The Influence of Social and Psychological Interventions on Collective Action for Water Management: a Framed Field Experiment in India

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Abstract

Rural households in resource-poor regions typically rely on communal water sources for their drinking water. However, a persistent lack of investment in the 'human' dimension means that communities often fail to collectively manage their communal water sources, resulting in abandoned water points and treatment systems across the developing world. Using a public goods game framed in terms of communal management of water treatment systems, this study investigated the potential for a range of social and psychological interventions to increase cooperation vis a vis communal water sources in nine rural villages in the district of Yavatmal, India. Results show that interventions involving public disclosure of behaviour had the very significant effect of *decreasing* contributions. This is contrary to findings in lab-based studies, confirming that culture and context play a large part in determining cooperation behaviour. On the other hand, communication with mandatory negotiation was found to increase cooperation, albeit intermittently. Findings from this study might be applied to a range of social dilemmas, such as the management of watersheds, forests, fishing grounds and other socio-ecological systems. In terms of policy, these results highlight the importance of accounting for cultural and contextual factors in the development of solutions to social dilemmas.

Keywords: collective action, cooperation, framed field experiment, public goods game, water treatment, decision-making, developing country, rural

JEL classifications: C99, H41, O12, D71, Q25

1. Introduction

The long-term health and wellbeing of individuals, communities and entire socio-ecological systems often depends on the resolution of conflicts between short-term individual interest and long-term collective interest, otherwise known as 'social dilemmas' (Dawes, 1980). Protecting the environment, managing natural resources, providing basic needs such as safe water, clean air, education and healthcare, are all social dilemmas. In all these examples, it is in everyone's best interest to cooperate; however, any one individual may benefit most by free-riding on other people's efforts. If no-one cooperates however, the collective good fails to be provided and everyone loses out.

In many parts of the world, the provision of safe drinking-water represents a social dilemma. A lack of centralised infrastructure means that rural households in resource-poor regions typically rely on communal water sources for their drinking water. Despite decades of investment in the development of water technologies and hardware by the World Bank and other donors (Iyer and Yavuz, 2006), the long-term operation and maintenance of these communal water points is usually left in hands of the community, with little investment in capacity-building or training to ensure that the communities can actually take care of them (Skinner, 2009). This is particularly problematic when it comes to complex water treatment technologies, such as those needed to treat groundwater with naturally-occurring contaminants, such as fluoride or arsenic. These treatment technologies require ongoing operation and maintenance to produce safe water. In the absence of regular upkeep, the technology cannot treat the water, resulting in health and mortality impacts in the affected communities.

In these situations, it is clearly it is in the community's interest to cooperate in the management of their water treatment plants. However, this would require individual households to collectively organize themselves and craft agreements regarding responsibilities towards the operation and maintenance of the communal water systems, and ensure that contributions are made by all households on a regular basis. Although local communities have successfully cooperated in governing local resources across a range of ecosystems and resource-types (e.g. Ostrom, 1990), cooperation with regards to communal drinking water sources seems to elude success (Skinner, 2009; RWSN, 2009).

The present study aims to identify interventions that might encourage cooperation around the provision of safe water from communal water sources. In particular, we focus on rural villages in the state of Maharashtra in India which are heavily impacted by groundwater fluoride contamination. As noted above, water treatment systems for groundwater contaminants such as fluoride require regular operation and management, making ongoing cooperation in this context essential to the provision of safe water.

Our study involved a framed field experiment conducted in nine villages in the district of Yavatmal in Maharashtra. Framed field experiments are structured economic experiments that are conducted in the natural (field) environment of the subjects of interest. In contrast to standard laboratory-based experiments, framed field experiments use non-student subject pools and are framed in terms of the resource that needs managing, in this case, water treatment plants (Harrison and List, 2004; List, 2001). By selecting the field-based approach for economic experiments, the researcher makes a trade-off between some of the control inherent in a lab setting for increased realism and external validity. This is essential when researching potential policy interventions aimed at the wider population, or populations of different cultures. There is increasing evidence that the cultural and local context in which economic experiments are conducted have a significant impact on behaviour (Henrich et al., 2005; Anderies et al., 2011); by taking the lab to the field, these cultural and local factors are taken into account. Additionally, field experiments allow the researcher to test different potential policy interventions in a controlled setting without having to engage in the more costly randomized controlled experiments - which would ideally be the next step in any policy-motivated research.

Using a public goods game framed in terms of the communal management of village water treatment systems, we investigated the existing levels of cooperation in the district of Yavatmal, and the potential for a range of social and psychological interventions to increase cooperation levels with regards to the public good. These interventions were selected with policy-relevance in mind, as the Maharashtra state government is currently searching for approaches that may improve the likelihood of success of the water treatment plants that they have built over the ten years.

To the best of our knowledge, this is the first study to use economic field experiments to explore cooperation around drinking water sources in general. Given the fundamental role that safe

drinking-water plays in human health and survival, this represents a significant addition to the literature. Additionally, this is the first experimental economics study to explore the impact of an anticipated emotion priming intervention on cooperation behavior in the field. This analysis is mostly exploratory at this stage; however, it is anticipated that psychological interventions will become invaluable additions to the array of interventions designed to motivate cooperation in public goods settings. Finally, this paper adds to the growing number of studies that explore multiple social interventions within a single study (others include Lopez et al., 2012; Travers et al, 2011; d'Adda, 2011). In contrast to earlier studies which focused on single interventions, this multi-pronged approach allows the researcher to compare different interventions within a single setting, and identify those that might best be implemented as a policy tool.

The rest of the paper is structured as follows: Section 2 presents the case study background, Section 3 presents the experimental design including discussion of the various treatments implemented in the experiments, Section 4 presents recruitment and data collection, Section 5 describes the sample, Section 6 and 7 present the results, and Section 8 and Section 9 present discussion and conclusions respectively.

2. Case Study Background

In rural parts of India, most households depend on communal sources of water, including boreholes (hand pumps), hand dug wells, protected springs, and surface water sources. When surface water levels are inadequate to meet the demand for water, drinking water is sourced from groundwater. This is the case in the state of Maharashtra, where surface water levels are below the national average for India (GOI, 2007). As a result, many areas rely on groundwater sources for drinking water supply. However, groundwater can often contain very high levels of naturally-occurring contaminants, and fluoride is a particular problem across India.

Worldwide, India is the largest user of groundwater resources and one of the countries most impacted by unhealthy levels of fluoride. Rural areas, in which 90% of drinking water is based on fluoride-contaminated groundwater, are particularly vulnerable (Amalraj & Pius, 2013). The continuous consumption of fluoride-contaminated water can lead to *fluorosis*, which can affect

teeth, bones, joints, and in extreme cases, soft tissue organs. Unfortunately fluorosis has no direct cure. In the absence of alternative drinking water sources, defluoridation treatment is the only mitigation approach. According to a 2005 Maharashtra Development Report (Government of Maharashtra, 2005), as many as 1183 villages are impacted by fluoride. A more recent survey of chemical contamination in the Maharashtrian State[1] lists 179 villages as 100% impacted by fluoride contamination without any alternate drinking water sources within the community. Six districts in the Maharashtra state alone contain 133 of those villages, with the largest cluster (n=53) in Yavatmal, where this study is based.

Despite the successful development of defluoridation treatments and technologies, these solutions encounter a range of operational barriers (e.g. lack of economic and chemical resources, scarcity of skilled operators) and uptake is hindered by a lack of user understanding and participation in the development of communal treatment options (Rathore, 2004)[2]. In Maharashtra, treatment is often the last method of action taken by the government. When a village is found to be impacted by fluoride, the Maharashtrian government first considers the availability of alternate sources. If none are found, they assess the feasibility of bringing in piped water. If this option is not deemed feasible, then they attempt a treatment approach (Andey et al., 2013; Government of Maharashtra, 2011)[3]. When it is determined that treatment is the course of action, the government contracts a private company to build and maintain a treatment facility for the first 3-5 years. After this initial 3-5-year period, the treatment facilities are then turned over to the communities.[4] As of 2012, there were 36 villages with treatment plants in Yavatmal (although we could not obtain figures regarding which were functioning, and which were not).

The practice of turning facilities over to communities is part of recent policy reform, mainly the Government of India Sector Reform Pilot Programme (initiated in 1999), Swajaldhara (initiated in 2002), the Prime Minister's Gramodaya Yojana-Rural Drinking Water Programme (PMGY Programme) (initiated in 2000), and the World Bank-aided Jalswarajya Project (initiated in 2003). These schemes involve the decentralisation of planning and administration of water

[1] Details from GOI & GOM Guidelines and GR Issues presentation made by Er. S.A. Rode (2012)

[2] Many of these concerns were expressed by the NEERI researchers during a scoping visit in Feb-March 2014

[3] Conversations with the Government of Maharashtra officials in charge of fluoride mitigation

[4] Information from details of Nagpur Aquatech Pvt Ltd operation of the plants in Yavatmal provided by the District of Yavatmal Engineer and the Government of Maharashtra officer in charge of treatment.

supply to the gram panchayat (village council) level (GOI, 2007). However, the success of these programs in Maharashtra is hindered by a lack of investment in capacity-building required to ensure the long-term operation and maintenance by local communities, an issue affecting water provision worldwide (RWSN, 2009; Schouten et al., 2011).

In a survey of water treatment plant operators in eleven villages carried out in November 2014 by the Columbia University research team, eight out of the eleven surveyed operators claimed to be reliant on the company for repairs and maintenance with the expectation that the service would continue indefinitely. Most operators only received a half-day of training by the company to operate and maintain the plants. Only five of the eleven operators believed that the village will be successful in taking care of the treatment system after it is turned over to the community, with almost all of them defaulting to the Gram Panchayat (the village council) for guidance regarding the management. Unfortunately, communication between the Gram Panchayat and the other village members in this regard is lacking: results from a 'contingent valuation' survey that was carried out in the same villages in November 2014 (see Alfredo and O'Garra, 2015) indicates that over three quarters (83%) of the respondents did not know that the government was handing over the water treatment plants for the communities to manage and operate themselves.

Given this lack of communication between the village council and the village members, it is unlikely that villagers will organize themselves to manage their water treatment plants. Recognising that the transition to community-owned water systems is not working, the Maharashtrian state government is actively searching for solutions to the lack of community take-up of their water treatment plants[5]. This study represents a first step in that direction.

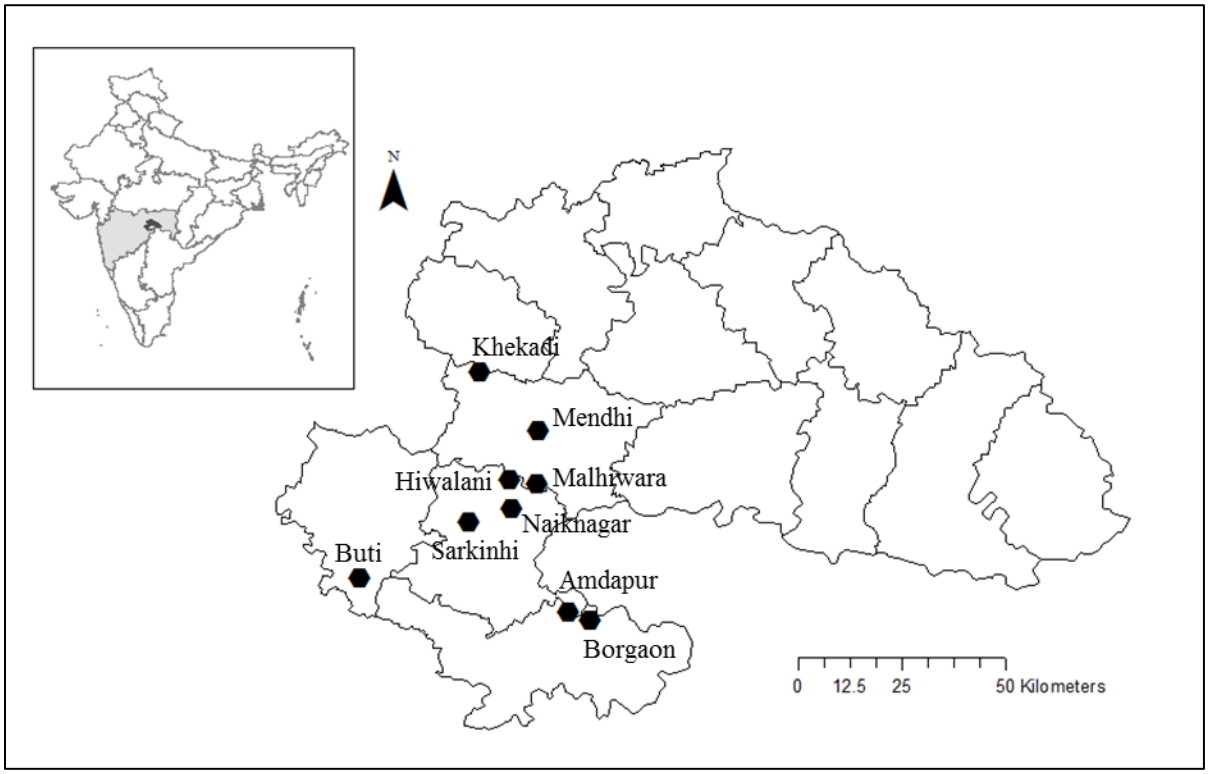
We conducted our study in nine villages (Figure 1) located in the district of Yavatmal, in the state of Maharashtra. As noted above, these nine villages had been previously surveyed using a 'contingent valuation' survey[6], which identified household water use, attitudes and beliefs regarding water and health, knowledge about fluorosis and its causes, and willingness to pay for the long-term operation and maintenance of the local water-treatment plant (for more details

[5] This was communicated to us by Dr Pawan Labhasetwar, NEERI.

[6] 'Contingent valuation' (CV) is a survey-based methodology which aims to estimate economic values associated with non-marketed goods or services, such as clean air, water or ecosytsem services. Respondents to a survey are presented with a hypothetical market in which they can pay for (or be compensated for) increases (or decreases) in the provision of a non-marketed good, such as environmental quality. See Bateman et al., (2002).

regarding the methods and results from this survey, see Alfredo and O'Garra, 2015). The villages selected for this study met the following criteria: (1) they are located in Yavatmal, (2) they contain identical technologies (electrocoagulation) for fluoride treatment, and (3) the water treatment facilities were in the process of being turned over from government-subsidised private companies to the communities between October-December 2014.

Figure 1. Location of framed field experiments in the district of Yavatmal, Maharashtra



3. Experimental Design

In order to explore the potential for local villagers to collectively manage their water treatment plant, we designed our experiments around a standard linear public goods game, also known as a 'voluntary contribution mechanism' game. In this game, *n* subjects play the game in a group. Each individual *i* receives an identical endowment e_i at the beginning of the game and has to decide how much to contribute towards a group account, c_i , and how much to keep for herself. The sum of each individual's contributions to the group account is multiplied by a constant, α, and the resulting amount is distributed equally amongst all the group members. Each individual's earnings is determined by the following payoff function:

$$\pi_i = e_i - c_i + \alpha_i \sum_j c_j$$

In our study, we used a value of $\alpha = 0.4$, which is a standard marginal per capita return used in linear public goods games (see REFS). At all values of $\alpha < 1$, the individually optimal decision is to contribute nothing ($c_i = 0$). By doing so, a player not only keeps her entire endowment but also receives $1/n^{th}$ of the total contributions made by the other players in the group. However, if all players choose to behave this way, they only earn $\pi_i = e_i$. The socially optimal contribution is for all players to contribute e_i , in which case players will earn $\pi_i = \alpha_i \sum_j e_i$.

The public goods game reflects social dilemmas in which individual and social preferences work in opposition to each other. This experimental design is well-suited for the purpose of the present study, which is to identify the potential for community members to cooperate in the long-term management of their water treatment systems. The instructions of the game were framed in terms of the potential contribution towards the communal management and operation of a water treatment plant that would benefit everyone in the village. The script read:

> *"I would like you to imagine that the group account in the game is like a community project which benefits everyone in the community. For example, think of the group account as a water treatment plant that benefits everyone in your village - when you contribute money or time towards the operation and maintenance of the water treatment plant, the whole community can have access to clean and safe drinking water*."

Framing the game in these less abstract terms helps to aid understanding, and increases the relevance of the exercise to participants (Harrison and List, 2004)[7].

We ran the experiments with n=5 subjects per group, and they played the game over twenty rounds. Group membership remained fixed over the entire experiment. At the beginning of each round, each player received an endowment of e_i =10 rupees. The maximum possible earnings per individual therefore came to 20 rupees per game, or 400 rupees per experiment[8].

During the game, players signalled their contribution decision by circling the number of rupees (between 0 and 10) that they wished to contribute towards the group account (see Supplementary Material for Experimental Script and Decision Sheets used)[9]. Once they had made their choices, players placed their decision sheets inside a folder and handed them to the instructor. An assistant then entered the contribution decisions into a mobile survey interface on a Smartphone (https://formhub.org/), which recorded the data and calculated the group contributions and individual earnings. Total group contributions and individual earnings from the group account were written on a large whiteboard at the end of each round. Meanwhile, participants were guided by the instructor in the completion of their 'calculation sheets', in which they would record their contributions and calculate their earnings in that round[10]. Participants with reading or writing difficulties were assisted by the instructor or the assistant. Communication between group members was not permitted during the baseline rounds (see below). Furthermore, in order

[7] It is worth noting that, in our study, although we framed the experiment in terms of contributions towards the water treatment plant, this is not necessarily a familiar concept, given that communal contributions had never been required previously to operate this public good. Thus, the setting for this study may have come across as rather more abstract to villagers, compared to the contexts presented in other FFEs in which the contribution mechanism might have been more familiar in terms of participants' experience of communal management or exploitation of common resources.

[8] The average daily wage in these villages is about 200 rupees per day, equivalent to about $3/day (based on results reported in Alfredo and O'Garra, 2015). We did not communicate the levels of potential earnings at any point during recruitment, or before playing the game.

[9] This is similar to the procedure used in Travers et al. (2011).

[10] Our motivation for encouraging participants to calculate their earnings themselves was based on feedback from a pre-pilot study carried out at Columbia University (n=5), in which it was found that participants lost interest whilst waiting for the assistant to calculate the earnings. The 'calculation sheet' (also used in Cardenas et al., 2011) was piloted in the field in Dongargaon (n=20) and found to be a very effective way of keeping participants engaged in the experiment through active involvement in calculating their own earnings.

to ensure that contributions were private, players were instructed to sit back-to-back whilst playing the game.

We implemented the experiment as a mixed within- and between- subjects design. All groups played ten initial **baseline rounds**, in which players made their contribution choices as described above - simultaneously and anonymously - followed by ten more rounds in one of five different treatments. The purpose of a common baseline is to establish patterns of individual behaviour in the absence of social interactions. After the baseline rounds, each group received a different treatment intended to explore the potential for specific social and/or psychological interventions to increase cooperation. As in the baseline rounds however, all decisions were made individually and privately. The treatments are described below:

Face-to-face communication: communication has been found to increase cooperation across a range of lab-based (Andreoni and Rao, 2011; Cason and Khan, 1999; Isaac and Walker, 1988) and field-based experiments (e.g. Cardenas et al., 2011; Cardenas and Ostrom, 2004), and is especially effective when carried out face-to-face (Balliet, 2009). The communication treatment implemented here is modelled on that implemented in Cardenas et al. (2011) in which participants are allowed to communicate with each other for two minutes before each round, but are not permitted to make promises about payments or side-payments with respect to the game.

Explanations for the positive effect of communication on cooperation include reputation building, group identity, development of norms, increasing expectations of cooperation, reduced 'social distance', or increased understanding of the game (Kerr et al. 1997; Balliet, 2009; Cardenas et al, 2011; Bohnet and Frey, 1999). Our intention in implementing this treatment is to reflect the day-to-day reality in the villages in which people might talk to each other informally regarding the management of public goods but do not necessarily enter into negotiations. As such, we consider this treatment a type of 'control' in which informal social interaction is present and yet others' private investment choices are not public.

Negotiation: this treatment is almost identical to the face-to-face communication treatment except that participants were *actively* instructed to negotiate and try to reach an agreement

regarding their contribution decisions in the two minutes given for discussion before each round. Any agreements are 'cheap talk' and have no influence on player payoffs. However previous empirical evidence indicates that voiced agreements increase cooperation even if they are non-binding (Orbell et al., 1988). Hence, we anticipate that, by actively instructing participants to negotiate agreements, this will increase the likelihood of voiced agreements *vis a vis* the simple communication treatment, and hence, this will increase cooperation. Our intention is to explore whether unstructured communication is sufficient to motivate the crafting of agreements, compared to the explicit requirement to negotiate agreements.

Public observability: the threat of public disclosure of one's actions is typically found to be a very effective motivator of pro-social behaviour (e.g. Andreoni and Bernheim, 2009; Rege and Telle, 2004; d'Adda, 2011), and the evidence suggests this may be mostly due to a desire for social approval. At the beginning of this treatment, the instructor explained to the group that individual contributions were to be made public at the end of each round. Players made their decisions individually and in private, and when all decisions had been made, the decision sheets were collected by the instructor who proceeded to write down the individual contributions on a whiteboard, in the same order in which participants were seated in the room to ensure association between contribution and subject identity. This fact was iterated by the instructor when writing down the individual contributions.

Leading-by-example: leadership influences have been explored fairly extensively in relation to public goods games in the lab, and the evidence overwhelmingly indicates that players who make public contributions first in sequential games give significantly more than later-movers (O'Garra and Sisco, 2015; Dannenberg, 2014; Rivas and Sutter, 2011; Figuieres et al, 2012). Second-movers typically increase their contributions when first-movers set a good example, particularly if the 'first-mover' self-selected herself into the role of 'leader' (e.g. Rivas and Sutter, 2011). To the best of our knowledge, leading-by-example has not been explored in framed field experiments. In our leadership treatment, the leader was selected by the instructor. The process of leader selection was not implemented as a random process; all players took turns to be the leader. The leader was instructed to circle his or her contribution decision on his or her

decision sheet. All other players were instructed to wait for the leader to make a decision. The leader then publicly announced his or her contribution amount to the other players, who then proceeded to make their own contributions in private. Based on the literature, we expect that leader contributions will be greater than second-mover contributions and that good examples will motivate greater contributions overall.

Video with 'anticipated emotion' priming: this treatment involved priming participants to consider their 'anticipated emotions' in relation to their choices. Theories about the relationship between emotion and behaviour suggest that social behaviour is influenced not only by the experience of emotion, but also by the anticipation of emotion (Van der Schalk, Bruder, and Manstead, 2012). There is substantial evidence that suggests that anticipated emotions have the power to influence behavior and decision making (e.g. Schneider et al., 2015; Schloesser, Dunning, and Fetchenhauer, 2011; Mellers and McGraw, 2001; Baumeister et al, 2007), as well as promote positive behavior change in pro-social domains, such as environmental decision making (Schneider et al., 2015; Pooley and O'Connor, 2000). The anticipated emotion intervention was delivered to participants via a short video of people (actors) playing the public goods game and thinking out loud about their possible future emotions in response to different play strategies. The actors were graduate students from our partner institution in India (NEERI) who volunteered to take part in this study. To the best of our knowledge, the 'anticipated emotion' priming treatment is a novel intervention in the context of a framed field experiment.

Video (neutral): in order to control for any informational or motivational influences that the video may have had on participants *independent of the anticipated emotion priming treatment*, we also implemented a control for the priming effect. This treatment involved the exact same video as the priming treatment, with the difference that the voice-over script was stripped of any references to future emotions. Although we implemented this as a control for the priming treatment, it may also serve to identify whether providing reminders to participants about the various game play options and their possible outcomes has any influence on cooperation. The English-version scripts of both the priming and neutral video treatments can be found in the Supplementary Material.

4. Recruitment and Data Collection

We conducted the experiments in nine villages over the course of nine days between March 19th and April 9th 2015. Villagers were recruited the day before using a combination of verbal and written invitations; they were informed that the study was about 'community resources' and they would be compensated 150 rupees for participating (one day's wage is about 200 rupees in these villages, based on results from baseline study; see Alfredo and O'Garra, 2015).

Table 1. Summary of Data Collection

Treatment	No. villages	No. of groups	No. of players	No. observations (Rounds 1-20)
Communication	9	13	65	1300
Public	6	6	30	600
Negotiation	3	6	30	600
Lead-by-example	3	6	30	600
Video-prime	6	7	35	700
Video-neutral	6	7	35	700
Total	9	45	225	4500

A total of 235 villagers participated, resulting in 45 groups of five players (Table 1). The experiment was piloted in the field (n=20) which allowed us to adjust the experimental instructions in order to maximise learning and practice during the game. Instructions were provided by trained instructors in the local language, Marathi[11] (see Supplementary Material for Experimental Instructions), and participants were required to play ten practice rounds before the

[11] The instructions were scripted in English and translated into Marathi by a verified translator. The translation was further verified by two additional fluent English-Marathi speakers to ensure correctness of the translation.

final experiment. Participants with reading or writing difficulties were assisted by the instructor or the assistant.

The experiments were conducted in village schools (after school was out). Village protocol required the research team to be publicly introduced to the village Gram Panchayat (village council) prior to the start of each experiment. After formal introductions, one of the lead researchers randomly distributed 'participant cards' (indicating treatment group and participant number) among the gathered villagers. Members of the same household were not allowed to participate in the same group. Each group was then escorted to a separate classroom, where the instructor proceeded to read the instructions. All participants were informed about their rights and verbal consent was obtained as per Columbia University's ethics in human subjects' research requirements.

At the end of the experiment, players were instructed to remain quietly seated in the classroom whilst they were called out one-by-one to complete a short exit survey. The survey was conducted face-to-face by the assistant or main instructor, and data entered directly into a survey tool on individual smartphones. The survey identified basic respondent socio-economic and demographic characteristics, as well as involvement in community affairs, membership of the village council, voting behaviour, and trust. The trust question was taken from the World Values Survey, and reads: "*Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people*?"

We also asked respondents to indicate the thinking process they engage in when making contribution decisions regarding a communal resource. The question read: "*If you were asked to contribute to a water treatment plant. Would you . . .a) think about the costs and benefits, b) think about what is right or wrong, c) think about what makes you feel good or bad.*" The answer choices represent three qualitatively different modes of decision-making identified in work on judgment and decision making (Weber et al, 1998; Weber et al., 2005). Inherent tendencies of the decision-maker, as well as different decision contexts or domains, may prompt the use of a different 'decision-mode'. We refer to the three different 'types' of decision-mode in the context of the specific scenario presented above as: 'rational' (option a), 'emotional' (option b), and 'moral' (option c). This question about decision-modes will potentially allow us to identify interactions between decision-mode and the psychological treatments. We anticipate that our

anticipated emotion video treatment will show strongest effects on emotional decision makers, compared to the neutral video treatment.

After players had completed the exit survey, they were directed to a desk where they were paid. In order to receive their payments, participants had to hand in their decision-sheets and participant card. Including the show-up fee of 150 rupees, villagers made on average 430 rupees. The total time taken for each experiment was about three hours.

5. Sample Description

Table 2 presents summary sample characteristics for the whole sample (statistics for individual villages can be found in the Supplementary Material). Compared to the baseline survey carried out in November 2014 in the same villages, the experimental sample is significantly more educated and affluent. Chi-squared tests of differences in proportions indicate that these differences are statistically significant with respect to education ($p=0.002$), latrine ownership ($p=0.045$), electricity in household ($p=0.038$). This difference between samples is likely due to self-selection, whereby the more educated and affluent villagers might have felt more confident to participate in an experimental study. However, we do not consider this sample bias problematic, as communal decisions are typically made by the more affluent households in a community, a reality which in its most pernicious form manifests as 'elite capture' (Mansuri and Rao, 2004). We consider this sample to reflect the characteristics of the key decision-makers in rural villages, and hence, the individuals most likely to initiate cooperation *vis a vis* the public good. This is partly confirmed by statistics summarised in Table 3, which indicate that the experimental sample had significantly higher attendance from members of households with Gram Panchayat members ($p=0.047$).

Table 2. Sample characteristics

Variable	Field experiment (n=225)	CV survey (n=435)	Yavatmal statistics (pop=2,772,348)
Respondent characteristics			
Female (%)	48.0	55.6	48.8
Age [1]	31.96 (11.93)	36.29 (13.90)	n.d.
% No schooling	1.33	28.9	n.d.
% Higher secondary (grades 11-12)	28.4	10.6	n.d.
% Participants always lived in village	65.8	69.3	n.d.
% respondents Hindu religion	90.7	90.5	81 [2]
Household characteristics			
Household size (mean no. of people)	6.17 (2.87)	6.27 (2.86)	4.7 [3]
Number of children (<10 yrs old) per household (mean)	1.50 (1.57)	1.42 (1.51)	n.d.
Gross monthly household income (mean Indian Rupees)[1]	6,084 (6,816)	4,173 (4,433)	5,289 [3]
% Households have latrine on premises	57.8	36.1	31.2. [4]
% Households have electricity	81.3	65.6	70.0 [4]
% Households with water source on premises [5]	n.d. [7]	23.6	24.0 [6]
Employment (main source):			
% Growing crops on own land	60.4	67.9	n.d.
% Agricultural labour (not on own land)	31.6	27.6	n.d.
% Livestock rearing	5.33	1.18	n.d.

Figures in parentheses () are standard deviations

[1] Income taken as mid-interval of income categories

[2] This figure is from the 2001 Census. This data has not yet been released from Census, 2011.

[3] Statistics for Maharashtra, year 2005-6. Source: IIPS (2007)

[3] Source: MIDC (2012) 'Maharashtra Disctricts'

[6] Statistics for 2001. Source: UNICEF/ via http://knoema.com/INDAT2012/india-development-indicators-2012

[7] Due to an error programming the online survey, we did not collect data on this statistic

Statistics in Table 3 also indicate that self-reported involvement in community-level decision-making and state-wide elections is very high in both experimental and CV survey samples.[12] Furthermore, almost half of the experiment sample claim to 'always' be involved in decision-making regarding village affairs. We note that Maharashtra's history is peppered with prominent reformers (i.e. Ambedkar, Dnyaneshwar, Tukaram, and Phule) and major reformation movements. It is likely that this history of reformation combined with the Government of Maharashtra's commitment to engaging localities in development may explain why participation rates are so high in our sample. Voting in national and local election turnouts in Maharashtra are equal to the national general election average for India in 2014 (about 66%).

Table 3. Summary social capital and trust indicators (whole sample)

Question	Field experiment (n=225)	CV survey (n=435)
Did you vote in the last State election? (% yes)	83.1	90.1
Have you personally been involved in the decisions made in your community regarding village affairs? (% yes)	73.3	62.3
'Always' involved in community decision-making (% yes)	47.1	n.d.
Are you or anyone in your household a member of the village Gram Panchayat? (%)	14.7	6.9
Are you a member of the Gram Panchayat? (%)	9.1	n.d.
Trust ("Would you say most people can be trusted or that you need to be very careful in dealing with people?" (% trust))	49.3	n.d.

Figures in parentheses are standard deviations

[1] Income and savings taken as mid-interval of income/savings categories

[12] The Maharashtrian Legislative Assembly elections preceding this study occurred on 15 October 2014. This election selects all 288 members of the Maharashtra Legislative Assembly on a single election date and is a better measure of involvement in local politics than the Indian general election which occurred over nine phases from 07 April to 12 May 2014.

6. Experimental Results

Figures Figure 2Figure 4 present time-series of mean individual contributions towards the public good for the different treatments. Figure 2 presents all the data together; Figure 3 andFigure 4 present results for the 'social' (communication, negotiation, public observability and leadership) and 'psychological' (video-priming and video-neutral) treatments separately, for purpose of clarity.

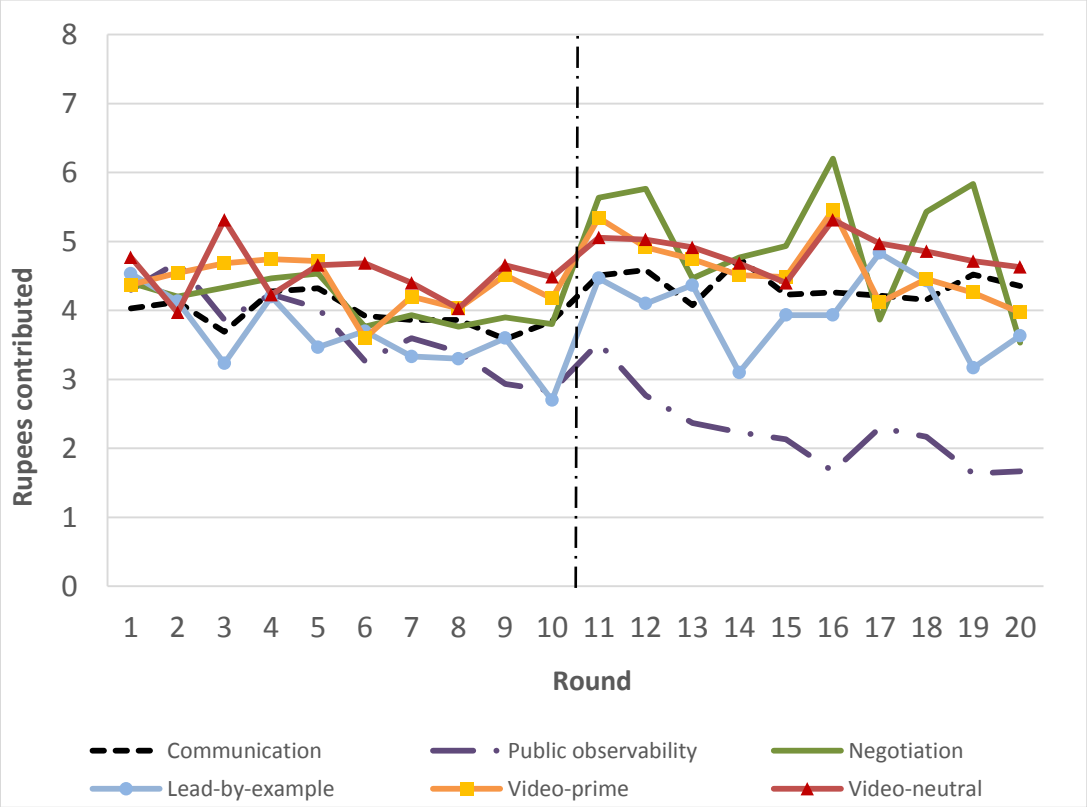
Overall, results show that mean contributions start at between 40-50% of the endowment, which conforms to the common finding in repeated public goods games that contribution levels typically start at between 40% - 60% of the endowment (Cardenas and Ostrom, 2004; Isaac and Walker, 1988). Players contributed on average 4.35 rupees (44% of the endowment) in the first round, but contributions declined to about 3.70 rupees (37% of the endowment) in round 10. This pattern of declining contributions over repeated rounds of play is an empirical regularity that has been found across thousands of public goods games (Ledyard, 1995; Croson and Marks, 2000). After round 10, the different groups receive their respective treatments, and play resumes for another ten rounds (from rounds 11-20).

As we can see from Figure 2, contributions in round 11 'jump' to about 47% of the endowment (averaged over all treatments). This is known as the 'restart effect' (Cookson, 2000), and refers to the observation that contribution levels in public goods games persistently return to about 50% of the initial endowment after a break between rounds of play *independent of treatment effects*. Thus, although part of the observed 'jump' in our data may be attributable to the treatments the increase is also partly a result of the restart effect.

We also observe in Figure 2 that mean contributions in rounds 1-10 (the baseline) overlap considerably between treatments. In order to verify whether baseline contributions are indeed from the same distribution, we compare baseline contributions between treatment groups using both a Kruskal-Wallis (KW) test, which is a rank-based nonparametric test used to compare the medians of two or more groups, and a Wilks Lambda test (WL), which is the parametric

counterpart[13]. Results of both tests confirm that baseline contributions between groups are not statistically different (KW: Chi^2 =3.700, d.f=5, p=0.5934; WL: F-stat=0.9841; d.f.=5, p=0.6189). This confirms that the baseline condition was identical across treatments as expected, and that our treatment samples are not systematically biased in any way.

Figure 2. Mean Individual Contributions over repeated play (All Treatments)



[13] Neither of these test identifies which specific groups of the independent variable are statistically significantly different from each other. They only indicate whether at least two groups are different and as such should be used as a first step in a series of tests.

Figure 3. Mean Individual Contributions over repeated play ('social' treatments)

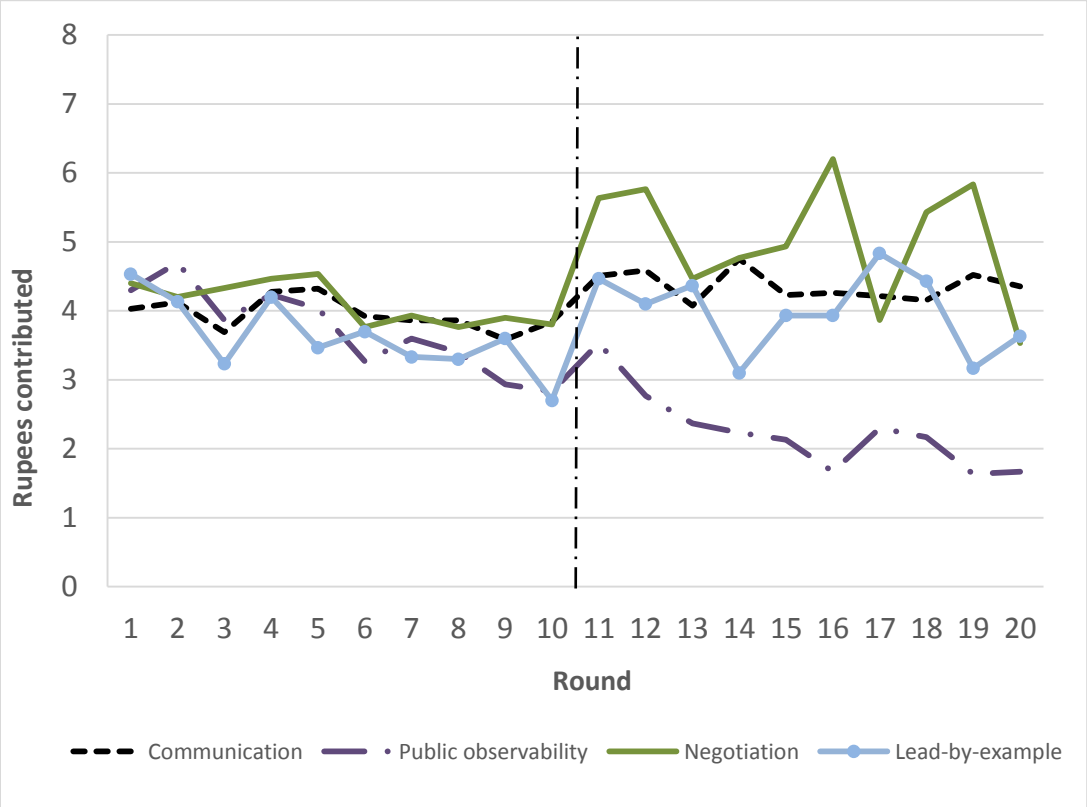
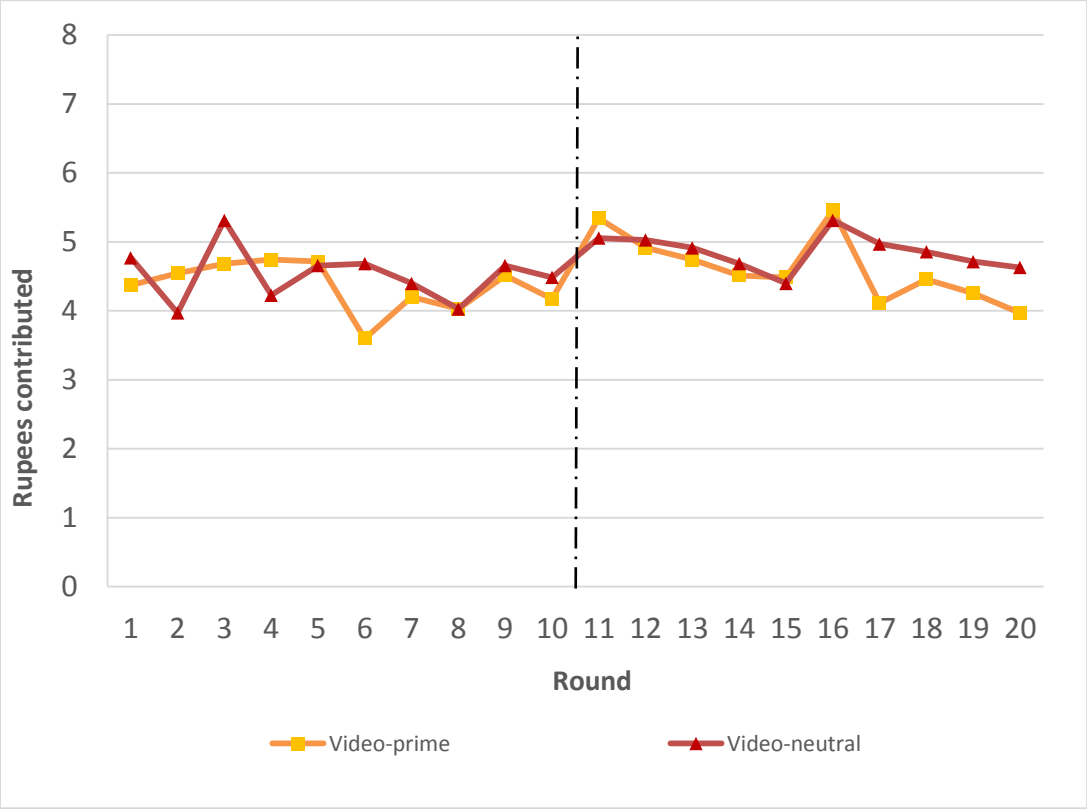


Figure 4. Mean Individual Contributions over repeated play ('psychological treatments')



The effects of individual treatments are summarised in Table 4. As we can see, player contributions increased significantly once participants were able to communicate or negotiate with each other. Comparing the two treatments, it is clear that negotiation has a more positive impact on mean contributions. While mean contributions of players in the communication groups increased from 3.95 rupees to 4.37 rupees (representing an increase of 11%), contributions in the negotiation groups increased by 23% from 4.11 to 5.04 rupees. This supports previous findings that communication only enhances cooperation when agreements are reached (Orbell et al., 1988). Our results suggest that unstructured communication alone is much less effective than communication with an explicit requirement to negotiate. Unfortunately, we did not collect data on the content of the discussions, so we cannot identify the proportion of communication groups that engaged in negotiations and reached agreements.

However, comparing averaged contributions (such as those in Table 4) only gives us part of the picture. Inspection of Figure 3 shows that the negotiation treatment has an apparently cyclical impact on mean contributions, whereas this pattern is not found for the communication treatment. The shape of the line suggests that negotiations temporarily build cooperation over several rounds (e.g. rounds 14-16) only for cooperation to collapse after a peak (e.g. round 17); then the cycle starts anew with another growth in cooperation followed by another collapse. Future research might explore the combining the negotiation treatment with additional mechanisms designed to mitigate the repeated ‘collapses of cooperation’ that we observe in this data.

Table 4. Summary of mean contributions and paired tests of differences (*individual level)*

Treatments	Mean 1 (rounds 1-10)	Mean 2 (rounds 11-20)	M2-M1	Wilcoxon sign-rank test p-value	Paired t-test p-value
Communication	3.95 (3.40)	4.37 (3.10)	+0.42	0.004***	0.001***
Public observability	3.72 (3.10)	2.25 (2.40)	-1.47	0.000***	0.000***
Negotiation	4.11 (3.02)	5.04 (3.42)	+0.93	0.000***	0.000***
Lead-by-example	3.62 (3.12)	4.00 (3.22)	+0.38	0.155	0.068*
Video-prime	4.36 (3.19)	4.63 (3.09)	+0.33	0.198	0.119
Video-neutral	4.52 (3.44)	4.86 (3.44)	+0.34	0.032*	0.057*

Figures in parentheses are standard deviations

Perhaps the most striking treatment effect however, is the negative impact of the public observability treatment. Whilst results in Table 4 show that all treatments had a positive impact on contributions (although not significantly in the 'video-prime' or leadership treatments), the process of making individual contributions known to the rest of the group had the very significant effect of *decreasing* contributions by an average of 1.47 rupees per player, representing a 40% decrease in mean contributions. This is a very large impact, and one that does not support previous findings in the literature (e.g. Rege and Telle, 2004; Andreoni and Rao, 2011; d'Adda, 2011).

The explanation given for the typically positive relationship between public observability and contributions in public goods games is that people desire social approval, and contributing to the public good is a socially-approved behaviour (Rege and Telle, 2004). However, in our study, this relationship doesn't play out as expected. We are confident that this is not because people in our study do not desire social approval; results from the CV survey carried out in November 2014 indicate that 94% of respondents agreed with the statement: "*It is important to me that people approve of my behaviour"*. Although we did not ask experimental participants the same question in the exit survey, we can confidently assume that the results from the CV survey study are broadly indicative of preferences for social approval. Therefore, it is possible that contributing to

the public good may not be considered a socially-approved behaviour in the context of a framed field experiment in rural Maharashtra. This possibility was raised by colleagues at NEERI, who suggested that our results reflect a societal norm in India whereby 'showy' behaviour such as 'setting a virtuous example' is frowned upon. An additional - or alternative - explanation is that the fear of being *seen* to be a 'sucker' overwhelms other influences on publicly-observable behaviour (De Cremer, 1999). These are very interesting questions that would benefit from further research. However, regardless of the motivations for declining contributions, this result highlights the hazards associated with extrapolating findings from one cultural context to another.

Results in Figure 4 and Table 4 indicate that the anticipated emotion priming treatment had no effect on mean contributions, although its control (the neutral video treatment) did have an effect (although this is only significant at the 10% level). This may be due to a number of reasons: players may not have been paying attention to the video. However, this certainly did not appear to be the case; whilst the videos were being shown on the tablets, all players gathered round and, based on our own observations, appeared to be very involved in watching the videos. Alternatively, the influence of the information may have only lasted a short time (the videos were only played to the groups once, and lasted only 3 minutes each), although mean contributions in the rounds immediately after the video do not confirm this to be the case (see Fig. 3).

In order to explore the reasons for the lack of influence of our priming treatment, we analysed contributions of participants according to their 'decision-mode', discussed in Section 3. Using this measure, we classed participants as 'rational', 'emotional' or 'moral' decision-makers. Results indicate that the priming video intervention has the strongest effect on emotional decision makers who on average contributed an additional 1.35 rupees post-intervention, followed by rational decision makers whose contributions increased by 1.23 rupees post-intervention and least on moral decision makers who contributed only 0.41 rupees more.[14]

[14] Difference measures in contribution post-pre intervention are calculated as the difference in the average contribution across games 11 and 12 compared to the average contribution in session 1 (games 1 to 10). The rational is that session 1 constitutes baseline game behavior and is thus analyzed across the entire session. Since the video treatment effects may 'wear off' quickly and not remain salient in people's minds during the entire duration of session 2 (see discussion above), analysis is based on an average of the first two rounds post intervention only.

To put these findings in perspective, we compare these results to contributions under the neutral video treatment (implemented as a control for the priming treatment). Results show that, after the neutral video intervention, rational decision-maker's contributions increased the most (by 0.97 rupees), followed by emotional decision-makers' contributions which increased by 0.81 rupees; moral decision-makers' contributions hardly changed (0.07 rupees increase). These results are in line with our expectations. The neutral video presented different behavioural strategies highlighting potential gains and losses and thus spoke most directly to a rational decision-maker. Since the concepts of gains and losses are closely linked to emotional reactions, it is understandable that the different possible behavioural outcomes spoke to emotional decision makers as well. Neither of the two videos particularly highlighted moral concerns and thus did not lead to a substantial behaviour change for moral decision makers.

Unfortunately, due to the very small sample sizes (ranging from n=8 to 15) for these various sub-samples, we hesitate to make any conclusions based on statistical significance of these findings. Nonetheless, these results are suggestive of the possibility that messaging may be most effective if geared toward the specific decision making mode people will follow regarding contribution to the public good. This is an exciting, albeit novel, area of research in framed field experiments; more research would be warranted before we can make any claims as to the impact of anticipated emotion priming on behaviour in the field.

Finally, the leadership treatment had no significant effect on mean contributions. An inspection of the behaviour of first-movers compared to second-movers indicates that the leaders fail to set an example: leaders give an average 3.98 rupees per round, compared to second-movers mean contributions of 4 rupees per round. Given our findings in the public observability treatment, this result is not unexpected – although we cannot comment on underlying motivations, results do suggest that it is not socially-acceptable to give too much even if it is for the public good.

Overall, results suggest that negotiation had the strongest *positive* effects on cooperation whilst public observability had a very pronounced negative effect on cooperation. What does this tell us about possible interventions to support the long-term communal management of village water treatment systems? On the one hand, results tentatively suggest that increasing the participation of community-members in decision-making processes regarding communal issues has great potential. Of course, this is not news to the development community where participation has

been an important tool for years (Gaventa, 2004). However, participation takes many forms, some of which might be more 'participatory' than others (Cornwall, 2003). Our results confirm that the active crafting of agreements by members of an interacting group represent by far the most promising policy intervention in this area.

Results also clearly indicate that increased transparency does not necessarily increase pro-social behaviour. Reasons for this may include a fear of being *seen* to be a 'sucker', or as suggested by colleagues at NEERI, who suggested that our results may be the consequence of a societal norm in India whereby overt displays of wealth, whether through consumption or contribution behaviour, may be frowned upon. We cannot identify the particular motivation behind this negative relationship between publicly-observable behaviour and cooperation, but this would be a very interesting angle to pursue in future studies in the region.

7. Regression Analysis

We complement the previous analysis with linear regression models, which will allow a more rigorous assessment of treatment impacts on individual contributions. Given that we have multiple observations per individual participant, we can analyse the data as a panel (also known as a 'cross-section time-series'). In selecting between a fixed or random effects model specification, our first consideration was whether time-invariant influences such as age, gender and village-membership were likely to have significant impacts on our dependent variable (in this case, individual contributions). If we assume they do, then fixed effects models are preferable as they control for these influences. However, by controlling for the time-invariant characteristics, a fixed effects model will essentially 'remove' these effects from the model leaving us only with the net effects of the treatments on contributions, i.e. the impacts of the treatments on contributions, but would not allow us to explore whether the socio-economic characteristics influence contributions. In this case, a random effects model is preferable.

Given our interest in assessing the influence of socio-economic and attitudinal characteristics on our dependent variable - in addition to the main effects of the treatment variables - we use a random effects model. This assumes that the individual-specific constant terms are not correlated

with any of the independent variables in the model. Tests confirm that this is not an issue, and that the random effects model is appropriate with our data.[15]

Table 5 presents results from the random effects panel regressions, all run with robust standard errors. The first model identifies the main effects of the treatments on individual contributions, controlling for learning effects associated with playing repeated rounds of the game. All the treatment variables are dummy variables, which take a value of one for contributions made during treatment (i.e. between rounds 11-20), and zero if otherwise ('communication' is omitted as the reference category). Thus, we do not assign the treatment dummy to the individual player, but to the contributions, in order to distinguish treatment contributions from 'untreated' (baseline) contributions.

Model (2) incorporates two additional dynamic variables intended to capture how a player's present behaviour is shaped by past contributions. These dynamic variables include the round (to control for learning effects), and the sum of contributions by the rest of the group in *t-1*. Finally, model (3) incorporates socio-economic characteristics, demographic and social capital indicators identified in the Exit Survey, in order to explore their relative impact on cooperation in the games. In addition, we include a dummy variable controlling for participation in the contingent valuation survey that was conducted in these villages in November 2014.

[15] We performed a Hausman test (see Greene, 2008) to identify whether a fixed or random effects model was most appropriate for our main effects regression. The test result of Chi2=3.74 (6 degrees of freedom), p= 0.7120 fails to rejects the null hypothesis that the individual-specific constants are correlated with the regressors, hence the random effects model is more appropriate. Additionally, the Breusch-Pagan Lagrange multiplier test (p=0.0000) rejects that variances across entities are equal to zero, confirming that the random effects model is preferable to a pooled model.

Table 5. Linear random effects panel regressions on individual contributions

Dep var:	(1) Main effects			(2) Incl. dynamic vars			(3) Full effects		
individual contributions	Coef.	Std. Err.		Coef.	Std. Err.		Coef.	Std. Err.	
Treatments									
Public obs. treatment	-1.51	0.31	***	-0.91	0.29	***	-0.66	0.17	***
Negotiation treatment	0.93	0.32	***	0.86	0.29	**	0.54	0.25	***
Leadership treatment	0.33	0.26		0.50	0.28	*	0.25	0.24	**
Video-prime treatment	0.29	0.25		0.36	0.25		0.11	0.23	
Video-neutral treatment	0.38	0.30		0.48	0.29		0.24	0.23	
'Dynamic' variables									
Rounds (1 to 20)				-0.01	0.01		-0.01	0.01	
Rest of group's contribution at *t-1*				0.03	0.00	***	0.02	0.00	***
Socio-economic & social capital indicators									
Female (1=yes)							0.04	0.49	
Age							-0.004	0.00	***
Secondary-school education level or above							-0.44	0.29	
Income/1000							0.04	0.02	**
Born in village (1=yes)							-0.14	0.47	
Trust							0.21	0.29	
Member of village council							1.03	0.71	
Participation in village decision-making (1=yes)							-0.21	0.14	
Voted in elections (1=yes)							0.90	0.43	**
Participated in contingent valuation survey (1=yes)							0.05	0.02	***
Village dummies (nine)								Included	
Constant	4.10	0.16	***	3.10	0.24	***	2.42	0.83	***
N. obs.	4500			4275			4161		
N. individuals (panels)	225			219			219		
Wald chi2	(d.f.=5)	38.13	***	(d.f.=7)	115.91	***	(d.f.=25)	241.62	***

* p<0.10, ** p<0.05, ***p<0.01.

Results in Model (1) largely confirm hypothesis tests reported in Table 4. Public observability exerts a significantly negative influence on contributions; negotiation has a significantly positive effect. The other treatments have positive effects, but these are not significant. When we introduce the dynamic variables into the model (model (2)), public observability and negotiation remain significant. Interestingly, leadership has become significant in Model (2), suggesting that some variation has been reduced by including the dynamic variables, allowing for leadership effects to be identified – although only at the 10% level.

The negative sign on the variable 'Rounds' indicates that there are declining contributions over time, as expected; however this effect is not significant. On the other hand, past contributions made by the rest of the group clearly have a very powerful effect on contributions in the present round. This positive impact of other group members' past contributions is suggestive of positive reciprocity, which is expected in cooperative settings.

Results also confirm that neither of our video treatments had a significant effect. As discussed earlier, preliminary analyses suggest that the priming treatment had a different effect on participants conditional on their 'decision-mode'. Unfortunately, with our present data, we cannot confirm that this is the case; inclusion of the decision-mode dummies in preliminary rounds of regressions indicated that none were significant, even in interaction with the video treatments. For this reason, we omitted them from the final models. However, this was mostly an exploratory treatment in a field setting, and future research in similar settings would help to identify whether messaging-effects are indeed dependent on decision-mode. Furthermore, future research in this area may help disentangle the effects of anticipated emotions primes (if any) from the effect of the medium, or the content of the script, used to prime participants.

Finally, Model (3) incorporates socio-economic, demographic and behavioural variables in the model. Results indicate that income has a positive effect on cooperation, whilst age has a negative effect. Interestingly, most of the indicators of social capital and trust are not significant. Neither participation in village affairs, nor having been born in the village, have any bearing on contributions and members of the *Gram Panchayat* village council are not significantly more likely to contribute more (although the sign on the coefficient is positive). Interestingly, however, voting in the state elections appears to be a strong predictor of cooperation. Thus, indicators of local participation are not adequate indicators of local cooperation. This raises a

chicken-and-egg question: does participation in local affairs lower one's tendency to cooperate, or does participation depend on other factors of which cooperation is not one of them? We cannot answer this question here, but this result raises the question: are existing decision-makers most suited to initiate collective action?

Interestingly, participation in the survey study that our team carried out six months earlier in the same villages has a significantly positive effect on cooperation. This warrants some comment. We note that our survey study was a 'contingent valuation' study (described in footnote 6). As part of the process, respondents were provided with extensive information about their communal water treatment plant and the health impacts of fluoride contamination. A hypothetical market was then presented to respondents involving a democratically-elected water committee (see Alfredo and O'Garra, 2015 for more details). Thus, it is possible that this cooperative behaviour during the games was partly motivated by the information that we provided during the survey, particularly relating to the water committee and the idea of the community cooperating in the long-term operation of the water treatment plant. In effect, we might have 'planted' the idea of a cooperative water committee during that survey, and this may have motivated greater contribution levels in the experiment. This is not unlikely. One cannot expect in-depth survey studies, such as our contingent valuation study, to have no effect on participants' attitudes and beliefs.

However, another more parochial possibility is that the survey sample suffers from survey-response bias, whereby those who participated in the surveys were simply more cooperative people to begin with. We argue this is unlikely to be the main reason for the positive influence of previous participation, as survey response rates were very high, which is often the case in developing country studies (Whittington, 1998). Therefore, we consider that the most likely explanation is that our survey study positively influenced intrinsic cooperation levels in respondents – a kind of positive spill-over from social science research. We propose that a valuable research question would be to identify the long-term impacts of in-depth social science field-based research on the people that it samples.

Overall, results indicate that, when controlling for other sources of variation in the sample, only the public observability treatment has any persistent effect on contributions. The policy implications of this funding are discussed below.

8. Discussion

Results in the present study adhere to results from previous empirical studies showing that people's behaviour does not conform to rational choice expectations. Cooperation levels in our experiments started at between 40%-50% of the endowment in all groups, and only experienced modest and non-significant declines over time (similar findings reported in Cardenas et al., 2011). Introduction of new sets of rules (the treatments) in general bolstered cooperation, although this was not the case in the public observability treatment. When group members could observe each other's contributions, this had the unexpected effect of *decreasing* contributions over time.

In general, public observability has been found to increase cooperation mostly in lab studies conducted with Western students (e.g. Rege and Telle, 2004; Andreoni and Bernheim, 2009) although similar findings have been reported in field experiments in Bolivia (d'Adda, 2011) and the Caribbean (Lopez et al., 2012[16]). We note however that Noussair and Tucker (2007) found that the positive effect of observability disappeared after a few rounds of play. The explanation given for the typically positive relationship between public observability and contributions in public goods games is that people desire social approval, and contributing to the public good is a socially-approved behaviour (Rege and Telle, 2004).

We suggest that publicly observable contributions to the public good may not be universally considered a socially-approved behaviour, as appears to be the case in the present study. An additional - or alternative - explanation is that the fear of being *seen* to be a 'sucker' overwhelms other influences on publicly-observable behaviour (De Cremer, 1999). These are very interesting questions that would benefit from further research. However, regardless of the motivations for declining contributions, this result highlights the hazards associated with extrapolating findings from one cultural context to another, lending support to the notion that solutions to local problems must be 'home-grown' (Easterly, 2006).

[16] Comparability with the Lopez et al. (2012) is limited because their public observability treatments involved revealing a randomly-selected individual's contribution, and highlighting how that individual's contribution produced a loss for the rest of the group.

Closely related to the above is the 'leadership' treatment, involving public disclosure of first-mover contributions as a form of descriptive norm. This also failed to motivate higher contributions, largely because leaders did not increase their giving relative to followers as is standard in leadership experiments (e.g. O'Garra and Sisco, 2015; Dannenberg, 2014; Rivas and Sutter, 2011). This probably occurs for the same reason that disclosure of everyone's behaviour does not increase cooperation: because social approval does not follow from contributing generously to the public good. This is a very interesting finding, and one that warrants follow-up research.

Another key finding in this study is that negotiation has a positive effect on contributions compared to open, unstructured communication. This is perhaps unsurprising: allowing a space for communication does not lead naturally to the negotiation of agreements. It is clear that the mandatory negotiation treatment had a much more positive - if cyclical - effect on contributions. However, the positive effect of negotiations on contributions disappears when we introduce the dynamic variables into our regression model. Specifically, the past contribution behaviour of one's group overrides any positive negotiation effects (regressions with and without this variable confirm this to be the case). The implication is that negotiation effects are positive, but that cooperation is contingent on reciprocity. If the members of the group fail to adhere to agreements reached during negotiation, then cooperation collapses in the following round. This makes intuitive sense, and explains the cyclical nature of the negotiation effects.

We consider that on the basis of our findings, there is ample scope for negotiation to promote cooperation, whilst taking into account reciprocity. This implies that negotiation/communication processes would require mediation to resolve potential conflicts arising from breaching of agreements with the aim of minimising the 'collapses of cooperation' observed in our data. Furthermore, mediation would be needed to encourage participation of all members involved in the discussion and avoid elite capture. We did not collect data on the content of the negotiation/communication process within the groups, or participation levels, so we cannot identify how many of the group members actually engaged in discussions, and whether agreements were reached.

These results allow us to derive some initial policy recommendations regarding potential interventions to be implemented in villages with communal water treatment plants in

Maharashtra, India. On the one hand, our findings suggest that social interventions involving public disclosure of behaviour may have the unintended effect of decreasing cooperation. Such interventions might have been as simple and cost-effective as posting the names of the families or households who had made their contributions towards the water treatment plant in a public place such as a community centre, school or at the treatment plant itself. These types of intervention have been successful at encouraging reductions in residential energy-consumption in the U.S. (e.g. Cuddy et al., 2010). Unfortunately, results from our study suggest that such policies do not necessarily transfer easily from one cultural context to another.

Communication with negotiation, on the other hand, appears to have the greatest potential as a tool to increase cooperation in the villages. This conforms to the literature, and also to general development thinking *vis a vis* participatory decision-making (Gaventas, 2004). However, results also show that negotiation effects are cyclical, suggesting that agreements are as strong as those who fail them. In the long-run it is likely that cooperation declines to zero as repeated attempts to negotiate agreements fail time and again (although we cannot verify this with our data). We propose that negotiation processed be coupled with additional mechanisms to sustain stable levels of cooperation over time. These mechanisms might include contractual agreements, combined with economic instruments such as fines and/or rewards[17], and/or mediation by an impartial observer. We propose that future research explore the potential for a range of different mechanisms to minimise agreement-breaking in negotiation interventions in the field.

9. Conclusions

Our experiments explored the impact of a range of social and psychological interventions on cooperation *vis a vis* a water management in a developing country setting. Specifically, the results presented here represent a first step in the identification of potential policy interventions that might be implemented in rural villages across Maharashtra with water treatment plants that require communal management. The failure of communities to operate and manage these water systems is largely a result of poor communication between the various stakeholder groups

[17] Economic instruments however have been found to crowd out cooperation in field experiments more often than not (see Rode et al., 2014 for review) so we hesitate to advocate for their use here.

involved in the process (government, private companies, district officials, village councils and community members) and the lack of a structured transition process from government-run to communally-managed operation. Results from our previous contingent valuation survey (Alfredo and O'Garra, 2015) confirmed that villagers valued their water treatment system and were willing to contribute time and/or money to support the long-term operation of these systems. Thus the present study was designed as the next stage in the key question of how to ensure rural communities have access to safe water.

Results from this study shed light on the social interventions that might best support cooperation in this regard – and those that definitely will not. Public disclosure of behaviour is not a policy-option in these villages. How much this applies across the state of Maharashtra and beyond, across India, is a matter of culture and context and would require further research. Participatory processes in which participants are encouraged to negotiate agreements however appear to hold great promise; yet participatory decision-making is costly and labour-intensive to implement. These processes are typically mediated by external observers, and require continued involvement for their success in the long-term. Nonetheless, participatory decision-making is likely to yield positive spill-overs as social capital resulting from increased participation and engagement in negotiating of agreements will likely benefit resource management in general, a key to sustainable development in rural developing country communities.

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