Social capital dynamics and collective action: the role of subjective satisfaction in a common pool resource experiment

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ABSTRACT. In low-income countries, grassroots collective action for the management of a common environmental resource is a well-known substitute for government provision of public goods. In our research we test experimentally what its effect is on social capital. To this purpose we structure a 'sandwich' experiment in which participants play a common pool resource game (CPRG) between two trust games in a Nairobi slum where social capital is scarce but informal rules regulating the commons are abundant. Our findings show that the change in trustworthiness between the two trust game rounds generated by the CPRG experience is crucially affected by the subjective satisfaction about the CPRG, rather than by standard objective measures related to CPRG players' behaviour. These results highlight that subjective satisfaction in a collective action has relevant predictive power on social capital creation, providing information which can be crucial to designing successful self-organized environmental resource regimes.

1. Introduction

There is widespread consensus in the literature about the role and importance of social capital as a 'lubricant of economic activity' (Arrow, 1974). Most social and economic relationships occur in a framework of asymmetric information and incomplete contracts and are structured in sequential moves in which investors make themselves vulnerable to others' action (Greig and Bohnet, 2008). As a consequence, the levels of trust and trustworthiness (a crucial dimension of social capital) are fundamental to reducing 'social risk' and fostering exchange and cooperation which, in turn, ensure higher creation of economic value. In essence, trust acts as a substitute for formal contracts, significantly reducing transaction costs in social and economic interactions.[1] In the absence of high levels of trust and social capital, economic transactions would most often be feasible but surely less profitable. Given the relevance of this topic, the research on the determinants and consequences of social capital has become an important field of inquiry during the last two decades.[2]

   Based on what is considered above, we focus on studying changes in social capital in the Nairobi slum of Kibera, a particularly relevant context in which to run trust and public good games (PGGs) given the extreme local scarcity of social capital. Such scarcity is confirmed by recent empirical findings. Cassar and Wydick (2010) show in a microfinance game carried on in low-income areas of five different countries (Armenia, Philippines, India, Kenya and Guatemala) that the contribution levels are lowest in the African country and, more specifically, in Nairobi slums. Greig and Bohnet (2008) find similar results in a one-shot trust game (TG).[3]

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[1] In their study on the role of social capital in financial development, Guiso *et al.* (2004) provide an excellent example when reporting that Jewish diamond merchants in New York save a substantial amount of lawyers' fees by conducting their economic transactions informally. The power of the community is sufficient to enforce informal contracts, since a merchant's misbehaviour would damage his reputation and exclude him from future transactions.

[2] The positive effect of the level of trust on economic growth and institutions has been documented by a large number of studies (see, among others, Keefer and Knack, 1997; Zak and Knack, 2001 on the first point and Putnam, 1993; La Porta *et al.*, 1997 on the second). Trust and trustworthiness have been shown to impact positively on firm productivity (Fullenkamp and Chami, 2002). The lack of trust and trustworthiness prevents the development of economic relationships among individuals belonging to different ethnic groups and is therefore one of the microeconomic causes of poor economic performance (see, among others, Alesina *et al.*, 1999; Gradstein and Justman, 2002; Montalvo and Reynal-Querol, 2005a, b). On the positive side, it has been shown how microfinance membership as a signal of trustworthiness may create a virtuous circle between social capital and economic performance for borrowers (Becchetti and Conzo, 2011).

[3] The reasons are both structural and related to specific recent historical events (the civil unrest following the December 2007 elections). Among the structural elements, two main factors are the huge demographic pressure from the rural areas and the circular migration patterns weakening ties among slum dwellers. As documented by Beguy *et al.* (2010), the majority of Nairobi slum dwellers spend on

The novelty of our experiment is in the investigation of the dynamics of social capital via the evaluation of how PGG-like activities affect changes in trustworthiness among players in TG. To this purpose we devise a 'sandwich' experiment in which the introduction of a modified PGG (a common pool resource game, or CPRG) treatment between two TG rounds is meant to analyze the effects of the community provision of local public goods (PGs) and common pool resource management, a typical phenomenon in socio-economic environments of developing countries like Kenya, on trust and trustworthiness.[4] Due to the scarcity of government resources, the informal practice of *harambee* ('let's pull together' in Swahili), that is, local cooperation for the realisation and maintenance of small infrastructures in the slums, is a well-known feature in Nairobi. In this large city, community fundraising and gratuitous effort provide fundamental support to build and manage schools, clinics, water spouts (Greig and Bohnet, 2008),[5] infrastructure like roads and bridges, systems to generate and carry electricity, and churches (Wilson, 1992).[6] In this respect we wonder whether and under what circumstances this practice (and, more generally, activities with PGG features) may affect social capital – thereby contributing to strengthening an important factor in economic development – and reducing 'tragedy of the commons' phenomena when dealing with the management of a common resource.

This paper is divided into six sections (introduction and conclusions included). In the second section we illustrate the hypothesis under investigation. In the third section we describe our experiment design. In the fourth section we discuss non-parametric tests and in the fifth we present and comment on the econometric findings. The sixth section concludes.

2. The role of satisfaction in CPRG activities

The specific hypothesis tested in our experiment is the importance of subjective satisfaction vis-à-vis standard objective measures of CPRG behaviour in producing changes in social capital.[7]

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average less than three years in the area and a quarter of them stay for less than 12 months.

[4] The impact of the experiment on trust and trustworthiness is examined in Becchetti *et al.* (2013).

[5] Fundraising for community projects can be either private or public. Private *harambees* typically raise funds from family and friends for funerals and weddings, college fees and medical bills. Public *harambees*, in contrast, raise funds for development projects of common interest such as schools, health centres and water projects.

[6] For an analysis of *harambee* activities carried out in Kenya between 1980 and 1999, see Transparency International Kenya (2001).

[7] The literature on determinants of life satisfaction has boomed in recent years for several reasons. First, it helped economists to investigate at the aggregate level why subjective wellbeing does not always coincide with standard objective measures and, at the micro level, to identify non-objective factors affecting utility beyond standard objective measures. Finally, life satisfaction estimates with the compensating surplus approach provided relevant contributions concerning

Our investigation is motivated by the fact that the standard approach to economics relates individual utility almost uniquely to measurable objective economic outcomes (income, consumption, savings), even though the latter are only part of it. It is in fact well known that the same level of consumed goods or perceived income may generate completely different levels of satisfaction due to concurring factors related to motivation, development, and the peripheral circumstances of the economic actions leading to a given objective result.

Roughly speaking, the same basket with two apples (or, in our case, the same objective payoffs in the CPRG) may correspond to completely different levels of satisfaction for the individuals who enjoy them. Such differences may be determined by the capacity of the objective outcome to satisfy/not satisfy complex psychological elements of individual preferences (positional competition, other-regarding preferences, conformity, search for exclusivity, kindness, etc.), heterogeneous goals and motivations of the action, its development and circumstances, perceived intentionality beyond other people's decisions, the gap between expectations and realizations, or the quality of the relationships among people.[8] Marketing managers are well aware that these non-objective factors are crucial for predicting patterns of subsequent objective behaviour and they use consumer satisfaction surveys as a main instrument of inquiry, together with objective evidence on actual consumption patterns.

From what is considered above, we understand that many factors may affect the gap between objective outcome and subjective satisfaction. In our opinion, the easiest and most parsimonious way to take them into account in our experiment is by asking directly about satisfaction with other players' behaviour in the CPRG and testing how much it matters vis-à-vis objective characteristics in the second TG.

Since a subjective evaluation of the experiment treatment such as CPRG satisfaction cannot obviously be randomized *ex ante*, it may be argued that a third driver may affect the observed correlation between satisfaction

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the measure of the shadow value of non-market goods (for a survey see, among others, Frey and Stutzer, 2002, 2010; Clark *et al.*, 2006).

[8] Along this line Frey and Stutzer (2002) and Frey *et al.* (2003) develop the concept of procedural utility, arguing theoretically and finding empirically that satisfaction with a given outcome is significantly higher if individuals have been involved in the process towards the outcome itself. In addition, different levels of satisfaction for the same achievement may classically arise due to relative income preferences of the kind documented, among others, by Ferrer-i-Carbonell (2005). This is because in the relevant income literature what matters is not just the absolute income level but also the gap between one's own income and the average income of a reference group of 'peers'. A third field of research is intentionality. Intentionality implies that appreciation for a counterpart's action depends not just on the observed choice but also on the set of the discarded alternatives. Recent empirical findings have shown, for instance, in gift exchange models that the same amount received can trigger more reciprocity in response when the receiver knows that the sender did it without knowing of the existence of a second round (Stanca, 2010).

itself and changes in social capital. For this reason, in our experiment we control for endogeneity by: (i) randomizing *ex ante* the participation in the CPRG/no CPRG treatment; (ii) looking at changes in trustworthiness between the two TG rounds, that is, eliminating the effect of time-invariant idiosyncratic components by use of first differences; (iii) controlling *ex post* that balancing properties on observable characteristics are met between more and less CPRG satisfied; (iv) using propensity score (PS) weights in weighted least squares (WLS).

It is important to underline that, even in the extreme case in which, after all these checks, we might still perceive the existence of complex unobservable components interacting with game situations (but not affecting *ex ante* trustworthiness levels) and producing the observed outcome, our policy implications would remain. In fact, in order to enhance social capital creation in disadvantaged economic environments such as those examined in our experiment, our findings suggest the usefulness of identifying those individuals who, for the same given observable dynamic of PG activities, are more apt to be positively affected in terms of changes in social capital.[9] This identification can be done by extracting (via satisfaction surveys) subjective factors related to the process of creation of PGs. If individuals more prone to finding positive elements in these activities are properly selected for participation in the most important processes of creation of PGs in crucial socio-economic frameworks (i.e., individuals to be elected to boards of collectively managed commons, in local political institutions, etc.), the learning to trust benefits arising from CPRG activities may be magnified, with significant effects on the reduction of transaction costs of social and economic relationships at a wider community level.

An interesting application of our results is in the management of common pool resources. According to established theoretical and empirical evidence (Ostrom, 1990, 2000), the first principle which makes the difference between a 'tragedy of the commons' and a well-managed self-organized resource regime is a 'boundary rule' (i.e., the selection of a small core group of users who identify each other based on the reliability of their social attitudes). Since such successful resource regimes depend in large part on endogenous levels of trust and reciprocity, understanding how PGG activities reinforce or weaken such endogenous levels and identifying individuals for which the relationship is less strong is of fundamental importance.

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[9] The qualifying difference between the two alternative interpretations of our findings (in the presence or not of endogeneity) is that, if the observed significant change in social capital is produced by the CPRG, situations of that kind significantly affect the creation of social capital for the special types of (more satisfied) individuals identified in the experiment. If, on the contrary, the observed finding depends on unobservable *ex ante* time-invariant components (endogeneity), extraction of satisfaction is fundamental to identifying and selecting more cooperative subjects.

3. Experimental design

Experiments were conducted in July–August 2010 in Kibera (Nairobi, Kenya), one of the biggest slums in the world. For this project we created a sample of 404 randomly selected slum dwellers.[10] The experiment consists of two identical *individual* sessions (TGs) where participants play the game face to face only with the instructors, and an in-between *group* session, where participants also interact with their peers in groups of four members each (PGG). The sequence of the sessions is: (i) *Trust game 1* (TG1) aimed at measuring *ex ante* trust and trustworthiness levels (individual session); (ii) *Common pool resource game* aimed at observing cooperation dynamic over five rounds (group sessions); (iii) *Trust game 2* (TG2) in which participants repeat the TG1; (iv) demographic survey (see figure 1). In order to prevent confounding effects, 100 individuals participate only in the two TGs without being involved in the CPRG: we call this sample the 'control' group. In this way we are able to causally attribute any change in the players' trust/trustworthiness levels (from the first to the second TG) to the outcomes of the CPRG group sessions.

Experiments were carried out by local field assistants who were informed about details and procedures only after the selection of the sample and just before the beginning of the games. This was meant to avoid potential word-of-mouth phenomena and strategic or collusive behaviour. In each session experimenters were alternated for two reasons: (i) to exclude confounders such as psychological pressure when playing two rounds with the same experimenter; (ii) to prevent a possible bias arising from different experimenters' attitudes or their previous relationships with some players.

Players were not aware of the sequence of the games and did not obtain feedback on their payoff from the first TG (but not that of the CPRG) until the end of the whole experimental session. The following subsections explain the games in detail.

3.1. Trust game

Our TGs are standard two-player investment games (see Berg *et al.*, 1995), where players are matched with a counterpart of unknown identity. People selected as trustors receive 50 Kenyan shillings (KSh) at the beginning of each TG and have to decide how much to give to the counterpart (trustee), knowing that this value gets tripled. Those selected to be the trustees receive an initial endowment of KSh50 and have to decide *ex ante*, without

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[10] Participants received a show-up fee (KSh150) and were told that they had the possibility of winning up to KSh800, based on their performance in the experimental sessions. They were randomly recruited with a map of the informal buildings in the Kianda area of the slum of Kibera (Nairobi). In situations with two households in the same building, local experimenters tossed a coin and selected one; in case they found three, they randomly extracted one token out of the four representing directions (North, South, West, East). Only individuals above 18 years of age were selected, alternating the gender for each household. After this first selection we made a list of all the individuals identified in the area willing to participate and randomly shortlisted the 404 participants.
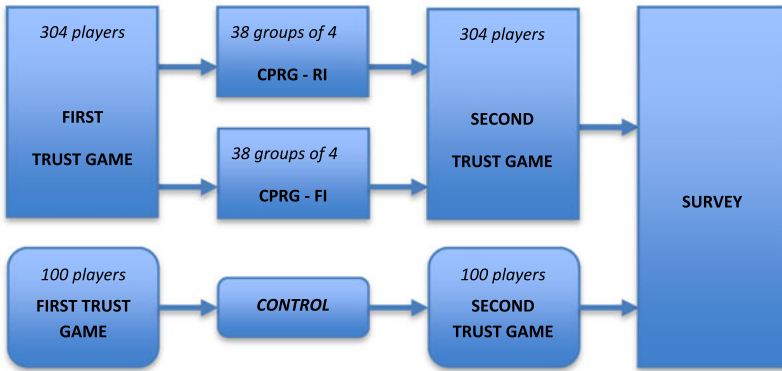
Figure 1. *The experiment design*
Notes: CPRG-RI: common pool resource game – restricted information design (players do not see how much other peers in the group withdraw and receive); CPRG-FI: common pool resource game – full information design (players see how much other peers in the group withdraw and receive).

knowing the amount sent by the trustor, how much to give back to the first player. The use of this 'strategy method' allows the experiment to be conducted in a non-simultaneous framework without any loss of information about the trustees' overall response strategy.[11] *Ex post* surprise questions capture the so-called first- and second-order beliefs (respectively FOBs and SOBs).

3.2. The common pool resource game

We rely on a modified version of the PGG[12] where players face a trade-off between individual and collective benefits when dealing with a common resource. This variant is usually referred to as the *Common pool resource game*.[13]

We randomly form 76 groups of four people each (304 people in total) who sit in a circle around a pile of KSh600 (€6.18 in the month of the experiment). Participants are allowed to withdraw any amount between zero and KSh150 from the pile and keep it, the amount left being doubled and

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[11] For pros and cons about using the strategy method vis-à-vis actual choices, see, among others, Cason and Mui (1998), Brandts and Charness (2000) and Casari and Cason (2009).

[12] Camerer and Fehr (2003) summarize some stylized facts: in one-period PGGs, most subjects contribute either everything or nothing, the average being roughly half the endowment, while in repeated games the average contribution declines. An important determinant of players' contribution is their expectation about other people's behaviour in the game (Fischbacher *et al.*, 2001), with disappointment about free-riding choices determining a progressive decline in contributions. On the contrary, when players are allowed to punish their counterpart, the pattern is reversed (Fehr and Gächter, 2002).

[13] See Henrich and Smith (2004) for a common pool resource field experiment among tribes of the Peruvian Amazon.

divided equally among the four participants. In order to replicate a simultaneous setting, each player writes down on a sheet how many KSh he/she wants to withdraw. Then, experimenters make the calculations and write down the individual payoffs, that is, the sum of the withdrawn amount and one-fourth of the common capital (the money left by all players multiplied by two).[14] The CPRG is repeated five times but the number of rounds is known only to experimenters to reduce end-game effects. Players are informed at the beginning of the game that they will be paid for only one randomly chosen round. Based on these characteristics, our CPRG is equivalent to a PGG with an endowment of KSh150 and a MPCR of 0.5 framed as taking from the PG rather than giving to the PG.

In order to control for public approval/fear of punishment, half of the sample, 38 out of the 76 groups, play the game in the restricted information design (CPRG-RI, where each person does not see how much the other players receive), and the remaining half play in the full information design (CPRG-FI). In the CPRG-RI, the experimenter calculates the payoffs and distributes the money in envelopes, while in the CPRG-FI, each player has to announce how much he/she decides to withdraw and payments are visible to everybody.[15] To be sure that all participants fully understand the other players' payoffs, these are announced by the experimenter at the end of each round. During the five rounds, payments are made with tokens and reported on a sheet with its corresponding round number (from 1 to 5). At the end of the whole game, each player extracts a number from a black bag containing numbers from 1 to 5. The number extracted will indicate the round for which the player's payoff gets converted into real money.[16]

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[14] Experimenters explain the game with a few examples highlighting different potential scenarios. We do not believe that such examples may enhance strategic learning among players since the latter do not know other players' strategy but simply the potential payoff distributions in some of the potential scenarios. Moreover, since the game may sound too unfamiliar to them, we have to help them anyway in achieving a fair level of comprehension necessary to participate in the game.

[15] A main difference between our CPRG and standard PGGs is that we depart from a fully anonymous setting and let players see each other. This procedure is intended to mimic more closely the reality of common pool management in a given area where individuals know each other. Our full information/restricted information variant is intended to allow for the two reasonable possibilities that players are or are not perfectly informed about non-cooperative behaviour of other members due to the presence/absence of a monitoring process.

[16] We deem such complexity necessary in order to measure the change in trustworthiness determined by group activities in which participants may experience the opportunistic behaviour of the other participants. Consider, in fact, that a simple multistage dynamic TG, in which round specific payoffs are revealed at the end of each stage (hence without strategy method), would have made impossible the verification of the net effect of the group activity on the trustworthiness of TG participants. This is because, in the second round of the TG, players' behaviour would have been affected not just by the impact of the CPRG experience but also by the outcomes of the first round of the TG revealed to players.

As in most field experiments with low-income recipients, the maximum potential payoff (KSh800 from the two TGs, the PGG, and survey and show-up fees) is very high in relative terms. The amount at stake is roughly the average weekly wage in the area which, considering also the low local standard of living, makes us confident that players will take seriously monetary rewards in the game.[17]

4. Descriptive statistics and hypothesis testing

In what follows we present and discuss descriptive characteristics of our variables and results of our non-parametric (Wilcoxon Mann–Whitney rank-sum)[18] tests on the main hypotheses of our research.

4.1. Description of the variables used and summary statistics of the whole sample
Table A1 in the online appendix available at http://journals.cambridge. org/EDE describes the variables related to the trust and PG games and the socio-economic variables used as controls in the regression analysis, while table A2 (online appendix) provides sociodemographic summary statistics. Participants in the experiment are very young and gender is balanced in the sample. The majority of them are single. The average number of years of schooling is 11; the unemployment rate and employment in the informal sector are high with several ethnic groups living in the same district. Half of the sample volunteer more than once a month and/or are members of a microfinance institution. Impatience, risk and betrayal aversion[19] are frequent psychological attitudes.

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[17] Average weekly salaries are extremely low and a relevant share of the sample are unemployed. Furthermore, in Nairobi slums around 50 per cent of the adult and child population face hunger and, more generally, around 70 per cent live below the poverty rate (Faye *et al.*, 2011).

[18] The test is the non-parametric analogue to the independent sample *t*-test and can be used when removing the restrictive assumption that the variable of interest is normally distributed. Observations from the two groups are placed in a unique ranking and a significant difference in the sum of ranks for the two subgroups identifies a significant difference between the two subgroup variables. Results from parametric tests are in line with those of non-parametric tests. They are omitted for reasons of space and available upon request.

[19] By collecting experimental measures of betrayal aversion, Bohnet and Greig (2009) show that individuals are generally less willing to take risks when the uncertainty is due to another person rather than nature. In order not to complicate further the game and expose participants to an additional (and stressful) experimental activity, we collect survey measures of betrayal aversion by asking questions on negative reciprocity (see the questionnaire in the online appendix). Those measures should be proxy for betrayal aversion as argued by Fehr (2009), '[. . .] Betrayal aversion means that people dislike non-reciprocated trust [. . .] People with a strong preference for negative reciprocity (i.e., a preference for punishing non-reciprocal behavior) are, *ceteris paribus*, more likely to feel betrayed in case of non-reciprocated trust [. . .]' (Fehr, 2009: 247). In the questionnaire, negative reciprocity is calculated by looking at the level of consent to the following two questions: (i) If I suffer a serious wrong, I will take revenge as soon as possible, no matter what the costs; (ii) If someone offends me, I will also offend him/her.
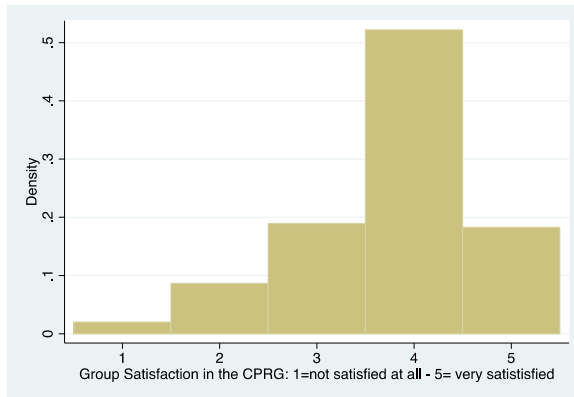
Figure 2. *Distribution of satisfaction with peers in the CPRG.*

Table A2 contains summary statistics as well for the variables related to the experiment. The amount given by the trustor (around KSh25) is roughly the same in the first and second TG. Hence, the change from the first to the second session is on average zero but ranges from −30 to +45, with a standard deviation equal to 8.61.[20] During the five sessions of the CPRG, players withdraw around 69 per cent of their money from the common pile, ranging from a minimum of 23 to a maximum of 97 per cent. The difference between the amount withdrawn by the player and the average of her/his group varies significantly (standard deviation equal to KSh26.63).

The declared level of players' satisfaction in the PGG can range from a minimum of one (*not at all satisfied*) to a maximum of five (*very satisfied*). We aggregate the five classes into three categories: *very satisfied* (score four or five), followed by *pretty satisfied* (score three) and *not satisfied* (score one or two). The level of satisfaction about the outcome of the PGG is high, since 70 per cent of players declare themselves *very satisfied*, 19 per cent *pretty satisfied* and only 11 per cent *not satisfied* (see figure 2).

Figure A1 in the online appendix shows the distribution of trustworthiness in the second TG round (proxied for by the amount returned by the trustee in that TG round) and how it varies according to the different levels of satisfaction with peers in the CPRG. The unconditional distribution (bottom-right graph) is left-skewed and centred around KSh30–40 while the conditional distribution highlights an increase in the number of trustees returning larger amounts of money when very satisfied with the behaviour

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[20] These first descriptive results suggest some insights into the debate on the persistence of social capital. According to some authors, social capital does not vary much in the short run and its geographical distribution is affected by long-run historical phenomena (Guiso *et al.*, 2008). However, our descriptive evidence shows that short-run aggregate invariance (confirmed by our findings) may conceal relevant changes at the individual level whose determinants deserve further inquiry.

of their peers in the CPRG (bottom-left graph vs. the top-left and top-right graphs).

4.2. Balancing properties

We test non-parametrically whether there are significant differences among the three groups (table A3, online appendix). When comparing *very satisfied* vs. the rest of the sample, we find that the former are younger and married in higher proportion (p-value = 0.03). When comparing *very satisfied* and *pretty satisfied* vs. *not satisfied*, we find that the latter are more affected by negative reciprocity (p-value 0.04). Note, however, that when we compare *very satisfied* vs. *not satisfied* (excluding *pretty satisfied* from the sample), the null of no difference on the observed characteristics is never rejected below the 5 per cent level.

In table A4 (online appendix), we look at balancing properties in the randomization of participants in the CPRG and the control group and do not find significant differences for any of the considered variables.

4.3. The behaviour in the CPRG

The dynamic behaviour of all subjects in the CPRG documents that cooperation decreases over rounds, with cooperation being measured in each round at the individual level as players' withdrawal ratio ($ withdraw/150), and at the group level as the left-in-the-pot ratio ($ left by the group/600). The decrease is, however, much smaller than what is usually observed, consistent with the fact that we do not inform participants about the number of CPRG rounds.[21] The mean withdrawal ratio is on average 68.6 per cent, moving from 65.2 per cent in the first to 70.7 per cent in the fifth round. Participants seem to observe the behaviour of the group members and react strategically to it: if one or more defect in a round, others also do in the following round. The overall scarce degree of cooperation in our sample is consistent with that found by Cassar and Wydick (2010) in the same area.

When comparing the two CPRG treatments, we find that the decrease in cooperation is larger under the full information treatment consistent with the 'downward cascade of cooperation' hypothesis of Ostrom (2000), arguing that information disclosure without sanctions or cheap talks may actually increase and not reduce opportunism.[22]

4.4. Hypothesis testing

Results from hypothesis testing document that the CPRG significantly affects changes in trustworthiness between the two TG rounds while not significantly affecting its levels (table 1). This is because CPRG *very satisfied* start with lower trustworthiness levels in the first round and end up with higher levels in the second round vis-à-vis the rest of the sample. More

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[21] We take this decision since, consistent with the goal of mimicking the effect of ongoing CPRG-like activities on social capital formation, we prefer not to introduce the influence on the latter of CPRG end-game effects.

[22] We address the issue in depth in a related paper (Becchetti *et al.*, 2015). Additional evidence is available upon request.

Table 1. *Trustees' transfers and satisfaction for other players' behaviour in the CPRG*

		TG1		ΔTG	
		0	*1*	*0*	*1*
Very satisfied (1) vs. rest of sample (0)	*Obs*	47	105	47	105
	Mean	43.91	40.56	−5.85	0.33
	Non-par test (z, p)	1.81	0.07	−2.09	0.04
Very satisfied (1) vs. *not satisfied* (0) (excluding *pretty satisfied*)	*Obs*	23	105	23	105
	Mean	43.91	40.56	−10.34	0.33
	Non-par test (z, p)	1.81	0.07	−2.11	0.03
Very and *pretty satisfied* (1) vs. rest of sample (0)	*Obs*	23	129	23	129
	Mean	44.55	41.06	−10.34	−0.02
	Non-par test (z, p)	0.79	0.43	−2.06	0.04
Not satisfied (1) vs. rest of sample (0)	*Obs*	129	23	129	23
	Mean	40.96	45.33	−0.02	−10.81
	Non-par test (z, p)	−1.06	0.29	2.10	0.04

Notes: The table provides two-tailed non-parametric tests for the difference in mean of trustees' transfer according to the degree of satisfaction declared about other players' behaviour in the CPRG. Mann–Whitney (Wilcoxon rank-sum) tests are used as two-tailed non-parametric tests for detecting group distributional differences in rank. The null hypothesis is that the underlying distributions of the sociodemographic characteristic in row headers in the two subgroups are not significantly different from each other.

specifically, when we compare *very satisfied* vs. the rest of the sample, we find that the former have a change of KSh0.33 against −5.85 of the latter with the difference being highly significant (*p*-value 0.04). The two values are −10.81 vs. −0.02 (*p*-value 0.04), if we compare *not satisfied* with the rest of the sample, 0.33 vs. −10.34 (*p*-value 0.03) if we compare *very satisfied* vs. *not satisfied* (excluding *pretty satisfied* from the sample) and, consequently, −10.34 vs. −0.02 (*p*-value 0.04) when we compare *very* and *pretty satisfied* vs. the rest of the sample. Note that the maximum difference between two groups of different CPRG *very satisfied* players is around KSh10, that is, about 25 per cent of the (pre-CPRG) first TG level of trustworthiness in the overall sample. As we use the strategy method in the TG to extract amounts sent by trustees, the results reported above refer to averages of responses conditional on the 10 possible trustors' transfers (from KSh5–50).

5. Econometric analysis: determinants of the trustworthiness dynamic
In the presence of a well-structured randomization process, parametric and non-parametric tests are usually considered as sufficient empirical evidence by experimentalists. Nevertheless, we decided to perform econometric estimates because we wanted to evaluate the magnitude of our effects, isolate them from other confounding factors and control for

the full information/restricted information feature of the CPRG. In table 2 we report a baseline regression in which we test the effect of three main variables (the first TG transfer, restricted information in the CPRG treatment, and control dummy) on the change in trustworthiness between the two TG rounds with inclusion/omission of all the sociodemographic variables listed in table A1 in the online appendix. The negative coefficient of the first round transfer suggests the existence of a convergence mechanism which makes the more 'generous' players in the first round increase their transfer less in the second. Finally, everything else being equal, not having participated in the CPRG negatively affects the change in transfer from the first to the second TG. This suggests a positive effect of the CPRG on the process of creation of social capital. The only significant (negative) variable among sociodemographic controls is daily food expenditure, probably documenting that the marginal utility of money is higher for poorer players. In table 3 we restrict the sample to the treatment group and introduce subjective (*very satisfied* and *pretty satisfied* dummies) and objective (individual and group withdrawal ratios, individual payoffs) CPRG indicators, controlling as well for ethnic and gender fragmentation with and without the inclusion of sociodemographic variables.[23] We find that subjective indicators are significant (positive effect of CPRG satisfaction with a magnitude of more than KSh8, roughly equal to the variable's standard deviation) while objective indicators are not. Among other regressors, note that gender fragmentation has a strong economic impact (in line with Bohnet and Greig, 2009), even though it is significant only at the 10 per cent level.

Table A5 (online appendix) provides a robustness check of our main results by using alternative *relative* objective indicators as controls (ranking in withdrawal ratios, average and specific round differences between individual and group transfers and payoffs). Objective indicators remain not significant while the significance of subjective indicators is unaltered. We also check directly in a separate estimate whether CPRG satisfaction is affected by demographics and objective outcomes of the game and find that this is not the case for the majority of the controls (table 4). The interpretation is again that subjective satisfaction may be idiosyncratic or depending on many non-objective factors (see section 2).

Tables A6–A7 (online appendix) illustrate how econometric results on average trustees' transfers translate into results on trustees' conditional responses for two of the specifications adopted in estimates reported (table 3, columns 4 and 5). The area of the strongest significance of the CPRG *very satisfied* dummy (*p*-value below 0.001) is for trustors' transfers between KSh5 and 35, consistent with evidence from non-parametric tests[24] (the highest magnitude is around KSh12 in correspondence to a trustor transfer of KSh30). The significance of the *pretty satisfied* dummy is weaker and the magnitude is smaller (with the exception of the right-end

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[23] Results on sociodemographic variables are omitted for reasons of space. Full details on these results are available upon request.

[24] Evidence is omitted for reasons of space and is available upon request.

Table 2. *The determinants of change in trustworthiness between the two TG rounds – full sample (control group included)*

Regressor	Coef.	S.E.	Coef.	S.E.
Constant	22.84***	9.02	19.13***	3.78
Age	−0.17	0.15		
Female	1.31	1.62		
Married	0.90	1.82		
Widowed	3.20	4.45		
Separated	1.23	3.45		
Years of schooling	−0.09	0.34		
House members	−0.28	0.38		
Food expenditure day	0.01**	0.01		
Unemployed	1.85	2.02		
Kikuyo	−3.55	3.05		
Luo	1.02	2.43		
Lubian	−4.43	3.48		
Luhya	0.40	2.51		
Muslim	2.30	3.15		
Mfi	−0.27	1.80		
Volunteer	1.31	1.78		
Risk averse	−3.50*	1.87		
Negative reciprocity	−3.31	2.44		
Impatient	0.72	1.57		
Amount_Returned_ TrustGame (first round)	−0.51***	0.09	−0.48***	0.09
Participant in the full information CPRG	0.21	1.99	−0.23	1.93
Friends	−0.70	1.05	−1.05	1.07
Control	−4.65**	2.12	−3.31*	1.81
N	201		202	
R^2	0.4132		0.3405	

Notes: Regressions are run with OLS and clustered robust standard errors and include all the trustees, including those who did not participate in the CPRG (control group). The dependent variable is the change in average trustee's transfer from the first to the second TG.

estimates where the magnitude is higher but significance declines). Results on trustees' conditional transfers for different specifications are omitted for reasons of space and are available upon request.

Tables A6–A7 (online appendix) document a clear-cut growth of the magnitude of the CPRG *pretty satisfied* dummy effect on the dependent variable as long as the trustor hypothetical amount grows, while this is not so evident for the CPRG *very satisfied* dummy in table A6. In order to test whether such growth is significant, we use a compounded estimate where we regress average changes in trustees' transfers from the first to the second round on the average of the 10 hypothetical amounts the trustor can send – *Amount_Sent_by_Trustor* – and on an interaction variable where the

Table 3. *Individual and group withdrawal ratios in the CPRG, treatment sample only*

Regressor	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Participant in the full information CPRG	0.552	1.103	1.863	1.841	2.391	1.705	−0.918	−0.431	0.421	−0.0301	0.544	−0.0758
	(2.195)	(2.074)	(1.916)	(1.979)	(1.838)	(2.002)	(2.063)	(2.020)	(1.844)	(1.935)	(1.823)	(1.940)
Friends	−1.106	−1.072	−1.017	−1.012	−1.176	−1.244	−1.043	−0.983	−0.948	−0.936	−0.982	−1.136
	(1.070)	(1.085)	(1.021)	(1.023)	(1.020)	(1.049)	(1.090)	(1.090)	(1.081)	(1.088)	(1.075)	(1.112)
Amount_ Returned_ TrustGame (first round)	−0.477***	−0.467***	−0.460***	−0.461***	−0.464***	−0.469***	−0.472***	−0.463***	−0.455***	−0.453***	−0.456***	−0.461***
	(0.0902)	(0.0905)	(0.0843)	(0.0850)	(0.0846)	(0.0841)	(0.0983)	(0.0998)	(0.0929)	(0.0922)	(0.0931)	(0.0929)
Ethnic fragmentation		−2.433	0.0867	0.266	0.554	0.887		−2.852	−1.515	−1.894	−1.338	−1.403
		(7.426)	(7.297)	(7.488)	(7.504)	(7.735)		(5.611)	(5.885)	(5.861)	(5.894)	(5.876)
Gender fragmentation		−14.34*	−14.56	−14.97*	−15.32*	−15.98*		−13.92*	−13.16*	−13.05*	−13.31*	−13.56*
		(8.648)	(8.858)	(8.780)	(8.828)	(8.555)		(7.819)	(7.559)	(7.735)	(7.586)	(7.533)
CPRG withdrawal ratio	−2.324	−2.728		−2.631		−9.682	−5.199	−5.513		−4.821		−10.78
	(6.328)	(6.411)		(6.160)		(7.742)	(6.126)	(6.143)		(5.950)		(6.793)
CPRG group withdrawal ratio	5.091	4.237		1.908		16.14	10.02	9.670		7.684		19.90*
	(7.249)	(7.373)		(7.558)		(11.76)	(7.294)	(7.431)		(7.591)		(10.36)
CPRG *very satisfied*			8.605**	8.626**	8.703**	8.384**			8.530***	8.323**	8.576***	8.282**
			(3.459)	(3.557)	(3.410)	(3.452)			(3.245)	(3.276)	(3.242)	(3.245)
CPRG *pretty satisfied*			8.388**	8.451**	8.217**	8.055**			8.140**	7.951**	8.132**	7.627**
			(3.374)	(3.425)	(3.355)	(3.500)			(3.594)	(3.633)	(3.609)	(3.702)
CPRG payoff					0.0215	0.0477*					0.00614	0.0404
					(0.0183)	(0.0271)					(0.0197)	(0.0252)
Sociodemographic controls	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
N	151	151	151	151	151	151	152	152	152	152	152	152
R^2	0.456	0.467	0.504	0.505	0.509	0.518	0.358	0.371	0.407	0.412	0.408	0.423

Notes: The table reports econometric findings on the determinants of withdrawal ratios in the CPRG. Regressions are run with OLS and clustered robust standard errors and include only the trustees who participated in the CPRG (treatment group). The dependent variable is the change in an average trustee's transfer from the first to the second TG. Sociodemographic controls include all regressors of table 2 which are not explicitly mentioned. Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

Table 4. *The determinants of satisfaction in the CPRG*

Regressor	Group satisfaction in the CPRG (1 = not satisfied at all; 5 = very satisfied)	
Age	−0.0214	(0.0336)
Female	0.261	(0.327)
Married	−0.105	(0.477)
Separated	−0.908	(0.635)
Widowed	−0.151	(1.308)
House members	0.120	(0.0764)
Kikuyo	−0.182	(0.614)
Luo	0.189	(0.478)
Lubian	−0.00298	(1.148)
Luhya	−1.153*	(0.768)
Muslim	−0.127	(0.904)
Years of schooling	−0.145*	(0.0775)
Food expenditure day	−0.00157	(0.00170)
Unemployed	0.285	(0.489)
Mfi	0.194	(0.408)
Volunteer	0.223	(0.378)
Riskaverse	−0.178	(0.346)
Negative reciprocity	−0.983	(0.692)
Impatient	0.748*	(0.399)
Participant in the full information CPRG	−0.489	(0.360)
Friends	−0.219	(0.172)
N	151	

Notes: The table reports econometric findings on the determinants of players' satisfaction with the behaviour of the other peers in the group in the CPRG (the variable is categorical and ranges from 1 = *not satisfied at all* to 5 = *very satisfied*). Regressions are run with ordered logit with robust standard errors and include only the trustees who participated in the CPRG (treatment group). Robust standard errors in parentheses. *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$.

latter is multiplied by the CPRG *pretty satisfied* dummy (table A8, online appendix).[25] The significance of the interaction variable in the estimate confirms that there is a significant growth of CPRG *pretty satisfied* respondents as long as the trustor hypothetical amount grows.

A potential source of bias in the previous estimates may come from selection. For example, individuals with better pro-social attitudes may be more likely to declare a higher satisfaction level about the CPRG. In order to control for this and similar sources of bias, we re-estimate models 11 and 12 of table 3 with WLS, where the weights are the inverse of the individuals' PS of CPRG satisfaction.[26] More specifically, in a first specification we exclude

[25] We thank an anonymous referee for suggesting this additional check.

[26] In particular, for each individual, the weights are: $\underbrace{\frac{S}{\text{p score}}}_{\text{(S)}} + \underbrace{\frac{1-S}{1-\text{p score}}}_{\text{(S)}}$, where

pscore is a non-parametric estimate of the propensity score and S is the satisfaction

CPRG *pretty satisfied* individuals and estimate on the remaining sample the PS of reporting a high satisfaction level (variable CPRG *very satisfied*).[27] We then use the PS measure to weight the outcome regression of CPRG *very satisfied* on the change in trustees' average trustworthiness between the two TG rounds (ΔTG). As a second specification, we compute the PS measure using as the dependent variable a dummy equal to one if individuals were *pretty* or *very satisfied* (*satisfied*) and we then compute the outcome WLS regression of the latter on ΔTG. The results in table A9 (online appendix) highlight two important facts: (i) variables proxying for pro-social characteristics have no predictive power on declared satisfaction; and (ii) the positive effect of CPRG satisfaction on the change in trustworthiness is confirmed both when excluding CPRG *pretty satisfied* (columns 1 and 2) and when *pretty* and *very satisfied* are jointly summarized in the more broadly defined *satisfied* variable (columns 3 and 4). These results come in support of our claim about the robustness of our baseline estimates to selection.

6. Conclusions

We investigate with a 'sandwich' experiment how PG activities affect changes in social capital in the Nairobi slum of Kibera, one of the poorest socio-economic environments, in which previous research documented that social capital is at its lowest levels worldwide. Results of our experiment document that limiting oneself to the use of objective CPRG results to predict future objective outcomes in terms of social capital creation is extremely poor since it rules out essential invisible non-objective factors which crucially drive future TG behaviour.

The contribution of the paper is twofold. First, from an experimental economics viewpoint, it documents the significant predictive power of subjective satisfaction when measuring the effect of CPRG activities on changes in social capital. Secondly, it suggests from a normative point of view that satisfaction measures may help to select individuals whose participation in common resources management activities may maximize effects in terms of social capital creation.

We believe that interesting implications may be drawn from our policy experiment since there are several reasons why our CPRG treatment mimics features which are important for the local socio-economic environment. First, roads, water and sanitation are provided and managed in these slums by local infrastructure community development projects in CPRG situations in which people from the local community donate money and/or labour in order to build the PG. Secondly, all individuals in Kenya experience widespread political corruption which may be viewed as an extreme

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dummy (*CPRG very satisfied* or *satisfied*). For details on this strategy, see, among others, Blattman and Annan (2010) and Hirano *et al.* (2003).

[27] Note that for the computation of the PS we use also variables that can be a proxy of the individuals' pro-social characteristics such as a trust index (constructed using the GSS questions on trust) and a sociability dummy (see Fehr, 2009). Further details about these variables are reported in the variable legend (table A1 in the online appendix).

of the opportunistic behaviour of participants in CPRG. In this respect, information on subjective satisfaction may be useful to predict dynamics of social capital formation and to identify individuals who may magnify effects of cooperation in PG activities. Selection of such individuals may be crucial to identifying management positions in political and economic processes or developing pilot development projects aimed at creating virtuous circles between common resources management and social capital. Thirdly and finally, our findings support the hypothesis that boundary rules are important to design grassroots management of the commons, consistent with the well-known theoretical literature on this point. In this respect they document the validity of subjective satisfaction-based selection rules which may help to reinforce links between PG management and the endogenous creation of social capital, which is fundamental to making the governing processes of common resources self-sustainable.

Supplementary materials and methods

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S1355770X15000340

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