

Social Capital: The Role of Group Size and Heterogeneity

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ABSTRACT

Group size and heterogeneity are important issues in the literature on cooperation. This study seeks to understand how group size and heterogeneity impinge on trust and cooperation using a repeated trust game. We find several interesting results. First, as expected in any finitely repeated game, subjects as individuals and in a group become less trusting and less reciprocal as the rounds progress. Second, the nature of cooperation also matters in understanding the factors influencing cooperation in a group. Third, income and caste heterogeneity affect cooperation and trust. We see a U-shaped relation between trust and group size that indicates the existence of threshold size of the groups for building social capital. Regarding the validity of these experimental results with the primary survey, the study finds that in villages where heterogeneity is negligible, people share a set of similar socio-cultural attributes that promotes cooperation as a cost-effective collective outcome. Thus, our experimental results are significantly valid in the context of community-based natural resource management. Further social capital like trust acts as a link between the group size, heterogeneity and cooperation. Therefore, policymakers should give due importance of the underlying issues related to group size and heterogeneity (that influence trust and cooperation.)

1. Introduction

A growing literature tries to speak about economic development and good governance to social capital. While the exact definition of social capital is subject to debate, most analysts treat it as a attribute of communities, and describe it in terms of trust, norms and networks that enable collective action (Woolcock and Narayan 2000; Bowles and Gintis 2002). Trust also plays a pertinent role in commons management (Ostrom 1990; Pretty and Ward 2001). Due to mutual trust and cooperation among the commons dependent households in some Indian villages, costs of cooperation for conservation (or transaction costs) have been low (Sarkar and Ray 2019). Trust cuts down transaction cost on the need to monitor others, giving members the confidence to engage in collective action, knowing that they will also care for the community resource. Trust leads individuals to cooperate for the welfare of the resource and the community as opposed to pursuing their own interests with the consequence of damaged forests (Pretty and Ward 2001). As Pretty and Ward (2001) observe, despite having high levels of social capital, some societies have values, norms, attitudes and beliefs that promote selfishness, inequality, mistrust and oppression. When development analysts speak of promoting social capital, they actually refer to the kind of social capital that enhances capacities to solve public problems and empower communities.

In this backdrop, a couple of questions arise. What are the factors that may help or hinder in building this type of social capital in community-based resource management? Do these factors necessarily lead to pro-social behaviours of the resource-dependent households? While commons management is a collective activity, how can one capture individual social preferences such as trust, reciprocity and cooperation? These are important as individuals lie at the back of the community-level cooperation. The existing empirical research in commons management is mostly based on field surveys at household level only. But, surveys may result in response bias, especially on issues related to local people's

perceptions about the costs and benefits of conservations and interpersonal relationships. Economic experiments may be a viable option to capture conservation-related behaviours both at the individual and household levels respectively.

Experimental evidence, suggests that numerous socioeconomic and cultural factors affect trust and cooperation at the individual level. While some studies find women trust others more (Bellemare and Kroger 2007), other studies show the opposite (Buchan et al. 2004). A few more studies do not find any significant relationship between gender and trust (Bouma et al. 2008). These ambiguities are result of context-dependent human behaviours. Further, these determinants are related to individual trust, whereas greater collective action and successful provision of public goods also require an understanding of the factors influencing group behaviours (group trust and reciprocity). To our knowledge, there is hardly any evidence which demonstrates that the determinants of individual and those of group-based trust are similar. In fact, they often vary (Kuglar et al. 2007). One plausible reason is that when we consider group behaviours, certain group characteristics come into effect. Two such factors are group size (number of members of a group) and heterogeneity. We argue that group size and heterogeneity matters in fostering social capital, both at household and community levels. This paper endeavors to find plausible answers to these queries on the commons from an experimental economics perspective because this approach captures human behaviors better than surveys (List 2006).

The rest of the paper is planned as follows. The perspective of this study objectives and hypotheses are discussed in section 2. Section 3 presents methods and measurement of study variables. Results and discussions are presented in section 4. Finally, section 5 deals with conclusions and recommendations.

2. Objectives and hypotheses: Insights from the cooperation literature

2.1. Evolution of cooperation

Cooperation plays a central role in social sciences (Axelrod 1984), especially for economics (Ockenfels 1993; Fehr et al. 1997). Commons dilemmas (also called resource dilemma) are a sub set of social dilemmas that have conventionally been defined as situation in which collective noncooperation leads to a serious threat to reduction of resource (Hardin 1968). The mechanisms of cooperation are a potent part of the design of organizations, solving public good problems and designing incentive systems. Zaggi (2014) identifies eleven different mechanisms through which cooperation evolves. The investment category subsumes the mechanisms based on trust and reciprocity (i.e., direct, indirect and strong reciprocity), costly signalling, group selection and voluntary participation. They share the characteristic that individuals spend resources voluntarily for the benefit of other individuals in expectation of future rewards. These mechanisms of the investment category crucially depend on the behavior of others. Indirect reciprocity appears to be the most attractive investment mechanism for the design of institutions. As the investment there is not directed to a particular individual, it provides an attempt to the problem of information and knowledge exchange. In community-based natural resource management, the most relevant mechanism is the investment-based mechanism for evolving cooperation.

2.2 Contested role of group size and heterogeneity in cooperation

Group Size: Group size in general refers to the number of members of a group. There are many reasons to expect a negative correlation between group size and collective action. Opportunities for frequent communication increases as the size of the group decreases and, frequent interactions create opportunities to build reputations. The reputation building and the mutual monitoring associated with frequent interactions suggest that smaller groups foster higher levels of trust and cooperation. If high levels of trust create conditions for successful collective action, group size should be negatively correlated with collective action.

Group size affects the strategy of collective action even if trust is not a limiting factor. Individuals may contribute because they think their contribution will make a difference, even if the gains are dispersed among all group members. If individual contributions do not make a perceptible difference to the cooperative outcome, the individual incentive to contribute vanishes. This happens when group size increases because individual members of a large group tend to perceive that her individual contribution does not make a difference. As group size increases, the cost of detecting the free riders becomes high. Olson (1965) emphasized the influence of group size on the fixed costs of collective provision; transaction costs increase in group size, further raising the costs of initiating collective action. In short, Olson hypothesis posits the negative relationship between group size and collective action or cooperation.

The relationship between group size and collective action may not always be negative if we incorporate income effect into our analysis (Chamberlin 1974; Sandler 1992). Individual co-operators consider their effort for conservation as income because they could sell this resource as much time at the market and earn money. Thus, when they put extra effort, they demand more of the forest benefits. Thus, most collective goods are normal goods. The level of provision of normal collective goods increases with group size, despite decreases in the size of individual contributions (Poteete and Ostrom 2004). Many authors have confirmed this positive relationship between group size and collective action empirically (Pecorino 1999).

Homogeneity/Heterogeneity of Groups: Homogeneity may also have a bearing on collective action. Sharing important

social, cultural, or economic characteristics may increase the predictability of interactions (Fearon and Laitin 1996). Predictability may in turn provide a basis for trust and cooperation. Because it promotes trust or reflects common interests, homogeneity may facilitate collective action. Baland and Platteau (1996) focus on the major sources of heterogeneity resulting from racial, ethnic, or other kinds of cultural divisions, and the differences in the nature of economic interests among individuals. The effect of several forms of heterogeneity has been studied empirically concerning irrigation systems (Tang 1991; Bardhan and Dayton-Johnson 2002) and forest regimes (Kant 2000; Ray and Bhattacharya 2011). Almost all of these studies have found a conflict between those who are wealthier and those who are poorer in regard to the use of a forest. Thus, heterogeneity, at least economic inequality, may lead to conflicts between those who are wealthier and those who are poorer regarding their use of a forest.

Such conflict may deteriorate the effectiveness of self-organized groups, but the association between heterogeneity and collective action is nonlinear and contingent upon other factors. Bardhan and Dayton-Johnson (2002), find that among the south Indian irrigators, economic variation has a U-shaped relation to collective action: collective action is higher at lower and higher level of inequality while others find inverted U-shaped relationship between economic inequality and cooperation (Molinas 1998; Naidu 2009). To explain this non-linearity, Poteete and Ostrom (2004) argued that economic heterogeneity (inequality in wealth, caste) interacts with the relative costs and benefits associated with cooperation in resource management. However, the relationship between caste diversity and cooperation is ambiguous; some authors have noted a negative relationship (Adhikari and Lovett 2006), the effect of caste heterogeneity was found insignificant in other studies (Somanathan et al. 2002; Ray and Bhattacharya 2011). Group size and heterogeneity have very much competing effects of collective action and so the CPR literature does not provide any firm conclusion regarding this relationship.

Trust and heterogeneity: What is the relationship between heterogeneity, group size and social capital? Complimentary to the CPR findings, experimental studies show that the varying impacts of heterogeneity have important policy implications. Inequality may create a perception of injustice and thus affect trust (Brockner and Siegel 1996). Because individuals feel more comfortable interacting with similar peoples, homogeneity is expected to foster trust and reciprocity. Zak and Knack (2001) argue that with increasing inequality the transaction costs attached to interaction with individuals of different income levels can become excessively high. Another possibility is that group size may also influence trust and cooperation (Kuglar et al. 2007). However, we do not find any uniform relationship between social capital and group size and the CPR literature remains inconclusive about this. Based on this inconclusiveness of the relationship between group size, heterogeneity and cooperation, the main purpose of this study is to examine the role of group size and inequality on pro-social behaviors (economic experiment called group trust game as described in section 3 below). Towards this end, we anticipate the following hypotheses:

- (1) *Pro-social behaviors of groups (such as group trust and reciprocity) will be different from the behavior of individuals;*
- (2) *Heterogeneous groups will be less trusting and reciprocating;*
- (3) *Trust and reciprocity negatively correlated with the size of the group. That is, smaller groups will trust and reciprocate more than the larger groups;*

- (4) People will free ride more in a large group and/or in a heterogeneous group respectively.

3. Methods and measurement

3.1 The trust Game

To measure respondents' pro-social behaviours and understand what affects them, we have implemented the standard 'trust game' as in Berg et al. (1995). It is the generally popular way of measuring trust via economic experiment. In this game, senders are given a certain amount of money and they make a decision how much of it to send to receivers and how much to keep. Any positive amount sent is tripled (to make sending socially efficient) before it reaches receivers, who then decide how much of the tripled amount of money received is to be sent back. Amount sent and fractions returned are treated as measures of individual player's trust and reciprocity respectively.

We extended the above experiment as follows. We employed a total of 90 students from Calcutta University, Rabindra Bharati University and North Calcutta Polytechnic College on a first-cum-first serve basis. These participants were selected from a Master List of 140 students based on their availability on the day of the experiment. Some of them were from economics discipline. Participants' socio-demographic data were recorded much earlier than the actual date of experiments. Based on an ex-ante matching that best fits our study objectives, they were invited to participate in a single session at the Department of Economics, University of Calcutta.

During the experiment, participants were given 100 rupees a show-up fee. Participants played in groups of 2, 3 and 4 members. Therefore, it was a group-based trust game. We introduced two treatments: constant group membership (CG) and rotating group membership (RG). The game was repeated for 5 rounds. The same experimenter instructed the players to avoid the experimenter effect on players' behaviors. At the beginning of each round, in case of rotating group treatment, each player becomes a member of a new group via ex-ante matching while players in the constant groups remain in the same group through the 5 rounds. Due to ex-ante matching,

the experiment could generate variations in heterogeneity and group size. 2-member groups were matched with 2-members' groups; 3-member groups with the 3-member groups, and 4-member groups with 4-member groups. In each round, each sender group was given 20 INR (USD 1= INR 65 approximately) per member as an endowment while receiver groups were not given any endowments. In each round, players were given paper slips to write the amount to be sent or returned. The Payoffs were given two days after the completion of the experimental sessions. Senders' and receivers' groups were given information about their rival groups' income, caste, gender and educational institution respectively. Information flow was made in such a way that the matched pair knew the same level of information of the rival groups. For example, if a sender group was given the information on receiver group's incomes, then the receiver group was also provided with the of the sender groups. To induce cooperation, each sender group was given 10 minutes to decide on the proposed sending, while receiver groups were given the same amount of time for deciding on actual return. Next, to capture free-riding, we instructed senders to make their individual actual sending privately. The discrepancy between actual and proposed sending is considered in this study as a measure of free-riding. Actual amount of money sent is tripled before the money reaches the receiver group to make sending profitable. Then receivers are instructed to send back collectively any amount (even zero) to senders. The money returned to the assigned sender group is shared equally by the members of that sender group. This motivates free-riding because even if one contributes nothing, he/she may get some positive amount of money in return when other senders contribute to the total amount of money sent. The amount left with the receivers will be shared equally among the receivers. So, the receivers did not have any space for free-riding. The payoff of a sender is equal to his/her endowment- amount sent by him/her + his/her share in the amount returned to the senders. The receiver's payoff is the shared amount of money left to them after sending back.

3.2 Measurement of variables

Table 1. Measurement and expected sign on pro-social behaviors (trust, reciprocity and cooperation)

Dependent Variables	Measurement	
Cooperation	Time taken for decision-making. More time taken implies less cooperation or costly cooperation	Dependent variable
Independent variables	Measurement	Expected sign
Income inequality	$I = \text{index of income inequality} = 1 - \sum (P_i)^2$ Where P_i = share of i^{th} category in the playing group	-
Caste inequality	$I = \text{index of caste heterogeneity} = 1 - \sum (P_i)^2$ Where P_i = share of i^{th} category in the playing group	-
Free-riding of individual	$I_f = 1 - (\text{actual sending}) / \text{proposed sending}$	-
Education	Years of schooling	+
Age	In years	?
Gender	Female=1, male=0	+
Treatment	CG=0, RG=1	-
Income	<5000 per month =1, otherwise = 0	-
Rural participants	Rural=1, urban=0	+
Caste	General=1, reserved=0	?
Information about rival's characteristics	No use=1, use = 0	?
Decision-making	If the participant makes decision on behalf of the group = 1, otherwise = 0	?
Partidpation in collective decision-making	If the participants are neglected or his opinion not sought = 1, otherwise = 0	+
Group size	Number of members of a group	-

Once sending and returning are complete, a round ends. Table 1 presents the description and measurement of the game-related and other variables.

3.3 Field survey and other variables

We also collected primary data on 419 CPR dependent households to check the validity of our experiment. The study sites are situated in West Bengal, India (21°20' to 27°32' N and 85°50' to 89°52' E). For this purpose, we have already selected Alipurduar, Bardhaman and West Midnapure districts. The primary survey times were November 2016 to April 2017 and May 2018 to July 2019. The reason for the selection of these districts as our study areas is that these districts have a long history of community-based natural resource management. We have also cross-checked the collected data with the local authority, such as local self-government or *panchayat* members, foresters, key informants like the teachers of the local primary schools and the dwellers of neighbouring villages. This two-step verification ensures the reliability of the collected data.

Attitudes towards social capital: Collective action is important for sustainable management of commons. We have considered collective action at the village level for comparing the relative performances of the villages. Besides, we also have measured individual households' attitudes towards their village's collective action for the sustainable management of CPR. For this, we consider ten indicators (based on Rural Participatory Appraisal) as depicted in Appendix B. These indicators reflect investment of the locals in the form of time and resources in the different activities relating to sustainable development and management of commons. We have used the typical Likert scale (Likert 1932) to rate the degree to which the interviewees (farmers and local authorities) agree or disagree with an indicator. The five-point response options running from 'very low' to 'very high' with the award of score 1 to 5 were used to convert the qualitative ranking into quantitative data (data transcription method). All the items were

framed in a similar direction. We have taken the mode value of the ratings for each indicator to draw an idea of what the majority of the local villagers think as their opinion instead of considering the average values to evaluate the social capital (Mukherjee 2002; D'Silva and Pia 2003; Sarkar and Ray 2019)². At the individual level, we sum up the scores (Appendix B) of the respondents. Since five-point scales were used, the convention is that the score of 3 for each indicator shows a neutral attitude (Ray and Bhattacharya 2013).

3.4 Data analysis and modeling

Since individuals played for 5 rounds, our individual preference data have panel data characteristics. To determine the factors influencing trust, reciprocity, cooperation and free-riding at the individual level, we used panel data using a random effect GLS model. However, we have used a linear regression method while computing the effects of group size and heterogeneity on the group-level social preferences because we have a small sample size (a minimum of 35 observations to a maximum of 150 observations, where senders' and receivers' groups are the unit of analysis).

4. Results and Discussion

4.1 Characteristics of the participants

Overall, 60 percent of the subjects are males, half of them hail from the Department of Economics, Calcutta University and colleges. 70 percent of them belong to upper general caste, around 50 percent of the players are rural participants, while half of them study, Master's Degree and above, 49 percent of these participants' family incomes are less than 5000 INR per month and one-third of the players belong to households with above 30000 INR as their income per month. Thus, the participants appear to have heterogeneous household characteristics. The similar heterogeneity is also noticed among the senders and receivers.

Table 2. Summary of the experiment: Social preferences of the playing groups differentiated by treatment

Group type	Number of investors' groups played	Number of trustee groups played	Number of members in the groups	Total number of participants	Rounds played	Mean investment ratio	Mean return ratio	Average time taken for group decision-making (in minutes)
Constant group membership	7	7	2-4	44	5	.37 (.22)	.28 (.22)	1.56 (1.11)
Rotating group membership	8	8	2-4	46	5	.17 (.13)	.23 (.16)	1.33 (.70)
All participants	15	15	2-4	90	5	.26 (.20)	.25 (.19)	1.44 (.92)

Figure within parenthesis are the standard deviations.

Table 2 shows a summary of our experiment. In both constant and rotating group treatments, the amount of money sent decline towards the latter rounds. This is expected in any finitely repeated game. The reason may be that people tend to behave more selfishly as rounds progress and are more likely to contribute nothing in the very last round. Interestingly, return ratio decline at a faster rate than the investment ratio. As regards the individual players' trust, we notice the amount of

money sent is always less in the RG treatment than the CG treatment. It is expected since in the constant group membership treatment tit-for-tat strategy is an effective strategy while in the rotating groups, the same strategy becomes an empty threat because the players' group membership is changing in each round. They know that this makes them less accountable to the receivers. Similar trends are observed in case of reciprocity.

Table 3. Trends of investment and return ratios of individual players

Rounds	Mean investment ratio of the playing groups (RG)	Mean return ratio of the playing groups (RG)	Mean investment ratio of the playing groups (CG)	Mean return ratio of the playing groups (CG)
1	0.2068	0.3865	0.4851	0.3083
2	0.2026	0.2709	0.437	0.3984
3	0.2031	0.2184	0.3625	0.4585

4	0.0744	0.1318	0.2673	0.1625
5	0.1318	0.1089	0.3012	0.0787

Round wise data on trust and reciprocity are presented in table 3. Clearly, average investment ratio and return ratio fall in between the trust and return ratio of the two treatments. A possible explanation is put forward by the social identity theorists (Sell 1997). The theory posits that people tend to become more liable when they have a stable identity (by

identity this theory refers to group membership). As identity of an individual changes, she hardly finds any in-group members due to changing group membership. Therefore, she may trust and reciprocate others less. These trends are summarized in table 3.

4.2 Determinants of individual behaviours

Table 4. Determinants of trust, reciprocity, cooperation and free riding of individual participants

Variables	Trust	reciprocity	Cooperation (time taken for making decision on proposed sending and/or actual return)	Free riding
Treatment (rotating group=1)	-.20** (.09)	-.06***(.02)	-.16*(.09)	-.01(.11)
Rounds	-.04***(.01)	-.07***(.004)	-.20***(.02)	.007(.06)
Group size	-.48**(.23)	.15*(.08)	.27(.94)	.45(.72)
Group size ²	.08**(.04)	-.02*(.01)	-.05(.15)	-.06(.11)
Amount received		.002*(.001)		
The participant did not use information	.02(.05)	.008(.04)	.26***(.08)	.07(.19)
The participation did not participate in decision-making	.18***(.04)	-.02(.08)	-.18(.22)	-.06(.07)
The participant is a decision-maker	.017(.014)	-.0002(.084)	-.02(.20)	.07(.09)
Free-riding index	-.14***(.05)			
The participant is a rural individual	.22***(.02)	-.09**(.04)	-.89***(.29)	-.26***(.05)
The participant is a female	.09***(.03)	-.05***(.005)	-.10(.07)	-.34***(.008)
The participant's family earning is below 5000 per month	-.18***(.06)	.12***(.03)	.43**(.21)	.09(.11)
General caste participant	-.16**(.07)	.005(.02)	.04(.24)	.45***(.16)
Age	-.001(.008)	-.014***(.003)	-.02(.04)	.06(.07)
Education (School years)	.005(.013)	.012***(.005)	-.05(.07)	.02(.02)
Constant	1.19***(.28)	.36***(.15)	3.1**(.145)	-2.27***(.41)
Prob	0.0000	.0000	.0000	.0000
Obs	225	218	450	225

Note: the figures in the parentheses are Robust Standard errors clustered at the three educational institutions.***, ** and * refer to 1, 5 and 10% level of significance respectively.

The regression results are reported in table 4. Game-related variables, rounds and treatment have their expected sign. Subjects trust and reciprocity is less in the latter the rounds and rotating groups. It may be noted that as rounds progress players take less time for cooperation. Most of the variables have their expected signs. For example, rural participants are more trusting and less free riding. Cardenas and Carpenter (2008) confirm these results. Perhaps, rural participants are less strategic than the urban participants are.

Females trust more, but reciprocates less compared to male subjects. These are found elsewhere also (Bellemare and Kroger 2007). In most cases, either male is more trusting than females while females are more trustworthy than males (Croson and Gneezy 2009). As usual, people with less income invest less because they are more risk averse. This is consistent with Bouma et al (2008). However, they are more trustworthy. Other factors are not statistically significant.

Table 5. Factors influencing types of cooperation

Variables	Type 1 cooperation (time taken by senders for making group decision on proposed BUT NOT sending)	Type 2 cooperation (time taken by receivers for making group decision on return)
Treatment (rotating group=1)	-.61***(.19)	.05(.13)
Rounds	-.17***(.05)	-.23***(.03)
Group size	.30(1.07)	.005(.60)
Group size ²	-.06(.17)	.0005(.1)

The participant did not use information	.56***(.19)	.08(.13)
The participation did not participate in decision-making	.40(.80)	-.65(.45)
The participant is a decision-maker	.17(.43)	-.14(.15)
The participant is a rural individual	-1.02*(.55)	-.96**(.48)
The participant is a female	.26(.32)	-.06(.24)
The participant's family earning is below 5000 per month	.25(.44)	.67*(.39)
General caste participant	-.13(.31)	-.07(.16)
Age	.03(.06)	-.04(.06)
Education (School years)	-.09(.09)	-.05(.06)
Constant	2.74(1.9)	4.03***(1.33)
Prob	0.0000	.0000
Obs	225	225

Note: the figures in the parentheses are Standard errors
 ***, ** and * refer to 1, 5 and 10% level of significance respectively.

Table 5 displays the determinants of cooperation. In this study, we have considered two types of cooperation, *senders' cooperation* and *receivers' cooperation*. While the former can be called cheap cooperation in the sense that subjects know that whatever the proposed amount to be sent is, in time of actual sending they may free ride. On the other hand, receivers' cooperation is based on actual return and therefore can be called *binding* cooperation (that is, no one can avoid

this). Most importantly, we notice that determinants of these types of cooperation vary (Cardenas and Carpenter 2008). Thus, one implication is that nature of cooperation also matters in understanding the factors influencing cooperation in a group. Many experimental studies have found that if cooperation is anonymous, people are less likely to build cooperation than when it is done publicly. This is evident in charity giving (Kumru and Vesterlund 2010).

4.3 From individual behaviour to group behaviour

Table 6. Factors affecting group trust

Variables	All sample (OLS)	Constant Group (OLS)	Rotating group (OLS)
Treatment (rotating group=1)	-.17***(.036)		
Rounds	-.037***(.012)	-.054***(.018)	-.013(.014)
Group size	-.32 (.23)	-.22(.38)	.25(.26)
Group size ²	.05(.04)	.04(.063)	.042(.043)
Income heterogeneity	.37(.28)	.92	-1.13* (.59)
Income heterogeneity ²	-.36(.40)	-1.32(.782)	1.25* (.647)
Caste heterogeneity	.56(.48)	-.45**(.20)	.076(.047)
Caste heterogeneity ²	1.20 (.99)	Omitted due to collinearity	-.93(.93)
Heterogeneity in Identity	-.64**(.31)	-.79***(.176)	.35(.55)
Heterogeneity in identity ²	.40(.52)	Omitted due to collinearity	-.34(.66)
constant	.99***(.31)	1.08*(.5)	.67*(.375)
Model statistic	F= 9.51 Prob=0.0000 R ² =.60 Adjusted R ² =.53	F=6.82 Prob=0.0001 R ² =.64 Adjusted R ² =.54	F=2.70 Prob=0.07 R ² =.38 Adjusted R ² =.19
Obs	75	35	40

Note: the figures in the parentheses are Standard errors
 ***, ** and * refer to 1, 5 and 10% level of significance respectively.

Thus far, we observe how individual players behave and what affects their behaviours. In this section, we examine whether groups also behave in similar ways. Table 6 describes that group trust declines over the rounds. Interestingly, factors affecting group trust are sensitive to treatment. For example, although income heterogeneity adversely affects trust in the rotating treatment, this effect vanishes in the constant group

treatment. Caste diversity matters in the constant treatment unlike the latter treatment. Most of the factors are, however, insignificant. Similar results are found in table 7 in case of reciprocity. Overall, the most robust factor is the variable *rounds*. Other factors are sensitive to type of pro-social behaviours.

Table 7. Determinants of group reciprocity

Variables	All sample (OLS)	Constant Group (OLS)	Rotating group (OLS)
Treatment (rotating group=1)			
Amount received	-.0005(.0024)	-.0046(.0041)	.0049(.0034)
Rounds	-.072***(.015)	-.085(.025)***	-.068***(.018)
Group size	.22(.26)	2.39*(1.20)	.31(.299)
Group size ²	-.037(.044)	-.37*(.186)	-.052(.049)
Income heterogeneity	.26(.30)	1.45 [†] (.794)	.006(.41)
Income heterogeneity ²	-.33(.50)	-.0147(1.49)	.093(.76)
Caste heterogeneity	-.45(.41)	1.74(1.13)	-.067(.90)
Caste heterogeneity ²	1.06(.78)	omitted due to collinearity	.36(1.90)
Heterogeneity in Identity	.34(.39)	1.71(1.11)	.39(.36)
Heterogeneity in identity ²	-.38(.60)	omitted due to collinearity	-.55(.52)
constant	.092(.40)	-3.42*(1.897)	-.14(.44)
Model statistic	F=3.36 Prob=0.0011 R ² =.41 Adjusted R ² =.23	F=2.27 Prob=0.0548 R ² =.41 Adjusted R ² =.23	F=2.77 Prob=0.0172 R ² =.51 Adjusted R ² =.32
Obs.	73	35	38

Note: the figures in the parentheses are Standard errors

***, ** and * refer to 1, 5 and 10% level of significance respectively.

4.4 Cooperation, group size, heterogeneity, trust and reciprocity

Table 8. Determinants of group cooperation

Variables	All sample (OLS)	Constant Group (OLS)	Rotating group (OLS)
Treatment (rotating group=1)	-.31*(.15)		
Rounds	-.193***(.051)	-.196**(0.084)	-.15(.05)
Group size	1.30(.93)	4.7**(1.87)	-.24(.99)
Group size ²	-.22(.15)	-.78**(.31)	.06(.16)
Income heterogeneity	1.55(1.08)	6.14**(2.86)	-1.13(1.77)
Income heterogeneity ²	-2.19(1.64)	-8.19*(4.20)	1.75(1.76)
Caste heterogeneity	-2.56*(1.46)	-2.20(2.36)	-.95(2.1)
Caste heterogeneity ²	4.32(2.89)	4.17(4.25)	-.099(4.32)
Heterogeneity in Identity	1.28(1.19)	3.86(2.88)	.71(1.25)
Heterogeneity in identity ²	-1.027(1.957)	-5.15(5.20)	-.05(1.83)
constant	.14(1.32)	-5.45**(2.72)	1.99(1.40)
Model statistic	F=3.08 Prob=0.00114 R ² =.18 Adjusted R ² =.12	F=2.93 Prob=0.0061 R ² =.31 Adjusted R ² =.20	F=2.54 Prob=0.014 R ² =.25 Adjusted R ² =.15
obs	150	70	80

Note: the figures in the parentheses are Standard errors

***, ** and * refer to 1, 5 and 10% level of significance respectively.

For example, caste heterogeneity is negatively associated with time taken in cooperation (table 8). However, caste diversity does matter in trust and reciprocity (table 6 and 7 respectively). In sum, the determinants of individual behaviours may not be the same as those of group behaviours. However, when we take into account the receivers' cooperation, we find that income heterogeneity has an inverted U-shaped

relationship with that type of cooperation. As income inequality increases, the time taken for cooperation increase and so, groups become less cooperative; after a certain point groups becomes more cooperative (table 9). That is, we observe a U-shaped relationship between income inequality and cooperation³.

Table 9. Determinants of group cooperation differentiated by nature of cooperation

Variables	Type 1 cooperation /Cheap Cooperation (cooperation among senders)	Type 2 cooperation/ Real cooperation (cooperation among receivers)
Treatment (rotating group=1)	-.61**(.28)	.006(.170)
Rounds		-.20***(.05)
Group size	1.42(1.71)	.91 (.89)
Group size ²	-.23(.28)	-.149(.149)
Income heterogeneity	1.59(2.16)	1.91*(.995)
Income heterogeneity ²	-1.02(3.02)	-3.09*(1.69)
Caste heterogeneity	-.48(3.62)	-3.52***(.1.3)
Caste heterogeneity ²	-1.71(7.52)	7.17***(.2.44)
Heterogeneity in Identity	-.38(2.33)	1.14(1.31)
Heterogeneity in identity ²	1.27(3.97)	-1.56(2.06)
Constant	.84(2.37)	.57(1.28)
Model statistic	F=1.85 Prob=0.0697 R ² =.22 Adjusted R ² =.10	F=3.83 Prob=0.0004 R ² =.37 Adjusted R ² =.28
Obs	75	75

Note: the figures in the parentheses are Standard errors
 ***, ** and * refer to 1, 5 and 10% level of significance respectively.

Figure 1. Relationship between group size and investment ratio (overall investment ratio)

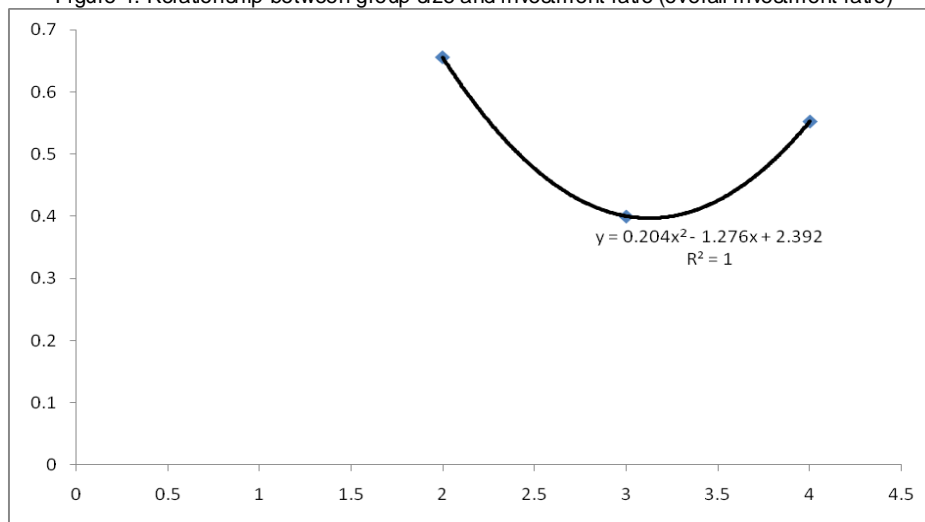


Figure 1 illustrates treatment-wise U-shaped curve linking trust with group size. Overall, this relation also holds. On the other hand, we see two counteracting relationships between

groups size and reciprocity in the two treatments, resulting in the positive correlation between group size and return ratio (figure 1). These findings are summarized in table 6.

Figure 2. Relationship between group size and return ratio (overall return ratio)

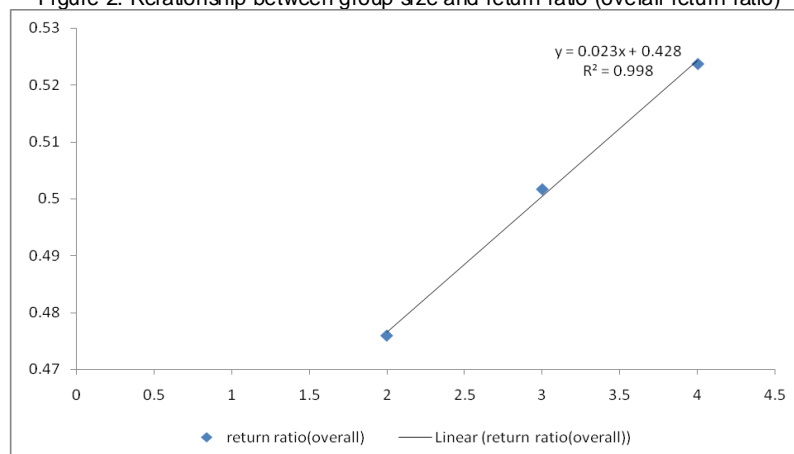


Figure 2 illustrates treatment-wise upward sloping straight line linking trust with group size.

4.5 From lab-induced behaviour to field validity: the implication for Common pool resource management

Do the experimental findings of this study really hold in practice? Do they reflect practical relations between inequality,

group size and social capital? If this really holds, then we are likely to monitor behaviours by reducing inequality within and between the resource dependent groups? We adopt the relevant data as shown in table 10 from Sarkar (2017a, 2017b) and Sarkar and Ray (2019).

Table 10. The impact of Group size and heterogeneity on collective action among forest protection committees in West Bengal

Serial no.	Name of the Villages	Types of CPRs	Village Household	Social Capital	Inequality in landholding (Gini)	Caste heterogeneity
1	ChhotoChandabilla (West Medinipur)	F+T	55	13	.42	.21
2	Chowkir Boss (Alipurduar)	F	176	36	.24	.30
3	Gadadhar FV (Alipurduar)	F	314	34	.36	.20
4	Gonna (Bardhaman)	C+T	300	34	.47	.70
5	Joyalbhanga (West Medinipur)	C	57	26	.40	.36
6	Lakshmiganj (Bardhaman)	C+F+T	177	26	.38	.50
7	Majhergram (Bardhaman)	C+T	505	31	.50	.75
8	Pachami (West Medinipur)	F+T	96	19	.32	.52
9	Salboni (West Medinipur)	C+F	135	21	.41	.26
10	Shirsi (West Medinipur)	C+T	122	14	.35	.41
11	Suata (Bardhaman)	C+F+T	326	26	.48	.68

Source: Primary survey November 2016 to April 2017 and May 2018 to July 2019. Above table 10, C stands for canal irrigation; F stands for forest and T stands for tank water and in the parentheses we have mentioned the name of districts.

Table 10 shows that there is positive and significant ($r = 0.6193$ and $p < 0.05$) relationship between collective action and group size. As suggested by Poteete and Ostrom (2004), income effect may explain this unexpected occurrence. However, caste heterogeneity appears to have a positive but weak correlation with social capital ($r = 0.2521$ and $p > 0.10$). In commons management where caste heterogeneity is insignificant, people share a set of similar socio-cultural attributes that promotes collective action as a cost-effective collective outcome. As a result, trust is present as a common knowledge in such institutions. On the other hand, we find a negative relation between land inequality and social capital ($r = -0.0079$ and $p > 0.10$). Thus, CPR evidence shows that our experimental results are moderately convincing in the context of commons management. Further, we have already observed above a non-linear relationship between economic inequality and cooperation. Once possible explanation behind this may be non-linear relationship between social capital and heterogeneity as found in this paper.

5. Conclusions and recommendations

Institution, communities and conservation are integral parts of community-based natural resource management. For successful conservation of natural resources such as fisheries and forestry researchers have identified an immense variety of local circumstances that affect whether local resource users organize themselves collectively to be long-term stewards of their resources. While many local success stories exist, all too many resources have suffered severe degradation at the hands of those highly dependent on those resources (Ostrom 1990; Adhikari and Lovett 2006; Ray and Bhattacharya 2011).

The essence of the above studies is that collective action is costly (Poteete and Ostrom, 2004). Actors or resource users must overcome co-ordination problems, distributional struggles and the incentive problems associated with commons. Characteristics of groups, such as their size and degree of homogeneity, gain significance because they influence the

severity of co-ordination problems and distributional struggles. Given this importance of group size and group heterogeneity in the CPR literature, this study has tried to capture the factors that establish the relationship between group characteristics and cooperation. We understand social capital is that link. The idea is that group size and heterogeneity affect trust and reciprocity which in turn affect cooperation.

However, in this study, we see that the relationship between pro-social behaviours and group characteristics are not straightforward. They are context-specific. The experimental evidence in the result section confirms our observations. While we see a U-shaped relation between trust and group size, the reciprocity, which is another form of cooperation is however positively related with group size. Further, this study shows that not every heterogeneity influences cooperation. Income heterogeneity affects cooperation and trust, but caste heterogeneity does not. The implication is that both heterogeneity and group size matter in promoting trust and cooperation, but the effects depend on the nature of heterogeneity and other group characteristics. In short, we should give due importance to understanding the issues that influence trust and cooperation. Group size and heterogeneity are two of such factors. The finding that investment ratio and group size have a U-shaped relation indicates that there is a threshold size the groups in commons dilemmas. However, further research is required to confirm the relationship between group diversity, social capital and collective action.

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NOTES

1. The term heterogeneity is used to describe asymmetric distributions of wealth and power, different preferences, opportunity costs, unequal claims to natural resources, and caste and ethnic divisions within a community (Adhikari, 2005, p.9).
2. Since the indicators are very much contextual, majority opinions are more important than the averages. So, mode values are a better measure of representing the relative importance of the indicators
3. It is important to note that a more cooperative group takes less time to cooperate. Then, the inverted U-shaped curve between time taken for cooperation and income inequality becomes U shaped curve relating income inequality and cooperation.

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Appendix A. Instructions of the experiment

Welcome to all of you. We have invited you to participate in an economic experiment. You can earn money from your participation in the game. All the participants present are the students from colleges of Calcutta University, Rabindra Bharati University and North Kolkata Polytechnic College respectively. We will now give each player an experimental kit, a large envelope. Within that envelope you will find some CODED small envelopes, a pen, a decision sheet and a participation fee of 100 Indian Rupees.

You will play the game as follows.

- All the players will play either as SENDERS or RECEIVERS but NOT both. Everyone will play in a group of either 2 or 3 or 4 members.
- Your group members will be either someone from your own institution or from other institutions. Your group will play either as a SENDER GROUP or RECEIVER GROUP.
- Each sender group will be paired with a receiver group that will sit in another room.
- Players' identity will NOT be disclosed to anybody— whether they are players of the same groups or those of the receiver groups or to our assistants.
- Each group will play the game for FIVE ROUNDS.
- Each player in a SENDER group will have a paper token of 20 Rupees in each round. You will have to discuss with other members of your group on how much to send to the receiver group. We will give you 10 minutes within which you have to reach a consensus on proposed sending. This proposed amount of sending will be shared equally. That is, if your group members propose to send 30 Rupees in aggregate to your receiver group, then per member proposed amount will be $30/2=15$ Rupees if you are a 2-member group or $30/3=10$ Rupees if your group has 3 members or $30/4=7.5$ Rupees if you are a 4-member group. Please write down per member proposed sending on your decision sheet.
- Next, you will go to the corridor where you have to make your ACTUAL SENDING decision. That is, out of 20 Rupees, you must decide how much you want to send to the receiver group. You may even send them NOTHING. It is your own choice. If you decide to send that group nothing, write 0 on the slip and put it in the coded envelopes that we have provided you. Come back to your seat. One by one the other members of your group will follow this procedure. Once all the members have sent the amounts to the receiver groups, the aggregate amount will be TRIPPLED and sent to your receiver group.
- If you are a receiver group, then you will open the envelope sent to you by your sender group and take the paper slip on which the amount sent by senders is given. Next, you will decide on how much to keep and how much to return to your senders. We will give you 10 minutes to decide. If you, for example, receive 60 rupees, it means your sender group has sent to you $60/3=20$ Rupees. If your group members decide to return 24 rupees, then write down 24 on the paper slip and place the slip within the coded envelope. Your group may RETURN NOTHING. IT IS YOUR CHOICE. If you return nothing, senders will get nothing. Whatever you return will be shared equally by the senders. For example, if you return 24 Rupees in aggregate, then senders get $24/2=12$ Rupees if they are a 2-member group, $24/3=8$ Rupees if you are a 3-member group or $24/4=6$ Rupees if your group has 4 members. Receiver groups, once these are done from your part, our assistant will take these envelopes to the senders.
- If you are a sender group, please open the envelope in front of your group members and divide equally whatever you have got from the receiver group. You write down the individual amount received in your decision sheet. If your receiver returns to you, say, 40 Rupees, then your individual receipt will be $40/2=20$ Rupees if you are a 2-member group, or $40/3=13.33$ Rupees if your group has 3 members or $40/4=Rs. 10$ Rupees if your group has 4 members.
- Once, sender groups, you get these from the receiver groups, round 1 of the game ends. Next four rounds will follow exactly the identical procedure.
- Senders and Receivers, please note that if you sit in the RG Room, then at the start of each round, you will have new group members. That is, a sender will play as the sender in all five rounds BUT IN DIFFERENT GROUPS. Similarly, receivers will play always as receivers BUT IN DIFFERENT GROUPS. However, in the RG room, cross-changing will not be allowed. That is, a sender can be a member of a new sender group but not of a receiver group. Similarly, a receiver cannot become a member of a sender group.

Appendix B. Social Capital for CPRs user villages

Indicator of Social Capital
Absence of hierarchy
Education level
Collective action in conserving resources
Broad-based understanding of group activities, leadership
Equity in benefit flow/ Status of financial capital base/accountability
Livelihood impacts and reduction in vulnerability
Group activities in term of decision-making/resources conservation/attachment/sense of responsibility.
Internal norms and role clarity and external linkage-vertical and horizontal
Mutual trust within community and conflict resolution
Maintenance of assets and improvement