	[0.007]
	Index of CPR extraction as main economic activity	0.029	-0.005	-0.099**	-0.067**	-0.097	-0.117	0.077	0.023
		[0.044]	[0.037]	[0.041]	[0.033]	[0.099]	[0.123]	[0.097]	[0.126]
Participant's perceptions	=1 if thinks that the CPR has not changed	-0.043**	-0.029*	-0.008	-0.008	-0.073	-0.085	0.080	0.076
		[0.020]	[0.016]	[0.022]	[0.019]	[0.055]	[0.054]	[0.063]	[0.065]
	Perceived interest in the community to cooperate	0.067	0.039	-0.007	-0.004	-0.193***	-0.190**	0.193**	0.198***
		[0.051]	[0.037]	[0.026]	[0.025]	[0.074]	[0.076]	[0.077]	[0.077]
	=1 if thinks the community should be the main vigilant of the CPR	0.015	0.018	-0.040*	-0.039**	0.028	0.046	0.036	0.030
		[0.026]	[0.020]	[0.021]	[0.019]	[0.046]	[0.046]	[0.045]	[0.046]
Social capital measures	=1 if individual has done any volunteer work in the past year	0.050*	0.040**	-0.021	-0.022	0.035	0.021	-0.049	-0.028
		[0.028]	[0.020]	[0.021]	[0.020]	[0.051]	[0.053]	[0.052]	[0.052]
Group composition (info within group)	% altruists among the rest of the group		0.192***		-0.051		0.149		0.056
			[0.069]		[0.042]		[0.156]		[0.123]
	% reciprocators among the rest of the group		0.111**		-0.074*		-0.083		0.152
			[0.044]		[0.044]		[0.152]		[0.108]
	% counters among the rest of the group		0.126***		-0.028		-0.104		0.304***
			[0.046]		[0.043]		[0.116]		[0.116]
	Average sex among the rest of the group		0.049*		-0.044*		0.071		-0.065
			[0.029]		[0.025]		[0.085]		[0.079]
	Average years of education among the rest of the group		0.015***		-0.004		-0.027**		-0.006
			[0.005]		[0.003]		[0.012]		[0.011]
	Average Index of CPR extraction as main economic activity among the rest of the group		0.126**		-0.064*		-0.151		0.134
			[0.063]		[0.037]		[0.162]		[0.178]
Observations		379	379	379	379	379	379	379	379

* Significant at 10%; ** significant at 5%; *** significant at 1%. Marginal effects reported. Robust standard errors in brackets clustered at the group level. We also control for landownership, if the household's kitchen uses gas or electricity, percentage of self-regarding among the rest of the group and average age among the rest of the group. For the additional controls results, see table E2.

Table 11. Probit estimation of determinants of being type q including the Index of time spent by household on CPR extraction

Dependent variable: 1 if player is type q		*Altruist*		*Self-regarding*		*Reciprocator*		*Counter*	
	Independent Variables	I (3)	I (4)	II (3)	II (4)	III (3)	III (4)	IV (3)	IV (4)
Participant's characteristics	Household Size	0.007*	0.005*	0.003	0.003	-0.005	-0.003	-0.008	-0.009
		[0.004]	[0.003]	[0.003]	[0.003]	[0.010]	[0.010]	[0.010]	[0.010]
	Age	0.001	0.001	-0.001	-0.001*	0.000	0.000	0.001	0.001
		[0.001]	[0.001]	[0.001]	[0.000]	[0.002]	[0.002]	[0.002]	[0.002]
	Sex	0.003	-0.005	0.032*	0.037**	0.050	0.007	-0.056	-0.020
		[0.024]	[0.021]	[0.018]	[0.016]	[0.044]	[0.049]	[0.049]	[0.049]
	Years of education	0.008**	0.005*	-0.004	-0.004*	-0.006	-0.002	-0.005	-0.003
		[0.004]	[0.003]	[0.003]	[0.002]	[0.007]	[0.007]	[0.007]	[0.007]
	Index of time spent by the household on CPR extraction	0.082	0.049	-0.141***	-0.074	-0.057	-0.234	0.110	0.239
		[0.065]	[0.044]	[0.051]	[0.062]	[0.123]	[0.158]	[0.113]	[0.153]
Participant's perceptions	=1 if thinks that the CPR has not changed	-0.047**	-0.031*	-0.007	-0.007	-0.076	-0.096*	0.077	0.084
		[0.019]	[0.017]	[0.021]	[0.018]	[0.054]	[0.053]	[0.063]	[0.065]
	Perceived interest in the community to cooperate	0.061	0.044	-0.009	-0.005	-0.190***	-0.193***	0.193**	0.203***
		[0.051]	[0.039]	[0.024]	[0.022]	[0.073]	[0.073]	[0.078]	[0.073]
	=1 if thinks the community should be the main vigilant of the CPR	0.016	0.020	-0.038*	-0.037**	0.026	0.044	0.037	0.024
		[0.026]	[0.021]	[0.020]	[0.018]	[0.047]	[0.047]	[0.045]	[0.047]
Social capital measures	=1 if individual has done any volunteer work in the past year	0.052*	0.041**	-0.015	-0.019	0.038	0.030	-0.049	-0.039
		[0.027]	[0.020]	[0.018]	[0.019]	[0.050]	[0.052]	[0.051]	[0.053]
Group composition (info within group)	% altruists among the rest of the group		0.173***		-0.024		0.131		0.070
			[0.063]		[0.040]		[0.143]		[0.122]
	% reciprocators among the rest of the group		0.118**		-0.067*		-0.048		0.132
			[0.047]		[0.040]		[0.149]		[0.110]
	% counters among the rest of the group		0.141***		-0.040		-0.112		0.314***
			[0.052]		[0.040]		[0.115]		[0.115]
	Average sex among the rest of the group		0.039		-0.042*		0.081		-0.079
			[0.030]		[0.024]		[0.086]		[0.077]
	Average years of education among the rest of the group		0.015***		-0.005		-0.023*		-0.010
			[0.005]		[0.003]		[0.012]		[0.011]
Observations		379	379	379	379	379	379	379	379

* Significant at 10%; ** significant at 5%; *** significant at 1%. Marginal effects reported. Robust standard errors in brackets clustered at the group level. We also control for landownership, if the household's kitchen uses gas or electricity, percentage of self-regarding among the rest of the group and average age among the rest of the group. For the additional controls results, see table E3.

Table 12. Linear estimation of determinants of parameters $\hat{\rho}$ and $\hat{\mu}$. First visit CPR users.

	Dependent variable	$\hat{\rho}$				$\hat{\mu}$			
	Independent Variables	V (1)	V (2)	V (3)	V (4)	VI (1)	VI (2)	VI (3)	VI (4)
Participant's characteristics	Household Size	0.019***	0.005	0.018***	0.003	0.002	0.002	0.002	0.001
		[0.006]	[0.005]	[0.006]	[0.005]	[0.002]	[0.002]	[0.002]	[0.002]
	Age	0.006***	0.001	0.006***	0.001	0.000	-0.000	0.000	-0.000
		[0.001]	[0.001]	[0.001]	[0.001]	[0.000]	[0.000]	[0.000]	[0.000]
	Years of education	0.029***	0.011**	0.028***	0.012**	0.000	0.000	0.000	0.000
		[0.005]	[0.005]	[0.005]	[0.005]	[0.001]	[0.002]	[0.001]	[0.001]
	Index of CPR extraction as main economic activity	0.243***	-0.013			-0.010	-0.012		
		[0.064]	[0.068]			[0.021]	[0.030]		
	Index of time spent by the household on CPR extraction			0.273***	-0.067			-0.003	-0.051
				[0.085]	[0.098]			[0.027]	[0.038]
Participant's perceptions	=1 if thinks that the CPR has not changed	-0.030	-0.044	-0.031	-0.046	-0.021	-0.021	-0.022	-0.025*
		[0.052]	[0.047]	[0.053]	[0.047]	[0.015]	[0.014]	[0.015]	[0.014]
	Perceived interest in the community to cooperate	0.184***	0.040	0.178***	0.043	-0.046***	-0.051***	-0.046***	-0.053***
		[0.061]	[0.056]	[0.062]	[0.057]	[0.016]	[0.017]	[0.016]	[0.016]
Social capital measures	=1 if individual has done any volunteer work in the past year	0.044	-0.011	0.042	-0.009	0.019	0.011	0.019*	0.014
		[0.033]	[0.031]	[0.035]	[0.031]	[0.012]	[0.012]	[0.011]	[0.012]
Group composition (info within group)	Average $\hat{\rho}$ among the rest of the group		0.469***		0.466***		0.010		-0.001
			[0.079]		[0.066]		[0.023]		[0.023]
	Average age among the rest of the group		0.003		0.002		0.001*		0.001*
			[0.002]		[0.002]		[0.001]		[0.001]
	Average years of education among the rest of the group		0.020***		0.020***		-0.002		-0.001
			[0.007]		[0.007]		[0.002]		[0.002]
	Average Index of CPR extraction as main economic activity among the rest of the group		0.216**				-0.032		
			[0.087]				[0.041]		
	Average Index of time spent on CPR extraction among the rest of the group				0.329***				0.048
					[0.106]				[0.042]
Observations		379	379	379	379	379	379	379	379
R-squared		0.873	0.900	0.872	0.901	0.058	0.088	0.058	0.089

* Significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in brackets clustered at the group level. We also control for sex, landownership, if the household's kitchen uses gas or electricity, average sex among the rest of the group and average $\hat{\mu}$ among the rest of the group. For the additional controls results, see table E4.

8. Concluding remarks

What is the role of the existence of different social preferences within a community in overcoming social dilemmas or the social efficiency of economic incentives? This question is not easily answered because differences in observed behavior may have two sources. People may differ in socio-economic characteristics as well as in perceptions and beliefs on the Common Pool Resource (CPR) and social capital within the community, which are exogenous for the policy designer. Yet another source of difference is the composition of social preferences in the surrounding community, which is revealed in the day-by-day interaction related to the CPR extraction process.

This is a study on type classification of social preferences (i.e. unconditional altruist, self-regarding, reciprocator and inequity averse) within a CPR game we conducted in some Colombian rural areas. We use a RCM specification to identify individual types and at the same time estimate the theoretical parameters within a (theory-based) structural specification. Within the same specification, we attempt to understand potentially different utility-maximizing behaviors across types. We find that individual pro-social behavior is consistently different across types: there are altruists who extract less, self-regarding individuals who extract more, and reciprocators who behave according to what we interpret to be a group norm. The composition of types in the group significantly explains the average level of extraction prior to treatment, the path of extraction and the outcomes.

In addition, we examine the impact of the incentive on each type and the composition of the group on the social efficiency of incentives. We find that different incentives have a different effect on behavior and non-monetary incentives are more effective in groups where other-regarding preferences are prevalent, whereas only the subsidy is effective in promoting behavior among self-regarding individuals and negative reciprocators (i.e. those who respond to individuals extracting an amount higher than the social norm). Estimating the RCM classification again after the incentives are introduced, we find that self-regarding behavior (own-profit-maximizing) endures partially over time: many self-regarding individuals move away from full extraction to minimal extraction (the new NE under high/very high fine) as the fine increases, consistent with own profit maximizing behavior. However, suboptimally high levels of extraction remain within this type, suggesting that among the Self-regarding category there are irrational over-extractors. Our specification generates a corner solution for the self-regarding NE. In other to identify over-extractors from rational maximizers, interior solutions for the best reply functions are needed.[30] The very high fine affects altruists since half of them become reciprocators. In sum, incentives may alter social preferences in forms that claim further exploration, confirming the results surveyed in the first chapter of this dissertation (Bowles and Polania-Reyes (2012)).

In order to compare our experimental results with real life behavior, we perform a probit regression analysis of individual type classification and estimate a linear model for both the altruism and the reciprocity parameters. Both analyses set these key variables as a function of socioeconomic characteristics, perceptions, social capital within the community and group composition (in terms of types and the observable variables). The results suggest that behavior may be determined, in part, by the composition of types (and their demographic characteristics) in the group as well as the perceived scarcity of the CPR, the level of

[30] We conjecture $U_i^S = \pi_i^{1/2}$ might work.

community willingness to cooperate perceived, whether the participant does volunteer work and whether the CPR is the household's main economic activity.

Other extensions are relevant for the discussion of heterogeneity. First and most important, this study motivates research that aims to identify a distribution of types -which are not observable- and not just point estimates as inferred from a random coefficients model. This is possible by using a finite mixtures model (for an example, see Echeverry and Polania-Reyes (2015), Bruhin, et al. (2010), Coller et al. (2011), Conte, et al. (2011) and Cappelen et al. (2013)).[31]

We examine the most popular types of social preferences in the literature. We also provide indicative evidence of determinants of altruistic or reciprocal behavior. Our model is nonlinear in parameters due to the presence of the β parameter of inequity aversion. The RCM approach does not allow for this non-linearity to identify the set of four types simultaneously given that we do not have enough exclusion restrictions. Although our cross-sectional specification relies on four specific types, testing for the optimal number of types would help determine whether the profiles chosen are appropriate and verify that the correct model specification is being used.

A trade-off seems to stem from two possible approaches. If types are derived from observing a short timeframe (even from one-shot games, e.g. Cappelen et al. (2013)) the evolution of the type can then be tracked over time but the question arises as to the robustness of identification. If instead types are defined from observing a consistent behavior over time, then the definition is robust but the apparition and evolution of types is out of question. Identification, which is the key issue in the study of social preferences, has therefore a time component to it as well as the (previously discussed) cross-sectional component. Addressing identification over the time series component likely calls for more sophisticated econometric techniques. Coupled with further studies on the underlying social and psychological mechanisms, such research can explain the formation of social preferences within a structural model.

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[31] This data set presents a challenge in term of estimation of finite mixtures since we need to specify a likelihood function that takes into account the panel structure of the data.

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Appendix A. Experimental protocol

Table A1. Table points of the Common Pool Resource game.

Total level of extraction by others	My level of extraction from the resource								Average level of extraction by others
	1	2	3	4	5	6	7	8	
4	758	790	818	840	858	870	878	880	**1**
5	738	770	798	820	838	850	858	860	**1**
6	718	750	778	800	818	830	838	840	**2**
7	698	730	758	780	798	810	818	820	**2**
8	678	710	738	760	778	790	798	800	**2**
9	658	690	718	740	758	770	778	780	**2**
10	638	670	698	720	738	750	758	760	**3**
11	618	650	678	700	718	730	738	740	**3**
12	598	630	658	680	698	710	718	720	**3**
13	578	610	638	660	678	690	698	700	**3**
14	558	590	618	640	658	670	678	680	**4**
15	538	570	598	620	638	650	658	660	**4**
16	518	550	578	600	618	630	638	640	**4**
17	498	530	558	580	598	610	618	620	**4**
18	478	510	538	560	578	590	598	600	**5**
19	458	490	518	540	558	570	578	580	**5**
20	438	470	498	520	538	550	558	560	**5**
21	418	450	478	500	518	530	538	540	**5**
22	398	430	458	480	498	510	518	520	**6**
23	378	410	438	460	478	490	498	500	**6**
24	358	390	418	440	458	470	478	480	**6**
25	338	370	398	420	438	450	458	460	**6**
26	318	350	378	400	418	430	438	440	**7**
27	298	330	358	380	398	410	418	420	**7**
28	278	310	338	360	378	390	398	400	**7**
29	258	290	318	340	358	370	378	380	**7**
30	238	270	298	320	338	350	358	360	**8**
31	218	250	278	300	318	330	338	340	**8**
32	198	230	258	280	298	310	318	320	**8**

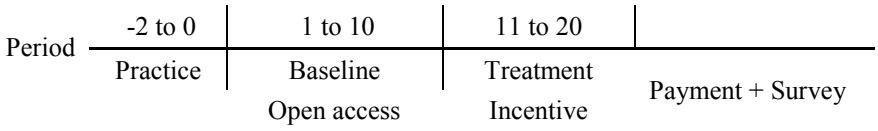


Figure Error! No text of specified style in document.**1 Timeline of the CPR game**

i. Experimental stages

The following stages were conducted for each of the sessions. This is cited by Cárdenas (2011).

Pre-game Stage (Instructions and Practice Rounds)
Each session of an experiment began with the welcoming and reading of the instructions to the group of five players, as well as the handing out of the following forms (available from author): the GAME CARDS, where participants wrote their choice for every round, that is, their extraction level; the DECISIONS RECORDS SHEET, where participants kept records of their choices and earnings; and the PAYOFF TABLE (see Table A1). Once all questions from participants were clarified, the experimenter continued by conducting one or two practice rounds as examples (see Figure **Error! No text of specified style in document.**1). After resolving all outstanding questions, stage 1 began.

Stage 1 (Rounds 1 to 10)
In Stage 1 of the experiment, each of the players had to decide privately their individual level of extraction from the commons. The decision was written down on one yellow slip (game card); the same information was also recorded on the blue records sheet. The monitor collected the five slips, added the total extraction for the group, which he wrote on the monitor's record sheet, and then announced publicly the total. Each player had to write down the group's total; by subtracting his or her individual extraction, the player was able to calculate his or her payoff for that round using the payoffs table. The player then wrote his or her total gains for the round and the experiment proceeded to the next round with the filling of a new slip. Under such rounds, it was common information that round 10 was the final round. Once they had finished calculating their earnings for round 10, players were told that the rules of the exercise were going to change for Stage 2 of the game. Additionally, they were never told in advance what the rules for Stage 2 were.

Stage 2 (New Rules, Rounds 11 to 20)
The second stage began with the announcement that they would be playing another 10 rounds under a new set of rules. For this stage, the previous record sheets were collected and new ones were distributed among the five players. For the case of face-to-face communication, we began Stage 2 by indicating to the participants that in every round, and prior to their making their decisions, they would be allowed to have a 3 to 5 min discussion on anything they wanted concerning the developments of the game, though no arrangements would be allowed for redistributing earnings once the experiment had ended. However, they were told that decisions would remain private and confidential. For the groups under the regulation treatments, Stage 2 began with an explanation from the experimenter in the following terms. The experimenter reminded the group that they had probably noticed that the group could earn the maximum of points if every player chose a level of extraction equal to one unit (this information was not given to the communication groups however).
They were also told that for achieving such a goal, the monitor would choose one player randomly for every round, and would verify his or her compliance with the stated rule. The

probability of such inspection was of 0.2, and was conducted by drawing a ball with a number from 5 balls in a bag. If a player was inspected and had chosen a higher level of extraction, his or her earnings were reduced by $50 ($175 for the high penalty treatment) times the units of extraction above 1. In the case where there was no fine, the monitor announced publicly the extraction level of the randomly chosen player, and proceeded to the next round. We also had control groups under a baseline treatment, with no change in the rules for Stage 2[32].

The text of the rule is the following: "You may have noticed that if each player in the group chooses a level of extraction of 1 unit the group makes the maximum possible of points. With this rule we will try that the group earns the maximum possible. We will try with this rule that each player in your group chooses a LEVEL OF EXTRACTION of 1 unit."

The Exit Stage (Calculating Earnings, Filling Out the Survey)
Following all of the rounds from Stage 2, the monitors calculated the total earnings for each player by adding the column of round earnings and subtracting the cases where a fine was imposed. While the monitors made the calculations, the players responded to the exit survey, anonymously and in private. Upon returning the filled survey, payments were made in cash to each player and in private.

ii. Experiment instructions (English translation) (from Cardenas (2005:268-265)

These instructions were originally written in Spanish and translated from the final version used in the field work. The instructions were read to the participants from the script below by the same person during all sessions. The participants could interrupt and ask questions at any time. Whenever the following type of text and font e.g. [. . . MONITOR: distribute PAYOFFS TABLE to participants . . .] is found below, it refers to specific instructions to the monitor at that specific point; when in italics, these are notes added to clarify issues to the reader.
Neither of these were read to participants. Where the word 'poster' appears, it refers to a set of posters we printed in very large format with the payoffs table, forms, and the three examples described in the instructions. These posters were hung on a wall near the participants' desks where the eight people could see them easily.

COMMUNITY RESOURCES GAME (Instructions)

Greetings. . .
We want to thank everyone here for attending the call, and specially thank the field practitioner _____ (name of the contact person in that community), and _____ (local organization that helped in the logistics) who made this possible. We will spend about two hours between explaining the exercise, playing it and finishing with a short survey at the exit. So, let us get started.
The following exercise is a different and entertaining way of participating actively in a project about the economic decisions of individuals. Besides participating in the exercise, and being able to earn some prizes and some cash, you will participate in a community workshop

[32] The reason for announcing this was to make sure that the players had a benchmark with which to compare when facing a penalty if chosen for inspection; also to ensure that the external policy was common knowledge. For many sessions, it was very clear that, by round 10 of the first stage, this was the social optimum solution for many of the players. On no single occasion was such a solution questioned, although participants were not allowed to formulate questions prior to stage 2.

in two days to discuss the exercise and other matters about natural resources. During the day of the workshop we will give you what you earn during the game. The funds to cover these expenditures have been donated by various international organizations and the University.

Introduction

This exercise attempts to recreate a situation where a group of families must make decisions about how to use the resources of, for instance, a forest, a water source, a mangrove, a fishery, or any other case where communities use a natural resource. In the case of this community _____ (name of the specific village), an example would be the use of firewood or logging in the _____ (name of an actual local commons area in that village) zone. You have been selected to participate in a group of five people among those that signed up for playing. The game in which you will participate now is different from the ones others have already played in this community, thus, the comments that you may have heard from others do not apply necessarily to this game. You will play for several rounds equivalent, for instance, to years or harvest seasons. At the end of the game you will be able to earn some prizes in kind and cash. The cash prizes will depend on the quantity of points that you accumulate after several rounds.

The PAYOFFS TABLE

To be able to play you will receive a PAYOFFS TABLE equal to the one shown in the poster. [. . . MONITOR: show PAYOFFS TABLE in poster and distribute PAYOFFS TABLE to participants. . .]

This table contains all the information that you need to make your decision in each round of the game. The numbers that are inside the table correspond to points (or pesos) that you would earn in each round. The only thing that each of you has to decide in each round is the LEVEL OF EXTRACTION that you want to allocate extracting resources (in the columns from 1 to 8).

To play in each round you must write your decision number between 1 and 8 in a yellow GAME CARD like the one I am about to show you. [. . . MONITOR: show yellow GAME CARDS and show in the poster. . .] It is very important that we keep in mind that the decisions are absolutely individual, that is, that the numbers we write in the game card are private and that we do not have to show them to the rest of members of the group if we do not want to. The monitor will collect the 5 cards from all participants, and will add the total units of extraction that the group decided to allocate. When the monitor announces the group total, each of you will be able to calculate the points that you earned in the round. Let us explain this with an example. In this game we assume that each player extract as maximum of 8 units of a resource like firewood or logs. In reality this number could be larger or smaller but for purposes of our game we will assume 8 as maximum. In the PAYOFFS TABLE this corresponds to the columns from 1 to 8. Each of you must decide from 1 to 8 in each round. But to be able to know how many points you earned, you need to know the decisions that the rest in the group made. That is why the monitor will announce the total for the group in each round. For instance, if you decide to extract 2 units and the rest of the group together, add to 20 units, you would gain ____ points. Let us look at two other examples in the poster.

[. . .MONITOR: show poster with the THREE EXAMPLES…]

Let us look how the game works in each round.

The DECISIONS FORM

To play each participant will receive one green DECISIONS FORM like the one shown in the poster in the wall. We will explain how to use this sheet. [. . .MONITOR: show the DECISIONS FORM in the poster and distribute the DECISIONS FORMS. . .]

With the same examples, let us see how to use this DECISIONS FORM. Suppose that you decided to play 5 units in this round. In the yellow GAME CARD you should write 5. Also you must write this number in the first column A of the decisions form. The monitor will collect the 5 yellow cards and will add the total of the group. Suppose that the total added 26 units. Thus, we write 26 in the column B of the decisions form. [. . .MONITOR: In the poster, write the same example numbers in the respective cells. . .] To calculate the third column (C), we subtract from the group total, MY DECISION and then we obtain THEIR LEVEL OF EXTRACTION which we write in column C. In our example, 26 − 5 = 21. If we look at the PAYOFFS TABLE, when MY EXTRACTION are 5 and THEIR EXTRACTION are 21, I earn ____ points. I write then this number in the column D of the DECISIONS FORM.
It is very important to clarify that nobody, except for the monitor, will be able to know the number that each of you decides in each round. The only thing announced in public is the group total, without knowing how each participant in your group played. Let us repeat the steps with a new example. [. . .MONITOR: Repeat with the other two examples, writing the numbers in the posters hanging in the wall. . .] It is important to repeat that your game decisions and earnings information are private. Nobody in your group or outside of it will be able to know how many points you earned or your decisions during rounds. We hope these examples help you understand how the game works, and how to make your decisions to allocate your UNITS OF EXTRACTION in each round of the game. If at this moment you have any question about how to earn points in the game, please raise your hand and let us know.
[. . .MONITOR: pause to resolve questions. . .]
It is very important that while we explain the rules of the game you do not engage in conversations with other people in your group. If there are no further questions about the game, then we will assign the numbers for the players and the rest of forms needed to play.

Preparing for playing
Now write down your player number in the green DECISIONS FORM. Write also the place _____ and the current date and time __/__/__, __:__am/pm. In the following poster we summarize for you the steps to follow to play in each round. Please raise your hand if you have a question. [MONITOR: Read the steps to them from the poster] Before we start, and once all players have understood the game completely, the monitor will announce one additional rule for this group. To start the first round of the game we will organize the seats and desks in a circle where each of you face outwards. The monitor will collect your yellow game cards in each round. Finally, to get ready to play the game, please let us know if you have difficulties reading or writing numbers. If so, one of the monitors will sit next to you and assist you with these. Also, please keep in mind that from now on there should be no conversation nor should statements be made by you during the game, unless you are allowed to. We will first have a few rounds of practice that will NOT count toward your real earnings, they are just for practicing the game.

Appendix B. Labs in the field Data

Table B1. Labs in the field: geographical allocation

Villages	CPR
Providencia	Coral reefs
	Coastal fisheries
	Crab gatherers
Gaira	Coastal fisheries
Sanquianga	Clamps
	Fisheries
	Shrimp
	Mangroves
Barichara	Andean Forests
Chaina	Firewood
Tabio	Andean Forests
	Water
La Vega	Water
Neusa	Damn reservoir
	Trout fishing

Note: The red squares are the villages. Source: Cárdenas (2011)

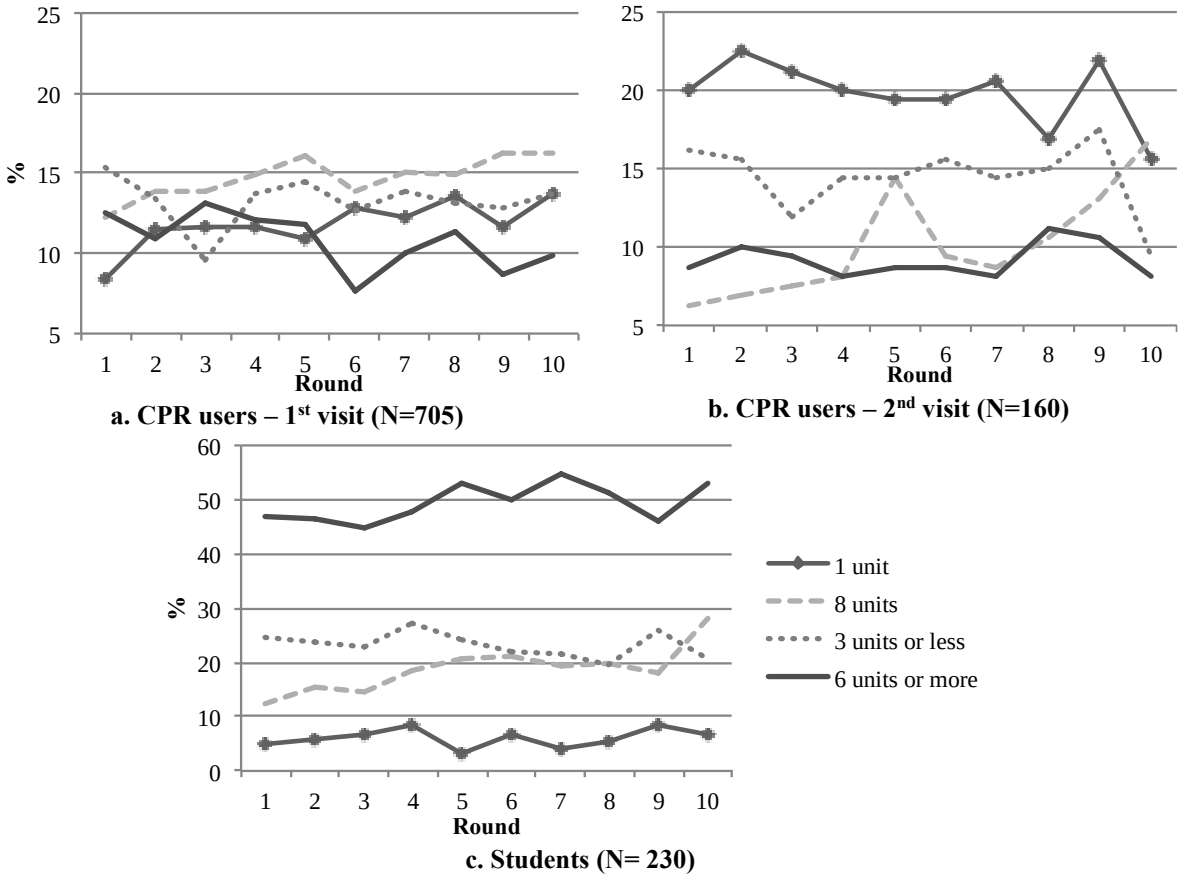


Figure B1. Baseline: behavior over rounds for Self-regarding, Pure Altruist and Percentage of participants that extracted 3 units or less, and 6 units or more. In panel a., the proportion of users that played the SNE is higher than the proportion of users that played the social optimum strategy. In panel b., in the second visit, the proportion of users who played the social optimum is the highest. In panel c., among students the proportion of individuals who played the social optimum is the lowest and the proportion of individuals who extracted 6 or more units of the resource is the highest.

Table B2. Real Users' perceptions on the CPR

Variable	Mean	Median	Standard deviation	Obs.
=1 if thinks that the CPR has not changed	22.0	0	41.44	678
=1 thinks the CPR is scarce	70.8	100	45.52	319
Perceived Percentage of families that cooperate in projects related to the CPR	56.6	50	38.84	708
Perceived interest in the community to cooperate	71.4	50	30.66	658
=1 if thinks the community should be the main vigilant	39.6	0	48.93	753
=1 if thinks the community should increase control of the CPR	52.6	25	36.54	743

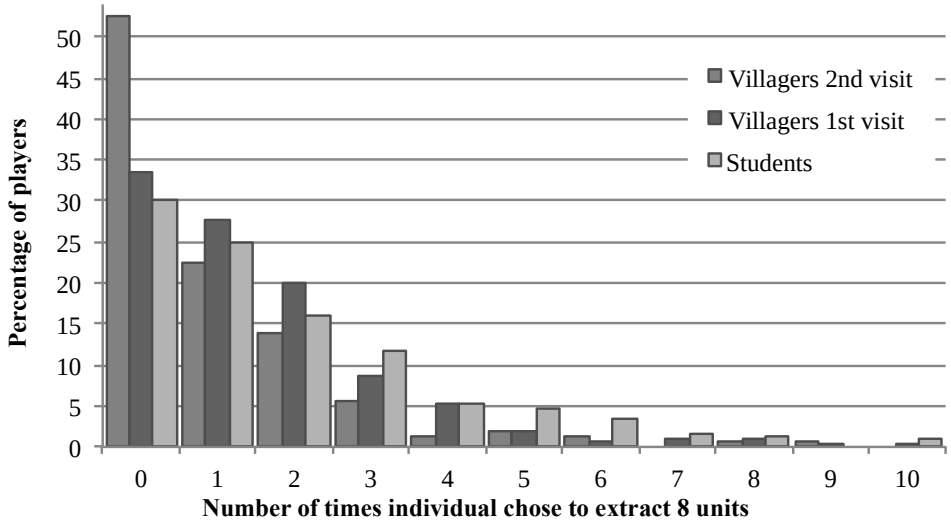


Figure B2. Comparison of self-regarding behavior -CPR users and students. Among students, 0.87% chose the Self-regarding NE strategy consistently during the first ten rounds. On the contrary, among CPR users in the first visit 0.28% chose the Self-regarding NE. The high percentage of 52.3 among CPR users that never chose to extract 8 units in the second visit is a signal of the difference in behavior from participants who knew the game with respect to those who played the game for the first time.

Appendix C. Individual best responses

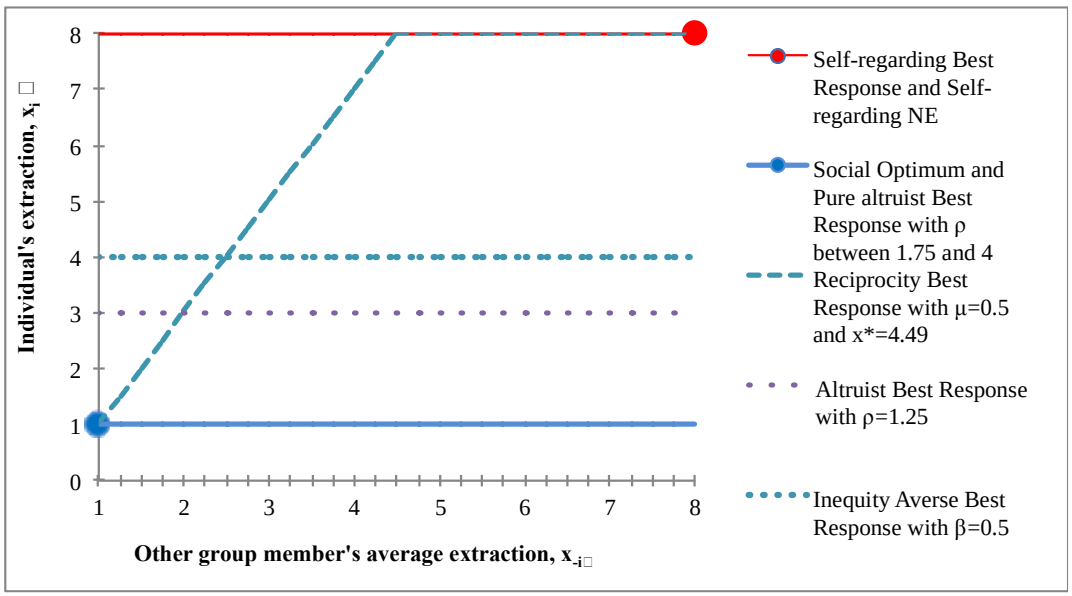


Figure C1. Best response functions example. Given the preference parameters $\rho_i = 0.08$ for an altruist, $\rho_i = 4$ for a pure altruist, $x_i^* = 4.49$ and $\mu_i = 0.5$ for a reciprocator, $\beta_i = 0.5$ for an Inequity averse.

Appendix D. Random Coefficient Model Classification

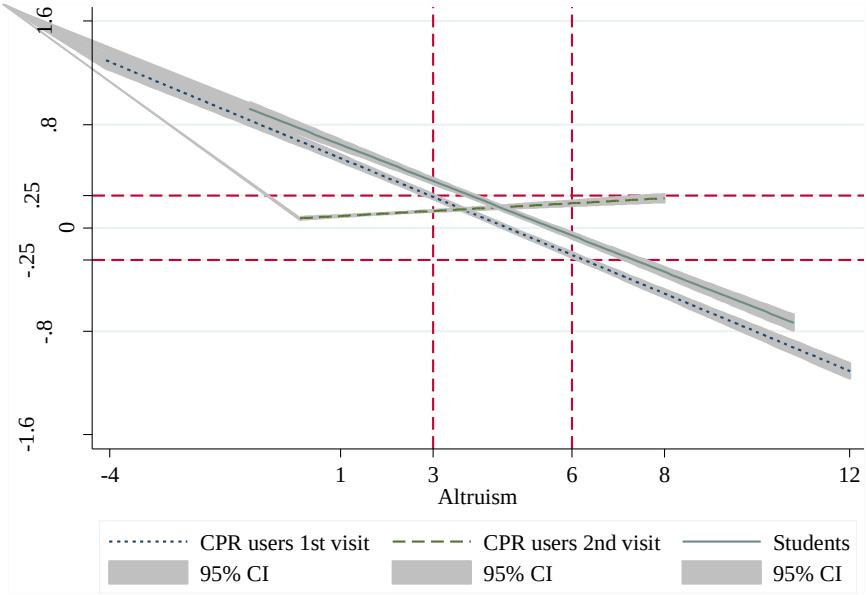
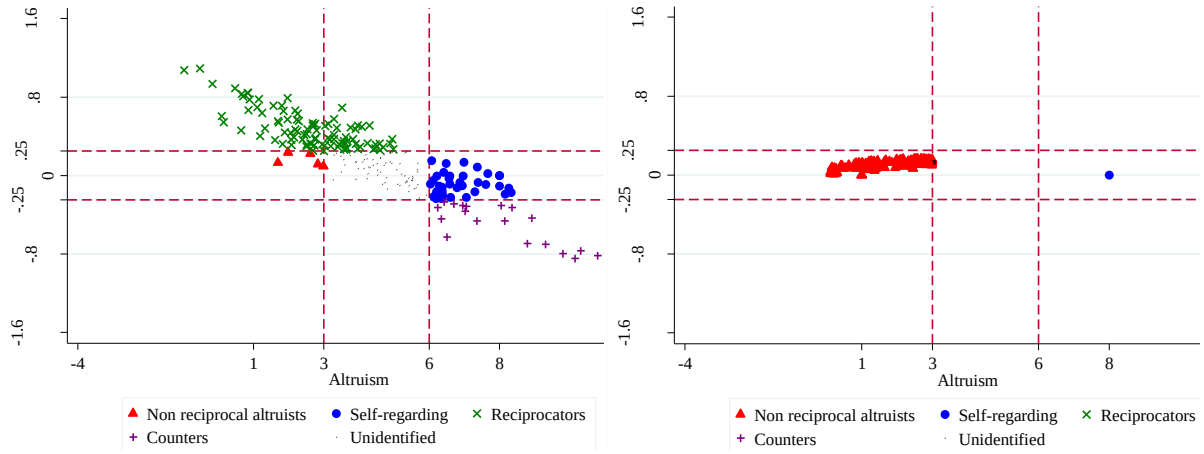


Figure D1. Linear Regression and confidence interval with 95% level of significance



a. Students (N=230) **b. CPR users – 2nd visit (N=160)**

Figure D2. The distribution of observed heterogeneity of altruism and reciprocity in the game with the RCM – Students and Second time visit CPR users

Table D1. Individual structural parameters estimators of Altruism and Reciprocity for each type – Second visit CPR users

Structural parameter		Non reciprocal Altruists	Reciprocator	Self-regarding	Counter	Unidentified
Altruism, $\hat{\rho}_i$	Mean	1.43	-	0.00	-	1.11
	Standard error	0.26	-	.	-	0.01
	Minimum	1.10	-	0.00	-	1.09
	Maximum	1.96	-	0.00	-	1.13
Reciprocity, $\hat{\mu}_i$	Mean	0.03	-	0.00	-	0.03
	Standard error	0.01	-	.	-	0.00
	Minimum	0.00	-	0.00	-	0.03
	Maximum	0.04	-	0.00	-	0.04
N		142	0	1	0	17

Notes: For CPR users in the second visit, we set $x_i^* = 3.83$, the average number of extracted units in the last practice round. The statistics for the Altruist type are very similar to CPR users in the first visit.

Table D2. Individual structural parameters estimators of Altruism and Reciprocity for each type – Students

Structural parameter		Non reciprocal Altruists	Reciprocator	Self-regarding	Counter	Unidentified
Altruism, $\hat{\rho}_i$	Mean	1.20	0.76	0.40	0.60	0.75
	Standard error	0.13	0.22	0.23	0.23	0.16
	Minimum	1.07	0.28	0.00	0.30	0.37
	Maximum	1.42	1.30	0.74	1.14	1.23
Reciprocity, $\hat{\mu}_i$	Mean	0.04	0.12	-0.02	-0.13	0.01
	Standard error	0.02	0.05	0.03	0.05	0.03
	Minimum	0.02	0.06	-0.06	-0.21	-0.06
	Maximum	0.06	0.27	0.04	-0.07	0.06
N		73	5	97	39	19

Notes: For Students, we set $x_i^* = 4.89$, the average number of extracted units in the last practice round. The statistics for the Altruist type are very similar to CPR users in the first visit.

Table D3. Social efficiency and group heterogeneity with the RCM- 2nd time visit CPR users

No. individuals in group g that are type q	Individual Type q label					
	Altruist	Reciprocator		Self-regarding	Counter	Unidentified
		$x_i^* > \bar{x}_{-i}^e$	$x_i^* \leq \bar{x}_{-i}^e$			
0	.	85.14	71.28	78.92	78.34	81.97
1	.	.	.	60.39	.	70.97
2	70.77	.	.	.	.	69.78
3	69.78	.	.	.	.	70.77
4	68.86	.	.	.	.	.
5	82.99	.	.	.	.	.

Number of groups is 32. The social norm is chosen as $x_i^* = \overline{x_{\iota 0}} = 3.84 \; \forall i$, the average number of extracted units in the last practice round among students. *** represents significance at 1% level, ** at 5%, * at 10%.

Table D4. Social efficiency and group heterogeneity with the RCM- Students only

No. individuals in group g that are type q	Individual Type q label					
	Altruist	Reciprocator		Self-regarding	Counter	Unidentified
		$x_i^* > \bar{x}_{-i}^e$	$x_i^* \leq \bar{x}_{-i}^e$			
0	66.71	68.85	62.03	68.91	68.02	64.65
1	73.35	70.40	66.08	66.71	66.60	67.61
2	.	70.49	66.45	67.19	.	68.84
3	.	73.78	64.43	61.92	.	65.69
4	.	70.11	61.63	.	.	65.89
5	.	.	.	.	.	.

Number of groups is 46. *** represents significance at 1% level, ** at 5%, * at 10%. The social norm is chosen as $x_i^* = \overline{x_{\iota 0}} = 4.89 \; \forall i$, the average number of extracted units in the last practice round among students.

Appendix E. Determinants of being type q

Table E1. Regressions for collinear variables

	Dependent variable: 1 if player is type	*Altruist*	*Self-regarding*	*Reciprocator*	*Counter*	$\hat{\rho}$	$\hat{\mu}$
	Independent Variables	I (5)	II (5)	III (5)	IV (5)	V (5)	VI (5)
=1 if one of two main economic activities in the household is	Agriculture	-0.045*	-0.021	0.041	0.002	0.879***	0.014*
		[0.027]	[0.020]	[0.038]	[0.035]	[0.023]	[0.007]
	Cattle	-0.036	-0.001	0.057	0.055	0.864***	0.008
		[0.032]	[0.027]	[0.057]	[0.049]	[0.035]	[0.013]
	Fishing	0.013	-0.064***	-0.001	0.019	0.911***	0.015**
		[0.027]	[0.017]	[0.035]	[0.037]	[0.024]	[0.007]
	Hunting	-0.035	-	0.142	-0.076	1.019***	0.028
		[0.067]	-	[0.116]	[0.099]	[0.086]	[0.028]
	Wood	0.085	0.034	-0.046	-0.033	0.928***	0.013
		[0.053]	[0.039]	[0.050]	[0.043]	[0.054]	[0.010]
Participant's perceptions	=1 thinks the CPR is scarce	-0.004	0.010	0.063	-0.026	0.888***	0.017*
		[0.036]	[0.024]	[0.053]	[0.052]	[0.028]	[0.008]
	Perceived Percentage of families that cooperate in projects related to the CPR	0.019	-0.010	-0.064	0.017	1.072***	0.003
		[0.032]	[0.020]	[0.051]	[0.041]	[0.029]	[0.007]
	=1 if thinks the community should increase control of the CPR	-0.082**	-0.024	0.083	0.018	1.060***	0.020***
		[0.038]	[0.026]	[0.051]	[0.048]	[0.034]	[0.007]
Social capital measures	=1 if membership in associations	-0.023	-0.045**	0.021	0.057*	0.899***	0.007
		[0.026]	[0.019]	[0.035]	[0.029]	[0.020]	[0.006]
	=1 if attends at least to one meeting	0.024	-0.045**	0.009	0.047	0.910***	0.009*
		[0.023]	[0.022]	[0.037]	[0.030]	[0.020]	[0.006]
	Number of associations meetings	0.000***	-0.002	0.000	0.000	0.005**	0.000
		[0.000]	[0.001]	[0.000]	[0.000]	[0.002]	[0.000]
	Number of days of volunteer work per year	0.000	-0.001	0.001	-0.001***	0.005***	0.000***
		[0.000]	[0.000]	[0.000]	[0.000]	[0.001]	[0.000]

* Significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in brackets clustered at the group level. For the types we report the marginal effects of a probit regression. For the parameters, we use a linear regression model.

Table E2. Determinants of being type *q*, additional controls (Table 10)

Dependent variable: 1 if player is type q		*Altruist*		*Self-regarding*		*Reciprocator*		*Counter*	
Independent Variables		I (1)	I (2)	II (1)	II (2)	III (1)	III (2)	IV (1)	IV (2)
Participant's characteristics	=1 if Landowner	0.018	0.009	-0.017	-0.011	0.055	0.060	-0.007	-0.001
		[0.024]	[0.017]	[0.024]	[0.020]	[0.066]	[0.067]	[0.054]	[0.052]
	=1 if the Household uses gas to cook	0.012	0.005	-0.002	-0.002	-0.036	-0.025	0.118**	0.125***
		[0.027]	[0.023]	[0.024]	[0.019]	[0.056]	[0.059]	[0.047]	[0.045]
	=1 if the Household uses electricity to cook	0.023	-0.022	0.080*	0.092	-0.038	-0.006	0.042	0.011
		[0.051]	[0.021]	[0.047]	[0.056]	[0.072]	[0.078]	[0.074]	[0.072]
Group composition (info within group)	% self-regarding among the rest of the group		0.073		-0.071		-0.336		0.217
			[0.088]		[0.065]		[0.241]		[0.193]
	Average age among the rest of the group		0.001		0.000		-0.001		-0.003
			[0.002]		[0.001]		[0.004]		[0.003]
Observations		379	379	379	379	379	379	379	379

* Significant at 10%; ** significant at 5%; *** significant at 1%. Marginal effects reported. Robust standard errors in brackets clustered at the group level.

Table E3. Determinants of being type *q*, additional controls (Table 11)

Dependent variable: 1 if player is type q		*Altruist*		*Self-regarding*		*Reciprocator*		*Counter*	
Independent Variables		I (1)	I (2)	II (1)	II (2)	III (1)	III (2)	IV (1)	IV (2)
Participant's characteristics	=1 if Landowner	0.018	0.009	-0.017	-0.011	0.055	0.060	-0.007	-0.001
		[0.024]	[0.017]	[0.024]	[0.020]	[0.066]	[0.067]	[0.054]	[0.052]
	=1 if the Household uses gas to cook	0.012	0.005	-0.002	-0.002	-0.036	-0.025	0.118**	0.125***
		[0.027]	[0.023]	[0.024]	[0.019]	[0.056]	[0.059]	[0.047]	[0.045]
	=1 if the Household uses electricity to cook	0.023	-0.022	0.080*	0.092	-0.038	-0.006	0.042	0.011
		[0.051]	[0.021]	[0.047]	[0.056]	[0.072]	[0.078]	[0.074]	[0.072]
Group composition (info within group)	% self-regarding among the rest of the group		0.080		-0.079		-0.291		0.190
			[0.097]		[0.061]		[0.237]		[0.194]
	Average age among the rest of the group		0.001		0.000		-0.001		-0.003
			[0.002]		[0.001]		[0.004]		[0.003]
	Average Index of time spent by the HH on CPR extraction among the rest of the group		0.098		-0.111		0.102		-0.187
			[0.068]		[0.072]		[0.175]		[0.193]
Observations		379	379	379	379	379	379	379	379

* Significant at 10%; ** significant at 5%; *** significant at 1%. Marginal effects reported. Robust standard errors in brackets clustered at the group level.

Table E4. Linear estimation of determinants of parameters $\hat{\rho}$ and $\hat{\mu}$. additional controls (Table 11). First visit CPR users.

	Dependent variable	$\hat{\rho}$				$\hat{\mu}$			
	Independent Variables	V (1)	V (2)	V (3)	V (4)	VI (1)	VI (2)	VI (3)	VI (4)
Participant's characteristics	Sex (=1 if woman)	0.035	-0.017	0.041	-0.024	0.017	0.007	0.017	0.005
		[0.036]	[0.037]	[0.037]	[0.038]	[0.012]	[0.012]	[0.012]	[0.012]
	=1 if Landowner`	0.078	0.008	0.073	0.013	0.023	0.015	0.023	0.015
		[0.049]	[0.042]	[0.050]	[0.042]	[0.016]	[0.016]	[0.016]	[0.016]
	=1 if the Household uses gas to cook	0.162***	0.076*	0.176***	0.080**	-0.021*	-0.024**	-0.021*	-0.021*
		[0.044]	[0.039]	[0.047]	[0.040]	[0.012]	[0.012]	[0.012]	[0.013]
	=1 if the Household uses electricity to cook	-0.013	-0.050	-0.007	-0.049	-0.008	0.001	-0.009	-0.001
		[0.066]	[0.063]	[0.064]	[0.061]	[0.016]	[0.016]	[0.016]	[0.016]
Participant's perceptions	=1 if thinks the community should be the main vigilant	0.016	0.016	0.019	0.023	0.007	0.008	0.007	0.008
		[0.039]	[0.032]	[0.039]	[0.033]	[0.010]	[0.010]	[0.010]	[0.010]
Group composition (info within group)	Average $\hat{\mu}$ among the rest of the group		0.058		-0.013		0.157		0.171
			[0.224]		[0.224]		[0.140]		[0.144]
	Average sex among the rest of the group		0.073		0.076		0.020		0.022
			[0.050]		[0.051]		[0.018]		[0.018]
Observations		379	379	379	379	379	379	379	379
R-squared		0.873	0.900	0.872	0.901	0.058	0.088	0.058	0.089

* Significant at 10%; ** significant at 5%; *** significant at 1%. Robust standard errors in brackets clustered at the group level.