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WHAT DO PEOPLE BRING INTO THE GAME: EXPERIMENTS IN THE FIELD ABOUT COOPERATION IN THE COMMONS

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ABSTRACT

The study of collective action requires an understanding of the individual incentives and of the institutional constraints that guide people in making choices about cooperating or defecting on the group facing the dilemma. The use of local ecosystems by groups of individuals is just one example where individual extraction increases well-being, but aggregate extraction decreases it. The use of economic experiments has enhanced the already diverse knowledge from theoretical and field sources of when and how groups can solve the problem through self-governing mechanisms. These studies have identified several factors that promote and limit collective action, associated with the nature of the production system that allows groups to benefit from a joint-access local ecosystem, and associated with the institutional incentives and constraints from both self-governed and externally imposed rules. In general, there is widespread agreement that cooperation can happen and be chosen by individuals as a rational strategy, beyond the "tragedy of the commons" prediction. A first step in this paper is to propose a set of layers of information that the individuals might be using to decide over their level of cooperation. The layers range from the material incentives that the specific production function imposes, to the dynamics of the game, to the composition of the group and the individual characteristics of the player. We next expand the experimental literature by analyzing data from a set of experiments conducted in the field with actual ecosystem users in three rural villages of Colombia using this framework. We find that repetition brings reciprocity motives into the decision making. Further, prior experience of the participants, their perception of external regulation, or the composition of the group in terms of their wealth and social position in the village, influence decisions to cooperate or defect in the experiment. The results suggest that understanding the multiple levels of the game, in terms of the incentives, the group and individual characteristics or the context, can help understand and therefore explore the potentials for solving the collective-action dilemma.

Keywords: Collective action; cooperation; experimental economics; field experiments; local ecosystems

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Juan-Camilo Cárdenas[1] and Elinor Ostrom[2°]

1. INTRODUCTION

The use of local ecosystems by human groups through different farming and extractive systems involves the resolution of collective-action problems due to (1) the nature of interactions between individuals and the ecosystem and (2) the nature of the institutions that govern the rights and duties of those affected by the goods and services provided by these ecosystems. Understanding how individuals within groups make decisions about their use of the ecosystems, and how self-governed solutions at the group level can emerge that enhance sustainable use over time, are both crucial for the possibilities of a sustained management of the local commons. The use of economic experiments for addressing these questions was pioneered a decade ago by Ostrom *et al.* (1994). In the current paper, we take a further step and explore the possibilities of conducting these economic experiments in the field, with actual users of local ecosystems, in order to learn about their decision making in such settings.

Contemporary economic theory is one of the more successful, empirically verified, social science theories to explain human behavior. It does best, however, in the settings for which it was developed—the exchange of private goods and services in an open, competitive market. The theory is based on a theory of goods, an institutional mechanism, and a model of human behavior. When the goods involved are easily excludable and rivalrous, and individuals are interacting in a competitive market, theoretical predictions have strong empirical support. When

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the goods involved are not easy to exclude—public goods or common-pool resources, for example—empirical support for conventional theoretical predictions receives much less empirical support (Camerer 1997, 1998; Gintis 2000). In a static setting, the conventional predictions are that individuals will not produce public goods and that they will overharvest common-pool resources. The evidence for both predictions is mixed (Ostrom 1999).

In public good experiments, for example, instead of contributing nothing to the provision of a public good, as is predicted by neoclassical theory for individuals maximizing material payoffs, individuals tend to contribute, on average, between 40 to 60 percent of their experimentally assigned assets in a one-shot game (Davis and Holt 1993; Isaac and Walker 1988b). In repeated games, the average level of contribution starts at around 50 percent but, without opportunities for communication, slowly decays toward the predicted zero level (Ledyard 1995). With non-binding communication—cheap talk—subjects are able to sustain cooperation in public good experiments for long periods of time (Sally 1995; Isaac and Walker 1988a). Similarly, subjects in common-pool resource experiments approach near-optimal withdrawal levels when they are able to communicate, come to their own agreements, and use agreed-upon punishments if someone deviates from the agreement (Ostrom *et al.,* 1994). Probably the clearest rejections of theoretical predictions have occurred in ultimatum and dictator experiments where first movers tend to offer second movers a far larger share of the bounty than predicted and where second movers (when given a chance) turn down offers that are not perceived, given the experimental conditions, as being fair (see Güth and Tietz 1990; Roth 1995).

Field studies also find that the theoretical prediction that users are trapped in inexorable tragedies (Hardin 1968) are frequently not confirmed (Bromley *et al.*1992; Ostrom 1990), even though many examples exist of resources that have been destroyed through overuse. Achieving effective, self-organized solutions is, of course, not a guaranteed outcome. Attributes of resources and of participants have consistently been found to affect initial levels of organization (Gibson *et al.* 2000; Ostrom 2001). Social scientists interested in human-resource dynamics face a major challenge to construct a behavioral theory of human behavior that includes the classical economic model when applied to the exchange of private goods in full-information, market settings, but that assumes a wider range of motivations when individuals use resource systems that are non-private goods (Hirschmann 1985). The theory needs to encompass a full array of goods, a broader model of the individual (including the types of norms adopted by individuals), the importance of group characteristics, the possibilities for using reputation and reciprocity, and the specific rules used in particular settings. Given the number of variables involved, providing a framework for how they are interlinked is one of the most important next steps toward a new theoretical synthesis.

In this paper, we take a small step in this direction. We speculate that understanding how individuals learn about and interpret the information potentially available to them in a particular situation is an important factor affecting their decisions. We thus offer a simple framework for studying how individuals gather information about the incentives of a situation, the context of the group in which they face the dilemma, as well as information about themselves. We posit that these layers of information are differentially invoked by the structure of a situation to inform the decision on whether to cooperate or defect when facing such options within a group immersed in a local commons problem.

We illustrate the usefulness of the framework to explain behavior in a series of field experiments. Survey data collected from the participants (after the completion of the experiments about their perceptions and values related to the layers of the framework) enables us to explain a significant part of the variation in cooperation, as a function of variables associated with various levels of individual and group information in the game.

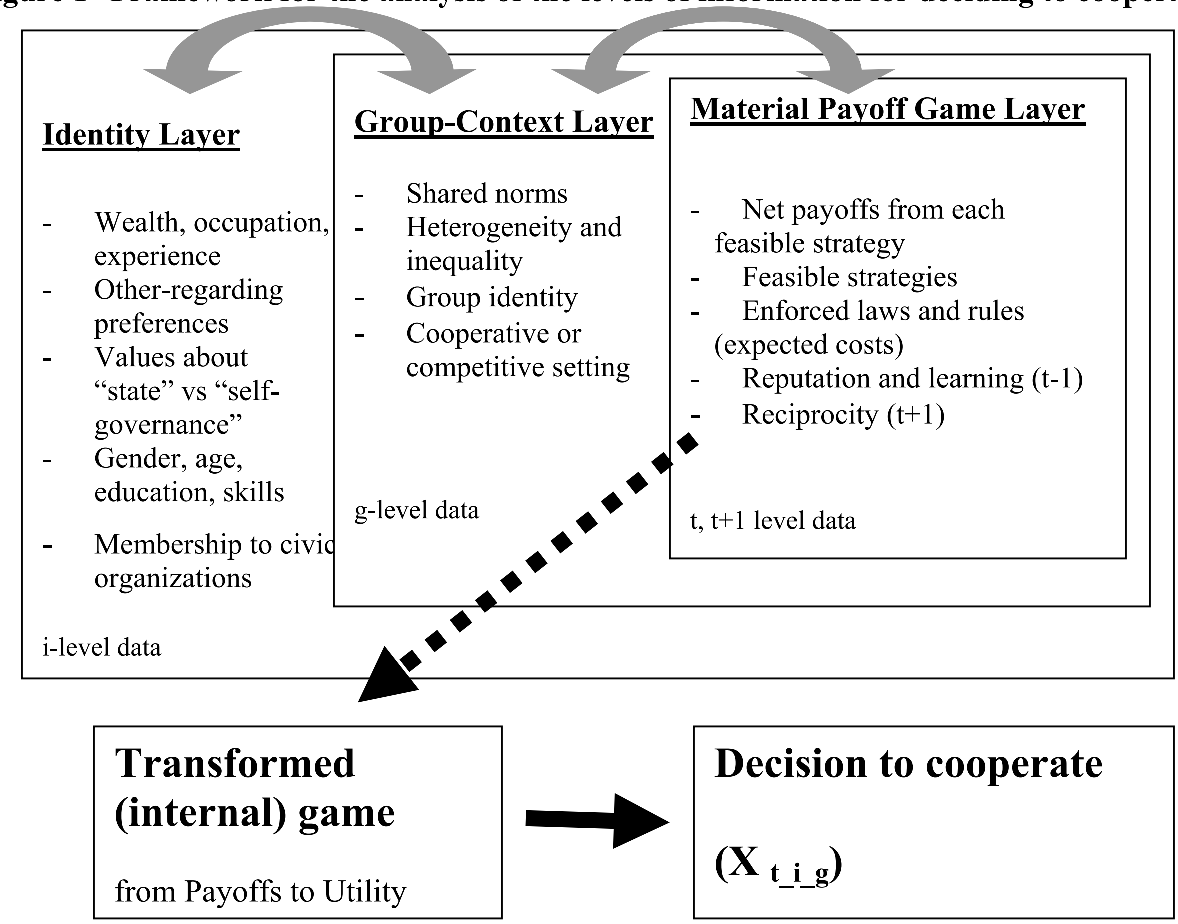
Most experimental studies that use information elicited by participants on their personal data have focused mostly on basic demographics like gender, age, or education, but rarely do these studies associate behavior in the experiments to the participants' actual experience on the kinds of phenomena being studied in the experimental design. Examples of exceptions are Cooper *et al.* (1999) where the experimenters invite actual Chinese managers to participate in a decision-making environment on planning and management in firms. Also, Karlan (2003) ran experiments and correlated trust and cooperation on repayment of actual microcredits in Peru. As for the case of common-pool resource experiments, we have to date no knowledge of experiments conducted with actual resource users and where the subjects' context is used to explain variation in experimental behavior.

2. THE LAYERS OF INFORMATION THAT PEOPLE BRING INTO THE GAME

Institutions as "rules of the game" transform key elements involved in the decision of an individual. Most of these elements enter the decision as information—or lack of it—about components of the game or other participants in the game. Individuals, by interacting with institutions, gather information by learning about others and their actions, and about the consequences of interacting within a specific set of rules.

Our framework, first proposed in Cárdenas (2000), combines inputs from Ostrom's (1998) behavioral model of collective action, from Bowles's (1998) arguments for a model of endogenous preferences, and from McCabe and Smith's (2003) cognitive model of social exchange (see Figure 1). The arguments are associated with the specific kinds of information that are available to members from the same rural village who hold information about each other, and information about the context in which the social interactions happen in the experiment or in their daily decision making about resource use.

Figure 1--Framework for the analysis of the levels of information for deciding to cooperate



Ostrom (1998, 2000) argues that studying the context of a game is crucial because institutions affect individuals' decisions to cooperate by performing at least three key tasks. First, institutions reinforce social norms that are consistent with the rules. Second, they allow participants to gather more or less information about the behavior of others. And third, they entitle people to reward and punish certain behaviors with material and non-material incentives.

The framework organizes the kinds of information that individuals may use in deciding whether to cooperate or defect in a collective-action problem. As a starting point, let us assume that an individual is facing a game with the characteristics of a particular collective-action dilemma. The game has a material payoff structure where the Nash strategy is to defect, but a

Pareto-optimal solution is achieved at universal cooperation. However, it is frequently observed that a significant fraction of individuals (roughly half) start cooperating in these experiments (Ledyard 1995). Arguments explaining this range from presuming a lack of learning and understanding of the game to inherited altruistic preferences of humans. Assuming that individuals engage in reciprocity is also offered as an explanation in repeated games. Information enables players to decide whether to trust the others in the group and cooperate, once they are aware that cooperation can achieve a Pareto-superior outcome.

The framework we propose classifies the pieces of information that the players gather to explain how players may transform the material payoffs of an externally defined game into an internal game. These data can be ordered in three layers of information, namely, the Material Payoffs Game layer, the Group-Context layer, and the Identity layer. We argue that players use these layers of information as sources for responding to questions like the following:

Layer	**Basic Questions of Participants**
Material Payoffs Game	What material payoffs can I obtain from my actions and those of others in this game? What can I learn from previous rounds of this same game? What can happen in future rounds of this game because of what happens in previous rounds?
Group-Context	Who are the others in my group? Can they be trusted? Do they usually cooperate in this and similar games? Do they follow social norms?
Identity	Do I care if I defect on others? Do I enjoy cooperating? Or competing? Does my experience in similar games provide hints on how to play this game?

These layers of information can be expressed in the framework shown in Figure 1, which provides examples of specific factors included in each of the layers that transform the game from an external, material payoffs game into an internal game. Our framework implies that individuals try to gather and evaluate information about these three layers, depending on the game structure. Once the game involves repetition, non-anonymity, and externalities among players, net individual and group gains may be achieved from gathering additional information, even if costly, to construct a new internal game. The transformed game will then have a different set of payoffs, a different set of preferred strategies, and eventually, in light of the change of behavior over time, a different set of Nash strategies. Depending on the initial distribution of intrinsic preferences and the information revealed, social dilemma games may be transformed into other games, such as an assurance game, with less conflict between individual and collective interest. The new internal game does not have to be a monotonic transformation of the initial material payoffs structure in the static one-shot game.

Given these possibilities, let us now look at the layers of information proposed in the framework.

a. The Material Payoffs Game Layer

In the first layer of information, the player observes the structure of material payoffs and feasible strategies for a one-shot game. The set of actions and payoffs will produce possible Nash equilibria, some of which may be more socially desirable than others. The valuation of the game at this layer is affected by common knowledge of the set of formal rules that are effectively enforced and that impose material costs or benefits on each decision. Therefore, the perceived game drawing on this information is in fact the one resulting after applying those formal rules and the material rewards, penalties, or restrictions that are fully enforced. Once the enforcement of rules suffers from any kind of transaction or enforcement costs, the other layers of information enter into play to affect the actual response to a certain formal but partially enforced rule.

Further, most social exchange relations of the collective-action type in the field involve a non-zero probability of facing the same counterparts in future rounds of the game. Axelrod's (1984) argument of cooperation emerging from self-oriented maximizers was based on such grounds. The likelihood that the same players meet in future rounds creates several effects in the dynamic game. Since players can learn and have memory, they can build a reputation and build a history of the reputation built by others. McCabe and Smith (2003), in their cognitive model, suggest a set of modules, one of which involves the process of goodwill accounting. Since the strategy of tit-for-tat produces strong results in the long run against most other strategies, the information that can be gathered about past rounds and the probability of future ones with the same players creates the conditions that are conducive for cooperation through reciprocity, including retaliation towards non-cooperators as a group selection mechanism. It is well recognized that in public good experiments with no possibilities for communication among players, contributions decrease over rounds. Players who start cooperating, but observe others free-riding, decrease their cooperation. This phenomenon of crowding-out of cooperative behavior (see Cárdenas *et al.* 2000 for more details) will play a crucial role in the empirical results we present below. It may also explain why one observes cases in the field where initial cooperative efforts fail after a period of time because cooperators, frustrated by the initial free-riding of others, switch to non-cooperative behavior. The argument behind the crowding-out hypothesis is that the intrinsic motivations (see Frey and Jegen, forthcoming, for a survey) can be crowded-out by explicit incentives such as rewards or sanctions because the intrinsic motivation can work in opposite direction than the material incentive within the internal rewards the player gets from each.

The time frame is also important. Isaac *et al.* (1994) explored extending the number of rounds in a linear public goods game from 10 to 40 and 60 rounds and show how while in 10 rounds the percentage of contributions falls from 50% to less than 10%, when ran over 40 rounds, by the 10^{th} round the percentage of contributions was of 40% and fell to less than 10%

only by the 40^{th} round. When extending to 60 rounds the same pattern happens, namely, starting at 50% contributions, at 30% by round 40, and around 10% by round 60. This pattern would be consistent with the behavioral model of the rational actor of Ostrom (1998) where longer time horizons can contribute to the virtuous cycle of reciprocity, trust, and reputation that sustain cooperation.

b. The Group-Context Layer

A second information layer is proposed on the notion that a player's decisions are also influenced by recognizing specifically who the other players are in the transaction. Knowing who the others in a game are may trigger the possibility that the same players will meet in a future round of the game. The possibility of reciprocity and retaliation processes affects future outcomes. Secondly, an individual's own set of preferences may include caring for the well-being of certain others (relatives, friends, or neighbors), and knowing who is involved affects their valuation for the payoffs going to others.

For repeated games, evolutionary models—where the gains from cooperating or defecting may be affected by the frequency of cooperators and defectors in the group (Bowles 1998)—also provide grounds for this argument. The information a player has about the composition of the group will determine if there is sufficient trust among those involved to choose to cooperate for mutual gains. Thus, depending on the fraction of trustworthy and opportunistic types observed in a group, the player will have a better estimate of the likelihood of cooperation by others and therefore of the gains and costs of doing likewise.

Empirical evidence supports this. Group identity, group cohesion, and social distance have been shown to affect the likelihood that individuals cooperate. Lawler and Yoon (1996), for instance, show in a series of experiments how the level and equality of power among players increased the frequency of mutual agreements. Kollock (1998) provides data from a set of prisoner's dilemma experiments studying how group identity has a direct effect on cooperative behavior. The behavior of college students changed depending on the information they received about the other players (being from the same fraternity, from any other fraternity, from the same campus, from another campus, from the police department). Significant changes in behavior were found consistent with the existence of strong in-group/out-group effects (see Orbell *et al.* 1988). Other non-experimental evidence might also support how group composition and context may determine cooperation. Alesina and La Ferrara (1999) show evidence from U.S. survey data that the participation of individuals in social organizations and activities is higher for more equal and less fragmented localities in terms of race or ethnicity. Group heterogeneity and inequality are still presented to be part of the core explanations for collective action since Olson (1965) and, more recently, with Bergstrom *et al.* (1986).

Accounting for the particular major of the student participating has also been a focus of attention. Early experiments in the 1980s asked whether economics majors showed higher levels of free-riding with modest strong results (Marwell and Ames 1981; Isaac *et al.* 1985, reported in Ledyard 1995). More recently, Cadsby and Maynes (1998) reported that nurses showed higher levels of cooperation than economics and business students in a threshold public goods game. These results would also be consistent with the work by Frank *et al.* (1993) on the behavior of economics majors being closer to game-theoretical predictions. In another interesting study, Ockenfels and Weinmann (1999) found that East German participants behaved less cooperatively than West German ones in both public goods (ten rounds, 5 person) and solidarity (one-shot, 3 person) games.

We are not claiming that groups that are homogeneous and closed to their outside environment are always more prone to cooperation. There are many other factors in the technology of the collective action and their relative position within that technology that can affect their willingness to cooperate. Further, different types of heterogeneity can act in ways opposite to the homogeneity → cooperation causality. Some evidence indicates that groups that are closer to markets, and less homogeneous in race or cultural identity, can in fact show high levels of trust and cooperative behavior. Our experiment suggests that heterogeneity in wealth and social position within a group imposes a barrier to finding self-governed solutions to the cooperation dilemma (see also Cárdenas 2003). Certainly, a long history of lack of cooperation within a homogeneous group can also impose a considerable barrier to future cooperation. Unfortunately, time frames of experiments are too limited to study such long-term processes.

Much of the arguments for heterogeneity inducing higher cooperation are based on the asymmetric payoffs structure where the players with higher stakes may be more willing to provide the public good. We would assign such effects to the static game layer in the framework. However, other elements arising from group composition may also enter into play even under a symmetric payoff. One of these cases is the effect that social differences may have in a group—for instance, due to wealth. For a more detailed discussion on how wealth differences may have an effect in solving these dilemmas see Cárdenas (2003).

c. The Identity Layer

In this third layer, the players store and process information about their own selves that may affect subjective payoffs and thus strategies chosen. Values internal to the player will increase or decrease the subjective payoffs from cooperating or defecting because of the existence of other-regarding or process-related preferences. This information is not necessarily invoked by a particular game. The information is already available. It is used depending on the externalities involved in the game. In the case of transactions under perfectly competitive markets where no externalities are involved, it is unlikely that the player will use this layer.

Positing this layer is consistent with Sen's (1977) rejection of egoism and opportunism as the *only* rationalities possible for humans. His discussion of behaviors based on sympathy—which is still based on an egoist rationality—may help to explain why we observe non-negative voluntary contributions in public goods. Also, inherently human traits such as reciprocal fairness (Fehr and Tyran 1997; Kahneman *et al.* 1986) create behavior that goes against the opportunist prediction. Falk *et al.* (2002) explore behavior in the commons based on the theoretical model proposed by Fehr and Schmidt (1999). They include individual preferences based on reciprocity and fairness to explain the levels of cooperation in experiments where communication and informal sanctioning are introduced (see also Crawford and Ostrom 1995). In their model, an individual's utility increases with material payoffs, but decreases with the level of disadvantageous or advantageous inequality in outcomes. This kind of other-regarding preferences model still maintains a utility maximizing rationality, but one that is based not only on one's payoffs but also on the others' outcomes. Therefore, the material payoffs game is transformed, not necessarily in a monotonic manner, after considering the outcomes of others. An example is the pleasure or joy one has from cooperating or defecting, depending on one's values or preferences about being the best, or observing how the group does well.

This identity layer is also quite important when imperfect information exists about the material game (payoffs, strategies, and other players). Past experience in similar games, skills, and education can inform the player about the game. For instance, the framing of the problem can induce the player to bring elements from prior experiences into the game. Games with the exact same objective structures produce different behavior depending on the framing (Hoffman *et al,* 1996, 1999). Institutions in field settings can induce different preferences in the way that they frame a social exchange situation. Although the econometric analysis and data will not allow for testing specifically the weights of others' well-being in the transformed payoffs of each player in our experiment, the findings will be consistent with the literature just mentioned of why we could find in the field and the experimental lab behavior that is rationally cooperative within these settings.

The two-way arrows above the layers in Figure 1 suggest that cross-effects between layers might play a role as well. The conditions of one layer may reinforce or diminish the effect of another layer. Sally (2001) has proposed a formal model to introduce the concept of sympathy as a key to determining the willingness to cooperate by a player. He defines sympathy as the "fellow-feeling person *i* has for person *j*" and models it as a function of both the physical and psychological distances between *i* and *j*. His approach, using our framework, combines the last two layers in the sense that it involves information both about self and about the others when playing the game. In fact, Sally differentiates sympathy from altruism. He uses a reciprocity argument for the former, since persons will reduce their fellow-feeling for another when they feel they are being taken advantage of. In general, the importance of cross-effects among the factors that determine cooperation has been understudied, particularly in experiments. Ledyard (1995, p. 144), in fact, mentions the lack of research on this area, on how the marginal effect of one variable depends on the level of another institutional variable. He cites the work by Isaac and Walker (1988b) and Isaac *et al.* (1994) on how the effect of the marginal per capita returns (MPCR) on contributions to public goods is affected by group size. In our framework, this suggests that the static game layer—where the MPCR determines the material marginal return from contributions—might interact with the group composition layer.

d. Hypotheses about Decision Making using this Framework

If the arguments presented above about the advantages of using the framework are valid, we could further explore why substantial differences are observed in behavior, under the same experimental design, when comparing different cultures. For example, Henrich (2000) and Henrich *et al.* (2001) report on a series of ultimatum, public goods, and dictator games from field experiments with 15 small-scale societies in 12 countries. The behavior under the same objective game varied with the culture of the group as well as with results obtained in experimental labs using American undergraduate students.

Individuals decide to gather information or not from added layers beyond the basic game layer depending on the overall structure of the game, including the payoffs, the feasible strategies, the other players, and the norms and rules that are shared by such groups. Bringing this information to the game depends on the ease and cost of gathering it. If players do not know who the others are in the group involved in a social dilemma transaction, the Group-Context layer is useless for them, unless this is inexpensive information to gather. If the player does not assume multiple rounds of the same game with the same players, there is no need about multiple time periods and implications related to reciprocity. In fact, Bowles suggests that "the more the experimental situation approximates a competitive (and complete contracts) market with anonymous buyers and sellers, the less other-regarding behavior will be observed" (1998, p. 89).

A case in which a player might want to bring information from other layers into the game is when a transaction involves some kind of externality or interdependency not corrected in the basic game through enforceable rules and material incentives, and which usually affects the well-being of others in the group. A Prisoner's Dilemma game is the typical case, although not the only one. If possible, every player would like to gather more information to better predict the other player's action and then use it along with elements like caring for the other to choose whether to cooperate or not.

A second reason for the player to search for information in other layers is the existence of asymmetric information and the costliness of writing and enforcing contracts. Many social exchange transactions involve some kind of private information that gives the player the possibility of deriving extra rents from the transaction. In common-pool resources, it would be very costly for other users or authorities to know the individual levels of appropriation that decrease the availability of the resource for others.

In summary, we suggest that when the game involves externalities and there are problems of asymmetric information among players, they will search for additional information from one or more of the three layers and use these to create an internalized vision of the game. Some will be more likely to cooperate because of this information, while others will be more likely to defect. The internal game values will be affected by their perception of self (Identity layer), the information they gather about the other players (Group-Context layer), and the dynamic game conditions. The basic structure of the game in the static game layer alone will not provide the complete picture, but players may try to complement it with the other layers of information if they can.

3. EMPIRICAL EVIDENCE FROM FIELD LABS

The second and third layers—Group-Context and Identity—are especially related to the kind of variables that are difficult to control in the regular experimental lab, as Ledyard (1995) pointed out. Experimenters usually try to downplay the importance of culture, beliefs, group identity, social context, and personal identity in the way they design experiments. The importance of these factors in forming the context of the basic game gives support for the methodological tactic we present, i.e., to bring the experimental lab to the field and enrich the analysis that Ledyard has identified as important but difficult.

An adaptation of the initial design for common-pool resource games established in Ostrom *et al.* (1994) was brought to three Colombian villages. All three rural communities had joint access to a resource and the respective groups all faced a common-pool resource dilemma. In one case, the shared ecosystem was a mangrove forest where they extracted mollusks, firewood, and fisheries. In another case, villagers extracted fibers from nearby forests for handcrafting activities and firewood, which affected the state of the forest and the conservation of water supply in the watershed. In the third case, the villagers obtained wild meat from hunting and firewood from the local forests. In all three cases, the forests were either state or private reserves, but exclusion was difficult due to weak state enforcement mechanisms and political conflict. In another study (Cárdenas 2001), using part of the data reported here, it is shown how the actual experience (measured through labor allocated to the actual extraction of these resources) explains variation in cooperation in the experiments. Below we will explore how this and other factors associated with the individual, group, and village context can play a role in explaining experimental behavior. Eventually, if the results are externally valid, this will increase our understanding of individual behavior in collective-action situations.

Let us now focus on the experimental design. Fifteen sessions (groups), with eight people each, were conducted within the same basic design where players had to choose an individual level of effort represented by the “number of months” of extracting resources from a forest.

The baseline design of the field experiment is as follows: Participants were told that they would participate in a group of eight people in the same room, in a game where they had to choose privately the number of times (e.g., months per year) they would go to a forest to extract a resource (e.g., firewood). Their earnings from such decision would depend not only on their individual extraction but also on the extraction levels that the other members of their group made in that round.

Participants could know the earnings in a round by looking at a payoff table where the columns represented the player's choice of "months in the forest," from 0 to 8 units; the rows of the table represented the sum of "months in the forest" by the other seven players of the group. The cells in the table had the monetary payoffs for such combination of one's choice and the sum of choices of the others in that group. The payoff function was constructed in such a manner that we created a typical common-pool resource dilemma where individual extractions increased personal gains, but aggregate extractions decreased everyone's gains. In each round, each player would learn from the experimenter the total extraction level by all eight players. From such number, each could calculate their earnings by using the payoffs table. Detailed instructions (translation) and the payoffs table are appended to this paper.

The data used here consists of a set of common-pool resource experiments conducted in the summer of 1998, where roughly 180 *campesinos* participated in a series of repeated-rounds sessions under different treatments. We asked each participant to fill out a survey at the end of each session—information that we were able to link to their decisions in the field lab for the analysis of individual and group contexts.

The framing of the decision making was that each participant had to decide how to allocate from 0 to 8 months for the purpose of extracting resources from a forest. The incentive structure in these common-pool resource dilemmas was that each participant's earnings increased with their own time in the forest, but decreased with the group's total time in the forest. The key payoff benchmarks were the social optimum, where every player harvests from the forest for only one month, yielding Col$645 (US$0.50) in each round; and the Nash equilibrium, where everyone would harvest for six months yielding a suboptimal result of Col$155 (US$0.12) per round, i.e., around 24% of the maximum social efficiency possible. For 18 rounds, each participant would earn around Col$2,790 (about US$2.15) if they followed the symmetric Nash equilibrium strategy. If all participants played the social optimum strategy, however, each could earn Col$11,610 (about US$8.9). The daily minimum wage was around US$5.40 at the time for all three villages.[3] Depending on the treatment, our participants each earned somewhere between US$5 to $7 for their participation, which was paid at the end of each session, in person and confidentially. They also received a show-up fee represented in certain items for their household with an average value of around US$2. Under these incentives, we expected participants to be compensated for their opportunity cost of coming to the sessions, which took about half a day total for each participant.

All fifteen groups of eight people in the sample participated in a no-communication treatment for nine rounds, at which point they were told that a new set of rules was to be introduced in the game. Five of these groups, which we will label REG, were told after the first stage ended that an *external regulation* would attempt to improve the group's earnings, while the other ten groups, which we will label COM, were allowed to have a *face-to-face group discussion* before each round to comment openly about the game developments. Each group,

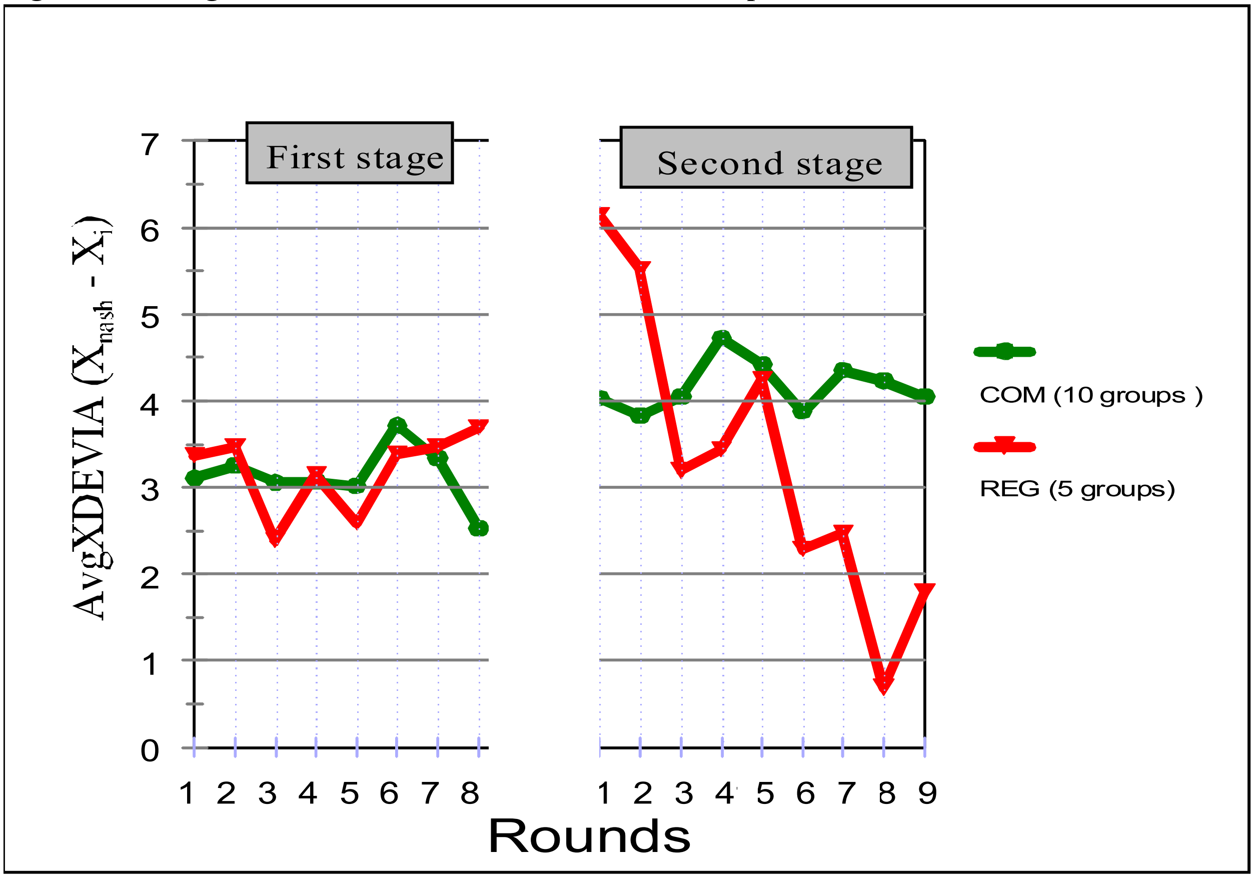
[3] The exchange rate at the time, 1998, was of Col.$1,300 per US$.

therefore, went through a no-communication stage to a single new treatment institution, but no group had to face both communication and regulation.

In the case of the external regulation design, the participants were informed before beginning the new rounds under this rule, that playing one month in the forest would yield payoffs at the social optimum and that to achieve such an outcome, an inspector (the monitor) would randomly audit one of the players with a probability of 1/16 in each round. If the player had chosen two or more months in the forest, he or she would have a penalty of Col$100 (U.S.$0.08) imposed for each month in excess. These points would be subtracted from the final earnings. However, those under the communication treatment were never told of a solution to the dilemma, i.e., that each player had to choose one month as their group maximizing strategy. Nevertheless, and as we will show later on, at the end of the second stage, the groups under communication were in fact achieving group results closer to the social optimum solution than those groups under the external regulation which in fact was devised, indicated, and monitored from outside of the group.

For purposes of the analysis of these experiments, we calculated the individual deviation from the predicted Nash strategy (in months in the forest) and used this measure as a proxy for cooperation. Figure 2 illustrates changes in this dependent variable over the set of rounds in both experimental designs.

Figure 2--Average deviations from individual Nash best-responses



Source: Cárdenas et al. (2000: 1,729).

During the first stage, behavior in both the REG and COM designs is very similar. This similarity lends support to our interpretation that the substantial differences in the second stage result from the difference in incentives introduced by external regulation versus face-to-face communication.

The difference in outcomes during the second stage of the experiment cannot be explained by the monetary payoffs alone. In the case of external regulation, the expected cost of violating the rules was intended to induce an improvement of social efficiency and, therefore, individual monetary outcomes. An improvement did, in fact, happen in the early rounds after external regulation was introduced. By the third round of the second stage of the experiments with external regulation, however, the gains were rapidly eroded. Selfish behavior, along with an imperfect monitoring, created *more* overharvesting, even when compared to the rounds *prior* to the introduction of the rule. These results are discussed in more detail in Cárdenas *et al.* (2000).

In the case of the groups under face-to-face communication, we found the results consistent with the earlier evidence in a university experimental lab (Ostrom *et al.* 1994). Despite agreements being non-binding, face-to-face communication did create and sustain, on average, a more cooperative behavior among players, thus increasing social efficiency. However, a wide variation in decisions and outcomes existed when looking at the individual data within and across groups.

The survey that we conducted at the end of the sessions included information about basic demographic variables such as gender, age, education; economic activities, assets, and occupation; as well as personal opinions about the role of government and community governance structures. In order to test for the combined effects of some of the factors discussed in the layers of the model, we used a regression analysis model in which we attempted to explain the individual level of cooperation in each round as a function of vectors of variables from all the layers, thanks to the round-level data from the experiment, the individual-level data we gathered about the participants, and the construction of group-level data for each of the eight player groups. Thus, each observation in the regression corresponds to the decision by one player in a specific round of the game.

As the dependent variable of this multivariate analysis, we have again chosen to measure the degree of deviation away from the predicted Nash strategy for each player as our measure of cooperation. The closer to the Nash strategy of material payoffs maximization as a best response to the others, the lower the degree of cooperation. We will call this variable XDEVIA and have calculated it as the difference between the Nash best response and the actual choice in that round. A major reason to choose this proxy for cooperation is that the typical common-pool resource experiment does not have a dominant strategy in game-theoretical terms. In our case, the Nash strategy changes depending on the level of extraction by the other players. With our proxy, we can make comparable different levels of extraction regardless of the extraction of the others. Notice that the estimation of XDEVIA depends on the sum of months by the rest of the group, which each player did not know with certainty. We tested the estimations with two options yielding equivalent results: one with the sum of months in the same round, and one with the sum of months in the previous round. A quick observation of the distribution of XDEVIA over rounds, for all rounds before and after the new rule, shows that less than 6% of choices were in the negative range and less than 1% were values of -3 units or more. All positive values meant strategies that were, at least, in the best response level or lower than that.

The independent variables for the estimation were:

DELTAVG7: Change (average reduction) in "months in the forest" by the other seven players in the group. This was calculated as the ($\sum$ months by the other 7 players in $_{t-1}$) - $\sum$ months in t. This measures the average intentions to cooperate by the rest of the group from their actual behavior in the previous round. If reciprocity is a factor in the decision, this variable should have a positive sign in the estimation, and if players behave with the opportunistic logic, a negative one.

ROUND: Round number. Accounts for the learning or adaptation processes in each treatment. Based on experimental behavior. Opportunistic players should show a decrease in cooperation over time, trustworthy players should either increase or maintain cooperation.

FINELAG: Fine in the previous round. This variable is considered only in the last estimation (REG) where the external regulation is introduced, and belongs to the first layer of information as it transforms the material payoffs of the game with an expected cost of a penalty. The value of the variable is the size of the fine ($\$100 * (X_{i,t-1} - 1)$) for those actually monitored, and it takes the value zero for those that were not monitored, in the previous round. Recall that they learn if are monitored and fined only after they decided their level of extraction. Such fine can have an effect in the next round as players may perceive they are likely to be fined and suffer a private cost.

AVCOOPLB: Average number of days in non-paid labor contributed during last year by the group members: a proxy of "cooperative" behavior in community projects. It was based on the anonymous survey filled at the exit of the session. If participants bring elements from their context to the lab, and they show differences in contributions to collective-action projects, this variable should help explain variations in XDEVIA.

HHWEALT2: Player's household wealth based on land, livestock, and machinery holdings, valued at local prices and adjusted across villages. Based on the survey.

WLTHDS2A: Wealth distance = Absolute value of the difference between the player's wealth and the average of other seven player's wealth. Based on the survey.

WLT_DIS2: Cross-effect variable = HHWEALT2 * WLTHDS2A. Accounts for differences in the marginal effect of wealth distance for different social (wealth) classes.

BESTATE: A dummy = 1 if individual believes that a "State" organization should manage the local commons from where they extract resources, and 0 otherwise. Based on survey. The coefficient for this variable might show different signs and sizes depending on the institution of the experiment, for instance, an external regulation vs. a self-governance rule such as face-to-face communication.

PARTORGS: Number of community organizations the player belongs to or participates in. Includes parents' association, cooperatives, water committees, etc. Based on survey. One could predict that those belonging to community organizations might show higher willingness to cooperate with the others in their group.

Given that all the experimental decisions were made under the exact same payoff structure and experimental environment regarding formal rules about the choice variable ("months in the forest"), the variables we could consider in the first layer would be the estimated intercept, and for the dynamic setting the effect of time (rounds) and of reciprocity. The sample size is in each case the number of decisions made during a set of rounds in a stage—starting at round 2 to allow for the dynamic effects—by all eight players and for all the groups under each treatment. Some observations showed missing data on the survey responses, therefore the slight differences in sample sizes used in the regressions that follow.

Table 1 summarizes the results of applying the estimation model using a simple "fixed-effects" estimator with an ordinary least-squares procedure. The fixed-effects estimator is a stronger test to the simple OLS because of possible effects created within each group, or within observations for a single player, which would violate the assumption of independence of observations. Individual fixed effects could not be used because of the sample size. Dummies for each of the groups were included in each estimation, but their coefficients are not reported. As one can expect, some of these dummy coefficients were significant while others were not, depending on how much, in aggregate, these groups, or individuals deviated from the mean behavior in the sample. However, we focus here on their role in solving the problem of independence of observations in this kind of experimental panel data.

The summary table of the estimated models is organized first in two major columns for each of the two stages: Stage 1 included data for rounds 1 to 9, where all fifteen groups faced a baseline treatment with no coordination, communication, or regulation allowed. In Stage 2 (rounds 11 to 19), ten groups (COM) faced the possibility of a face-to-face group discussion, while five groups (REG) faced the externally imposed and imperfectly monitored regulation.

Table 1--Fixed-effects with OLS estimation to explain deviations from the Nash selfish strategy as a function of the layers of information in Figure 1. P-values for Ho: coeff=0 under coefficients.

Dependent Variable: Deviation from the Nash Strategy—A Measure of Cooperation Label	Variable	Stage 1: Rounds (2 to 9) No-COMREG	Stage 2: Rounds (12 to 19) COM	 REG
Material Payoffs Game:				
Intercept	INTERCEP	4.5314	7.1965	13.4518
		0.000	*0.000*	*0.000*
Avg reduction by other 7 players	DELTAVG7	0.3916	0.2472	0.3710
		0.000	*0.002*	*0.014*
Learning	ROUND	0.0015	-0.0549	-0.4233
		0.965	*0.102*	*0.000*
Fine in previous round	FINELAG	---	---	-0.0001
				0.935
Group-Context Layer:				
Avg. labor contributions by group	AVCOOPLB	0.0401	0.0838	-0.1497
		0.488	*0.200*	*0.054*
Wealth distance	WLTHDS2A	0.1154	-1.6521	-1.8326
		0.712	*0.000*	*0.001*
Wealth*Wealth Distance	WLT_DIS2	-0.051	0.5371	0.5630
		0.963	*0.000*	*0.005*
Identity Layer:				
Individual's Wealth	HHWEALT2	-.0784	-1.0181	-0.5625
		0.710	*0.000*	*0.117*
1 if "State should solve problem"	BESTATE	0.0612	-1.1979	0.5301
		0.762	*0.000*	*0.087*
No. organizations participates in	PARTORGS	-0.1391	-0.1646	-0.7158
		0.133	*0.110*	*0.000*
Fixed Effects (No. dummies)		15 groups	10 groups	5 groups
Sample size	N	856	677	340
R2 adjusted	ADJR2	10.64%	18.67%	49.45%
F-Test		6.09	10.70	28.47

(P-Value)	*(0.000)*	*(0.000)*	*(0.000)*

The estimation results yield some light on how information from the three layers helps to explain the variation across groups and across players that otherwise could not be explained by the material incentives of the game within treatments. Recall that each group of eight people consisted of members of the same village. Therefore, a prior history existed of experience, reputation, beliefs, and other factors that determine their willingness to cooperate with the other seven people in their group. The significance and signs of many of these variables show how these affect behavior in the experiment.

Let us turn to some of the most relevant statistical results from these estimations.

With respect to the first level—where we account for the static and dynamic effects of the material payoffs game—we observe that reciprocity, expressed in the positive and significant sign of DELTAVG7, is confirmed for both treatments, COM and REG, and during both stages 1 and 2. A reduction (increase) in extraction by other players is followed by a reduction (increase) in one's own extraction. The effect is slightly stronger (negative reciprocity) in the regulation treatment, as a result of players being more responsive to average increases by the rest in the group. Negative reciprocity, caused by the external regulation, is what seems to crowd-out the intrinsic motivation not to choose their best Nash response that seemed to exist prior to the introduction of the external rule. The slightly larger coefficient for DELTAVG7 in the second stage for REG shows that in this case each player was, on average, increasing their deviation from the Nash best response (in "months in the forest") by 0.3710 units for each unit change in the average of the rest of the group. This erosion of cooperation in the REG treatment is also shown by the negative and significant sign of the ROUND variable, compared to the COM groups with weak and insignificant results, suggesting that the face-to-face communication institution sustained cooperation over time, other things held constant. These results strongly reject the free-riding hypothesis that predicts that as the other players reduce their “months in the forest,” the ith player should increase their “months” and personal earnings.

Laury and Holt (forthcoming), focusing on the decay or sustained rate of cooperation in linear public goods, test a non-linear public goods setting, which in fact is much closer to our experimental design of a common-pool resource, and observe as we find here, that the rate of cooperation in the base line treatment (first ten rounds) was constant and therefore the coefficients of ROUND during this first stage or during the communication stage were close to zero, if compared with the regulation treatment.

Other literature could also explain the rates of cooperation based on variables other than reciprocity, e.g., risk sharing and altruism (Fafchamps and Lund, 2003). It is certainly a major factor that gift-giving among members plays a fundamental role in the maintaining of social networks and the provision of public goods they provide. Our model here, however, does not technically reflect cooperative actions as gifts since this is not a zero-sum game. Choosing to reduce the number of months can, in fact, produce higher private payoffs if others in the group act similarly. The fact that DELTAVG7 shows a significant and positive sign confirms that players were responding reciprocally to the average play of the others in the group regardless of the treatment, and not necessarily that they were being altruistic in their decisions.

The result of the coefficient FINELAG deserves some attention, as it is statistically insignificant and close to zero. The statistical interpretation is simple. Players who were fined in the previous round were not responsive to such an incentive in the following period when compared to those not monitored. Notice that the probability in t-1 and t of being monitored is the same. A close look at the data for those actually monitored shows no special pattern of increase or decrease in their extraction in the next round. Some in fact increased their extraction, maybe expecting a much smaller chance of being monitored, while others reduced their extraction. Recall, however, that these same samples of REG players were on average responsive to the mean extraction of their group members in the previous round. This illustrates the weak effect of external regulation, but the stronger effect of reciprocity.

The estimated coefficients for the next layers of information provide some support for the argument that people also bring some of the information they have about themselves and others into the game. Regarding the context of the game and the group, we tested two sets of variables. On the one hand, AVCOOPLB measures the average level of actual labor contributions by the group members to community projects. Notice that during the second stage, this variable showed a negative and significant coefficient in the case of the REG groups. This suggests that groups that, on average, had a prior history of contributing more labor to community projects decreased their deviation from the Nash prediction; however, such effect was not significant for the case of the communication groups (COM), and overall positive and significant during the first stage.

Those players with higher levels of actual wealth (HHWEALT2) and wider wealth distance to the other players in the group (WLTHDS2A) seemed less willing to cooperate. This is consistent with the findings of Sally (2001), who suggests that sympathy—a key factor in cooperation—is a direct inverse function of physical and psychological distance between a person and others. The explanations emerge from a combination of "experience" in similar situations and the context of the group in which each player participates, particularly in terms of social distance. On the other hand, wealth itself can determine cooperative behavior in an individual. And, they do so with people of similar levels of wealth or social status. Thus, more homogeneous groups, and groups made of players who depend more on similar collective-action situations because of material poverty, show significantly higher levels of average cooperation.

Notice that BESTATE has opposite signs for the COM and REG data-sets, suggesting that under the external regulation, “state believers” will proportionally comply *more* with the rule, but cooperate *less* under the non-binding, face-to-face communication environment. Those who responded in the survey that a non-state solution was preferred for this type of problem showed higher levels of cooperation in the COM treatment, but lower in the REG treatment. In the meantime, notice that for PARTORGS the signs are negative in both cases, which would be counterintuitive. However, they are much larger and significant for the REG environment, which would be consistent with the effect of BESTATE and AVCOOPLB. “Natural cooperators” in the field under an experimental “external regulation” environment were less prone to comply with the externally imposed rule. We tested other demographic variables for the individuals, but they showed no results that were significantly better estimators than these, including—as one reviewer suggested—the individual value for labor contributed to projects (i.e., individual value of AVCOOBLB).

It is worth adding some comments on the fact that during the first rounds of the game, except for the reciprocity DELTAVG7 variable, no other variable shows any relevance in explaining variation in behavior, although the overall model does seem significant (see F-test at the bottom of the table). Our interpretation is that given the institution of no communication allowed among players (in fact, they were sitting facing outwards in a circle) and the learning necessary in the early rounds to understand the structure of the incentives, these factors could not play a role in helping guide the players in their decision making.

4. CONCLUSIONS

We have tested the proposed framework of the layers of information (material incentives, group context, and individual characteristics) that people may use when facing these games through a common-pool resource experiment in the field, and have used information not only about the experiment incentives but also about the actual context and persona information of the players. A possible transformation of material payoffs into an internal subjective game through the use of information about themselves, their group members, and the incentives of the repeated game may induce cooperative behavior as a rational strategy in games with material payoff structures of a social dilemma.

The framework that we have presented provides some initial guidance in organizing the multiple types of variables that appear to affect individual decision making when facing these dilemmas of cooperation. Depending on the context that individuals face, they may dig ever deeper into a set of layers of information that are relevant to their decisions, e.g., whether the game is ongoing, if group communication is possible, and whether the others and their attributes are known to the players.

The field experiments we report on here allowed the subjects to use information from their own context and for researchers to examine the impact of this information on decisions. We found positive support for the arguments derived from our framework. It does appear that individuals use diverse layers of information depending on the structure of a game and the context within which they are playing that game.

The use of experimental methods was enriched by having taken the lab into the field and invite actual users of natural resources to participate. This methodological approach, combined with survey data about the demographic and socioeconomic conditions of each particular participant and their group, has allowed us to enrich the experimental information and therefore help explain the variation in cooperation levels across the same experimental design.

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APPENDIX: EXPERIMENTAL INSTRUCTIONS

Instructions for Common-Pool Resource experiment reported in Cardenas and Ostrom "WHAT DO PEOPLE BRING INTO THE GAME?"

Experiment instructions (English translation).

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 this 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 hanged in a wall near to the participants' desks and where the 8 people could see them easily.

COMMUNITY RESOURCES GAME (Instructions)

Greetings...

We want to thank every one 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 should 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 in two days to discuss the exercise and other matters about natural resources. During the day of the workshop we will give you the earnings you make during the game. Besides a basic “show-up” prize for signing up and participate (examples: flash lamps, machetes, school kits, home tools), you will receive a cash bonus that will be converted into cash for purchases for your family. The funds to cover these expenditures have been donated by various organizations that support this study among which we have the Instituto Humboldt, el Fondo Mundial para la Protección de la Naturaleza, y la Fundación Natura.

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 8 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 number of MONTHS that you want to allocate EXTRACTING THE FOREST (in the columns from 0 to 8).

To play in each round you must write your decision number between 0 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 8 cards from all participants, and will add the total of months that the group decided to use extracting the forest. 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 has available a maximum of 8 MONTHS to work each year extracting 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 0 to 8. Each of you must decide from 0 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 in each round the total for the group. For instance, if you decide to use 2 months in the forest and the rest of the group together, add to 20 months in the forest, 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 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 8 yellow cards and will add the total of the group. Suppose that the total added 26 months. 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 MONTHS IN THE FOREST and then we obtain THEIR MONTHS IN THE FOREST which we write in column C. In our example, 26 - 5 = 21. If we look at the PAYOFFS TABLE, when MY MONTHS are 5 and THEIR MONTHS 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 decide 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 repeating that your game decisions and earnings information is private. Nobody in your group o 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 MONTHS 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 in each round your yellow game cards. Finally, to get ready to play the game, please let us know if you have difficulties reading or writing numbers and one of the monitors will seat next to you and assist you with these. Also, please keep in mind that from now on no conversation or statements should be made by you during the game unless you are allowed to. We will have first a few rounds of practice that will NOT count for the real earnings, just for your practicing of the game.

DECISIONS FORM

	Column A	Column B	Column C	Column D
Round No.	**MY MONTHS IN THE FOREST** (From your decision)	**TOTAL GROUP MONTHS IN THE FOREST** (Announced by the Monitor)	**THEIR MONTHS IN THE FOREST** [Column B minus Column A]	**MY TOTAL POINTS IN THIS ROUND** (Use your PAYOFFS TABLE)
Practica				
1				
2				
Total				

GAME CARD (Example)

GAME CARD	
PLAY NUMBER:	
ROUND NUMBER:	
MY TIME IN THE FOREST:	

COMMUNITY RESOURCES GAME
(Summary Instructions)

Objective of the game: To earn as much points as possible at the end of the rounds, which will be converted into cash prizes for your household.

How is it played: In each round, you must decide how many months in a year between 0 and 8, you want to devote to extract resources from a forest. The points you earn in each round depend on your decision and the decisions by the rest of the group, according to the PAYOFFS TABLE (blue table).

What do you need: To play you need a blue PAYOFFS TABLE, a green DECISIONS FORM, and several yellow GAME CARDS. Also you need a player number.

Steps to play in each round:

Using the blue PAYOFFS TABLE, decide how many MONTHS IN THE FOREST you will play.

In the DECISIONS FORM write your decision (MY MONTHS IN THE FOREST) in Column A for the round being played at that moment.

In a yellow GAME CARD write the round number, and your decision MY MONTHS IN THE FOREST. Make sure it corresponds to the DECISIONS FORM. Hand the yellow game card to the monitor

Wait for the Monitor to calculate the total from all the cards in the group. The Monitor will announce the TOTAL GROUP MONTHS.

In the green DECISIONS FORM write this total in Column B (TOTAL GROUP MONTHS IN THE FOREST).

In the green DECISIONS FORM calculate Column C (THEIR MONTHS IN THE FOREST) equals to Column B minus Column A.

In the green DECISIONS FORM write in Column D the total points you earned for this round. To know how many points you made, use the PAYOFFS TABLE and columns A and C (MY MONTHS and THEIR MONTHS). We will also calculate this quantity with the yellow cards to verify.

Let us play another round (Go back to step 1).

Rule A: THERE IS NO COMMUNICATION WITHIN THE GROUP
Besides the rules described in the instructions that we just explained, there is an additional rule for the participants in this group: You will not be able to communicate with any member of your group before, during or after you make your individual decision in each round. **Please do not make any comment to another participant or to the group in general**. After the last round we will add the points you earned in the game.

Rule B: COMMUNICATION WITH MEMBERS OF THE GROUP
Besides the rules described in the instructions that we just explained, there is an additional rule for the participants in this group: Please make a circle or sit around a table with the rest of your group. Before making your decision in each round, you will be able to have an open discussion of maximum 5 minutes with the members of your group. You will be able to discuss the game and its rules in any fashion, except you **cannot use any promise or threat or transfer points. Simply an open discussion.** The rest of the rules hold. We will let you know when the 5 minutes have ended. Then you will suspend the conversation and should make your individual decision for the next round. These decisions will still be private and individual as in the past rounds and cannot be known to the rest of the group or other people.

Rule C: EXTERNAL REGULATION

Besides the rules described in the instructions that we just explained, there is an additional rule for the participants in this group:

> This new rule is for making everyone obtain the maximum points possible for the group. Let us try to guarantee that each player in your group plays 1 MONTH IN THE FOREST. If a player were to play more than one month we will impose a penalty for each additional month he plays in the forest.
>
> However, it would be very difficult to inspect all members of a community. Thus, we will select one of you randomly in your group. Only those selected will have to show (to the monitor only) how manyt MONTHS IN THE FOREST they decided to play.
>
> For instance, suppose that the penalty is 500 points for each additional month. If a player is selected randomly, and he had played 3 MONTHS IN THE FOREST, the monitor will subtract 1,000 points from her total points earned in that round.
>
> The monitor will now announce how many points the penalty will be for each month above 1, and how the player to be inspected will be chosen.

Payoff table

	MY MONTHS IN THE FOREST								
	0	1	2	3	4	5	6	7	8	
0	619	670	719	767	813	856	896	933	967	0
1	619	669	717	764	809	851	890	926	959	1
2	617	667	714	760	804	845	883	918	950	2
3	615	664	711	756	798	838	875	909	940	3
4	613	660	706	750	792	831	867	900	929	4
5	609	656	701	744	784	822	857	889	917	5
6	605	651	695	737	776	813	847	877	905	6
7	600	645	688	729	767	803	836	865	891	7
8	595	638	680	720	757	792	824	852	877	8
9	588	631	672	711	747	780	811	838	862	9
10	581	623	663	700	735	768	797	823	846	10
11	573	614	653	689	723	755	783	808	830	11
12	565	605	642	678	711	741	768	792	813	12
13	556	594	631	665	697	726	752	775	795	13
14	546	583	619	652	683	711	736	758	776	14
15	536	572	606	638	668	695	719	739	757	15
16	525	560	593	624	653	678	701	721	737	16
17	513	547	579	609	636	661	683	701	717	17
18	501	534	565	594	620	643	664	681	696	18
19	488	520	550	578	603	625	645	661	674	19
20	475	506	535	561	585	606	625	640	653	20
21	461	491	519	544	567	587	605	619	630	21
22	447	476	502	527	548	567	584	597	608	22
23	433	460	485	509	529	547	563	575	585	23
24	418	444	468	490	510	527	541	553	561	24
25	402	428	451	472	490	506	520	530	538	25
26	387	411	433	453	470	485	498	507	514	26
27	371	394	415	434	450	464	476	484	490	27
28	355	377	396	414	430	443	453	461	466	28
29	338	359	378	395	409	421	431	438	442	29
30	322	341	359	375	389	400	409	415	418	30
31	305	324	341	355	368	378	386	392	394	31
32	288	306	322	336	347	357	364	368	371	32
33	272	288	303	316	327	335	341	345	347	33
34	255	270	284	296	306	314	319	323	324	34
35	238	253	266	277	286	293	297	300	300	35
36	221	235	247	257	265	272	276	278	278	36
37	205	218	229	238	245	251	254	256	255	37
38	189	200	211	219	226	231	233	234	233	38
39	173	184	193	201	206	211	213	213	212	39
40	157	167	175	182	188	191	193	193	191	40
41	142	151	159	165	169	172	174	173	171	41
42	127	135	142	148	152	154	155	154	152	42
43	113	120	126	131	134	136	137	136	133	43
44	99	106	111	115	118	119	119	118	115	44
45	86	92	96	100	102	103	103	101	99	45
46	73	78	82	86	87	88	88	86	83	46
47	61	66	69	72	73	74	73	71	68	47
48	51	54	57	59	60	61	60	58	55	48
49	40	44	46	48	49	48	47	45	43	49
50	31	34	36	37	38	37	36	34	32	50
51	23	25	27	28	28	28	27	25	23	51
52	16	18	19	20	20	19	18	17	15	52
53	10	12	12	13	13	12	11	10	8	53
54	6	7	7	7	7	7	6	5	4	54
55	2	3	3	3	3	3	2	2	1	55
56	0	1	1	1	1	1	0	0	0	56

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