An Application of the English Clock Market Mechanism to Public Goods Games*

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Abstract

We conducted a laboratory study with a public goods game in which contributions are not submitted all at once but incrementally as coordinated in real time by a clock. Individuals press a button as soon as the clock equals their willingness to contribute. This public goods institution exploits the idea that people are conditionally cooperative (i.e., they match at least the minimum contribution of the others) rather than opportunistic in order to implement the Pareto-optimal outcome. By providing information about the point at which subjects stopped further contributions we found that the decision of a subject to stop contributing induced an immediate reaction of the other group members. As a consequence, the individual contributions were closely related to each other and a fairer income distribution was achieved than in the standard case in which only aggregated information was supplied after each period.

JEL Classifications: C72, C92, H41, D44

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1 Introduction

A fundamental concern in the social science literature focuses around the market failure produced by the presence of public goods. Since the seminal work of Samuelson (1954) it is well understood that voluntary provision of public goods is inefficient: In the so-called *standard voluntary contribution mechanism* (henceforth SVCM) agents' dominant strategy is to free-ride. Although the experimental literature has provided evidence that this prediction is too pessimistic, still the outcome in experiments with the SVCM is sub-optimal.[1] In his survey of public goods experiments, Ledyard (1995) pointed out that research in public goods should not concentrate only on the SVCM but has to consider other organisational arrangements which may help to approach the Pareto-optimum. Moreover, since the standard theory lacks an explanation of experimental data, the effects of institutional changes on behaviour must be supported by an experimental analysis. The task for the social scientist is, thus, two-fold: investigating subjects' behaviour in the presence of public-goods and seeking institutional mechanisms which might help to move towards the social optimum.

In the recent literature there exists a consensus that conditionally cooperative behaviour (as a motivation *per se* or based on fairness preferences as "inequity aversion", "reciprocity" or "warm glow") plays an important role in public goods experiments.[2] According to Fischbacher, Gächter and Fehr (2000), a *conditional cooperator* is an agent who is willing to contribute the more to the public good the more others contribute. Hence, if everybody has a conditional willingness to forgo the material gains that are associated with defection, an outcome more efficient than the free-riding equilibrium may be achieved. However, even if conditional cooperation is behaviourally important, agents' expectations about others' contributions are decisive: A more efficient outcome can be established only if everybody *believes* that the other members of the society are willing and able to coordinate on a particular level of contribution.

[1] Extensive surveys of experimental studies on voluntary contributions to public goods are presented by Davis and Holt (1993), and Ledyard (1995).

[2] See, for instance, Sugden (1984), Andreoni (1995), Palfrey and Prisbey (1997), Croson (1998), Sonnemans et al. (1999), Fishbacher et al. (2000), Keser and van Winden (2000), and Brandts and Schram (forthcoming).

In this paper, we study an institution that we call the *English clock voluntary contribution mechanism* (hereafter ECVCM) which makes it possible to observe directly conditional cooperation in the laboratory.[3] In the ECVCM, agents make their contribution decisions on the basis of an ascending clock mechanism and their decisions are instantaneously transmitted to their partners. In this way, agents are informed about the exact point up to which the other group members are willing to contribute. Thus, problems associated with the formation of expectations about the others' contributions are reduced. Consequently, the ECVCM leads to the Pareto-efficient allocation if all agents behave *sufficiently* conditionally cooperative, i.e., if they care about contributing at least as much as the minimal contribution of the others.

Further details about the ECVCM and its theoretical implications are presented in Section 2. The experimental design is laid out in Section 3. Section 4 reports the main results of our experimental study. The data support the predictions of the model. However, heterogeneity of subjects and cross periodical dynamics slowed down the evolution of cooperation in the ECVCM. Finally, Section 5 concludes.

2 Theoretical considerations

Assume there are N identical agents, each endowed with e tokens. In the SVCM, agents decide privately and simultaneously about the amount to be contributed to a public good and the remaining tokens to be allocated to a private exchange. Let c_i denote player i's contribution to the public good, with $c_i = \{0, 1, 2, \dots e\}$, and let $y = \sum_{j=1}^{N} c_j$ be the total amount of public good provided. The individual payoff function of i is linear in c_i and y, and takes the following form:

$$\pi_i(c_i, y) = r(e - c_i) + vy \,. \qquad (1)$$

Here, $v > 0$ denotes the return from a unit of the public good, $r > 0$ denotes the return from a unit of the private good and $v \backslash r$ is the marginal rate of substitution between

[3] The ECVCM is related to the English clock market institution, which was found to be the most efficient common auction in single-sided experimental auction markets with independent private values. Kagel (1995) provides an excellent survey over such literature.

the private and the public good. A social dilemma arises if we assume that the parameters satisfy the inequalities $0 < v < r < Nv$. In this case, indeed, the unique dominant strategy in the non-cooperative game is to free-ride (i.e., $c_i = 0$ for all $i = 1, ..., N$) because $\partial\pi_i \backslash \partial c_i = v - r < 0$ whereas the socially optimal, symmetric Pareto-efficient situation demands that all tokens are contributed to the public good (i.e., $c_i = e$ for $i = 1, ..., N$) since (from the maximisation of the social objective function) $\partial\sum_{i\in N} \pi_i \backslash \partial c_i = Nv - r > 0$. The dominance of free-riding extends to the finitely repeated game: by means of backward induction it can be shown that the unique subgame perfect equilibrium is free-riding in each repetition.

The ECVCM differs from the SVCM in that contributions are not submitted "sealed" but "open", on the basis of an ascending clock, in e stages. Starting at a contribution level of zero, agents are simultaneously asked to make a binary decision between contributing either an amount $\varepsilon > 0$ to the public good or zero. After this decision, each agent is informed about the number of partners who contributed ε. Only those who contributed are asked at the *second stage* for an additional contribution of ε. The others *exit* the game and are not allowed to enter it again. The contribution level is subsequently increased either until it coincides with the endowment e or until all agents have exited. The individual contribution is determined by the last level of contribution accepted by the agent (before she exited).

Under the assumption of identical *opportunistic agents* who maximise their own payoff (as in Eq. (1)) the prediction in the ECVCM coincides with that in the SVCM, i.e., each agent will free-ride. This result is derived by repeated elimination of strictly dominated strategies (for $i = 1, \ldots, N$ we can eliminate first the maximal $c_i = e$, then $c_i = e - \varepsilon$, etc. until, at the end, $c_i = 0$ is the only remaining strategy). Also, this result extends to the finitely repeated case (where it can be similarly derived by the requirement of subgame perfection). Thus, the following proposition can be written down.

Proposition 1. *If all agents' objective function is to maximise their own payoff as in (1), the equilibrium prediction in the ECVCM is that each player will contribute nothing to the public good.*

Consider now the predictions in the two mechanisms if agents behave conditionally cooperative. In his influencing work on public goods, Sugden (1984) proposed that people who benefit from a public good feel moral obligations not to free-ride on those who contribute and, as a consequence, they contribute as well.[4] Inspired by his model, we designate an agent as a conditional cooperator if she suffers a loss of utility when she contributes less than the others although she dislikes contributing more than them. Let $\underline{c}_i$ be the minimum contribution of i's partners (i.e., $\underline{c}_i = \min\{c_j : j \neq i\}$), and let $P_i > 0$ be the (unit) loss suffered by i if her own contribution is smaller than any other contribution in the society (i.e., if $c_i < \underline{c}_i$). We define the utility function of a *conditional cooperator* as:

$$U_i(c_i, y) = \pi_i(c_i, y) - P_i \max\{0, \underline{c}_i - c_i\} \qquad (2)$$

where π_i is the payoff function described in (1) and the parameter P_i satisfies the constraint $P_i > r - v$ (which means that the loss suffered by a conditional cooperator for contributing to the public good one unit less than the others must be greater than the "net" unit return she receives from the private good). We can state the following:

Proposition 2. *If all agents' objective function is to maximise their utility as defined in (2) then*

I) *all uniform contribution vectors with* $0 \leq c_i = c_j \leq e$ *for all i, j = 1, …, N are equilibrium outcomes*;

II) *in the ECVCM the full contribution equilibrium can be selected by payoff dominance consideration.*

To see the first part of the proposition, consider the case in which $c_i = \underline{c}_i - \Delta_i$ with $\Delta_i > 0$. In order for $c_i < \underline{c}_i$ to be suboptimal with respect to $c_i = \underline{c}_i$, it must be that $\pi_i(c_i, y) < \pi_i(\underline{c}_i, y)$. The latter implies: $r(e - \underline{c}_i + \Delta_i) + v(y - \Delta_i) - P_i\Delta_i < r(e - \underline{c}_i) + vy$. Simplifying and solving, we obtain $r - v < P_i$. Thus, subotpimality in the case of

[4] In fact, Sugden assumes that a person maximises his own utility subject to the "principle of reciprocity". Conditional cooperation can be interpreted to a limited degree as *positive reciprocity*. See, e.g., Fehr and

$c_i < \underline{c}_i$ follows from the condition imposed on P_i. Suboptimality in the case of $c_i > \underline{c}_i$ (i.e., when Eq. (2) coincides with Eq. (1)) follows by elimination of strictly dominated strategies.

To see the second part of the proposition, note that the ECVCM allows an agent to observe if and up to which amount the others contribute. Since, according to the definition, the willingness to contribute of a conditional cooperator depends on the others' minimum contribution, she will never exit *before* one of her partners, but as soon as she has observes that one of her partners has exited. It follows that, if all N group members are sufficiently conditionally cooperative (i.e., if $P_i > r - v$ for $i = 1, ..., N$), no agent will exit the game until the last tick of the clock, when all contribute their entire endowment. This result extends naturally to the finitely repeated game.

Consider next, what will happen in the SVCM. The multiplicity of equilibria (as stated in Proposition 2.I) implies a non-trivial coordination problem, whose solution hinges crucially upon the beliefs of how the game will be played. The Pareto-optimal outcome will be achieved only if each agent i ($i = 1, ..., N$) believes that everybody contributes everything to the public good. Without making assumptions about beliefs, no prediction can be made. In this sense, the ECVCM can eliminate problems connected with the formation of expectations and, thus, it leads naturally to the most efficient outcome.

Setting the loss parameter P_i either equal to zero – as in Eq. (1) – or greater than ($r - v$) – as in Eq. (2) – for all $i = 1, ..., N$ takes into account only homogeneous populations. Most experimental studies, however, suggest that there is a mix of opportunistic and conditional cooperative individuals. Without making specific assumptions about agents' expectations, the coexistence of different types of players does not guarantee a high degree of cooperation. In fact, the ECVCM gives a conditional cooperator the opportunity to discover the others' less than fully cooperative behaviour, and to stop her contributions upon that discovery. Thus, in one-shot games, the ECVCM does not necessarily enable conditional cooperators to establish cooperation when they interact with opportunistic

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Gaechter (2000) for a definition of positive and negative reciprocity.

types. In finitely repeated games, however, the existence of conditional cooperators can change the behaviour of the opportunistic types. In particular, the observation of the conditional cooperators' immediate reaction to her opportunistic behaviour (i.e., their exit due to her zero contribution) may induce an agent with $P_i = 0$ to contribute almost everything (i.e., e - ε) from the second period on.

3 Experimental Design

The laboratory version of the voluntary contribution mechanisms studied here was implemented in a sequence of 10 periods in which subjects interacted in the same group of size $N = 3$.[5] At the start of each period, every subject was endowed with $e = 50$ British pence. A subject could allocate this amount between an *individual fund* and a *group fund*. The English clock, which displayed the contribution level on each subject's screen, started at 0p and stopped at 50p, increasing in steps of ε = 1p every second. Subjects had to press a button in order to stop further contributions and to exit the game. The monetary period payoff of a subject was determined as in (1), with the specified parameters $r = 1$ and $v = 0.5$. Subjects received their accumulated payoffs (plus a show up fee of £2) at the end of the experiment.[6]

Two experimental treatments were considered, which differed with respect to the information supplied to the participants. In the experimental treatment with the ECVCM, subjects received instantaneous on-screen information about their partners' decisions: as soon as a subject had decided to exit, each group member was informed about this decision. Additionally, the lowest, the median, and the highest contributions of the group were displayed at all time.[7] In the control treatment, the SVCM with clock, this information was not revealed and subjects were only informed, at the end of each period, about the aggregate contributions of their partners (as in standard public goods

[5] Although subjects could recognise the other participants in the room, they did not know the identity of the members in their group. They made their decisions anonymously via computer terminals and did not communicate with each other in any other way.

[6] All the treatments took approximately 30 minutes to complete. Subject earned on average 6 British pounds.

[7] There were 3 clocks running at the same time. As soon as the first member of the group had exited the game, the clock labelled "lowest contribution" stopped. Similarly, the clocks labelled "highest" and

experiments). Besides the use of the clock, this design is fully equivalent to the SVCM used in previous research. Subjects were given a record of all information of the past periods appended to a "history-table", which was displayed on a subject's screen.

The computerised experiment was conducted in the EXEC laboratory at the University of York.[8] Five sessions were run: two employed the SVCM with clock, three the ECVCM. In total, twenty-seven subjects participated in the former and forty-two in the latter treatment. Each subject participated only in one session. Subjects were undergraduate and graduate students from different fields. They were all volunteers recruited by mail-shot invitations. Before the experiment, written instructions (Appendix A) were read aloud. Subjects were given the opportunity to ask questions before they went individually through additional computerised instructions. These included explanations of the computer screens and exercises for the consolidation of the game rules.

4 Experimental results

The aggregated results of the experiment with respect to group-contributions are displayed in Table 1 and Figure 1.[9]

	SVCM	ECVCM
Mean	71.3	65.8
Std dev	43.7	60.0
Median	67	47
$r_s(\overline{Y},t)^‡$	-0.915***	0.745**

H_0: $r_s(\overline{Y},t)=0$, H_a: $r_s(,\overline{Y}\ t)\neq 0$, **: significant at p<.05, ***: significant at p<.01
‡denotes the Spearman rank correlation coefficient between mean group-contributions $\overline{Y}$ and time t

Table 1. Average group-contributions to the public good in the SVCM with clock and in the ECVCM

If subjects were not affected by the information about the exact point in which their group members stop contributing, we should observe no differences in contributions between

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"median contribution" stopped as soon as the last member had exited.

[8] The software was produced by means of Fischbacher (1999)'s *z-Tree*.

treatments. Although the average contributions reported in the first row of Table 1 corroborates this statement,[10] the Spearman correlation coefficient between average contribution and time reported in Table 1 as well as the graphs in Figure 1 reveal that mean contributions decrease highly significantly over time in the SVCM with clock and increase significantly in the ECVCM.[11]

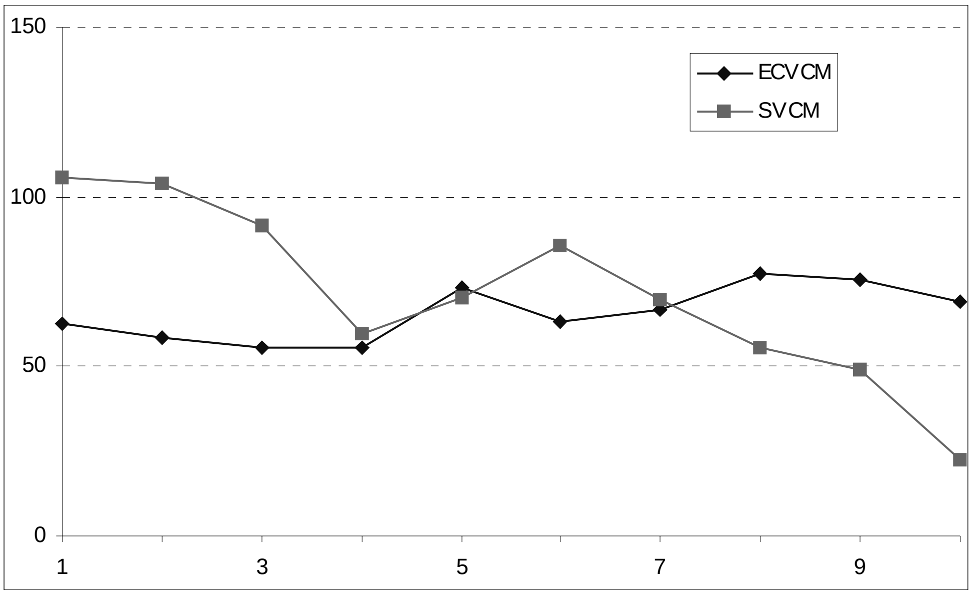

Figure 1. Average group-contributions over time in the SVCM with clock and in the ECVCM

The observed decrease in contributions in the SVCM with clock confirms one of the most robust behavioural regularities in repeated public goods games (that contributions drop over time to very low levels). On the other hand, the increase in mean contributions observed in the experimental treatment suggests that the ECVCM institution can prevent such a fall in contributions and overturn this downward trend.

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[9] The raw data featuring the individual contributions are reported in Appendix B.
[10] The null hypothesis that group contributions were the same in both treatments cannot be rejected on the basis of a Mann-Whitney test (p = .975).
[11] Group-contributions decline significantly over time for 67% of the groups in the SVCM and for 5% of the groups in the ECVCM. For 14% percent of the groups in the ECVCM we observe a significant increase in group contributions over time. These are the results of a two-tailed Spearman rank correlation test at p = .1 level of significance.

Going further into the differences between the two treatments, let us take into account the accumulated relative frequencies of group-contributions to the public good. Figure 2 depicts these frequencies. The distribution of the observed frequencies in the SVCM with clock is statistically equivalent to a uniform distribution (the Kolmogorov-Smirnov test returns a p-value of p = 1). However, the corresponding distribution in case of the ECVCM is different. A two-tailed Kolmogorov-Smirnov test shows that the

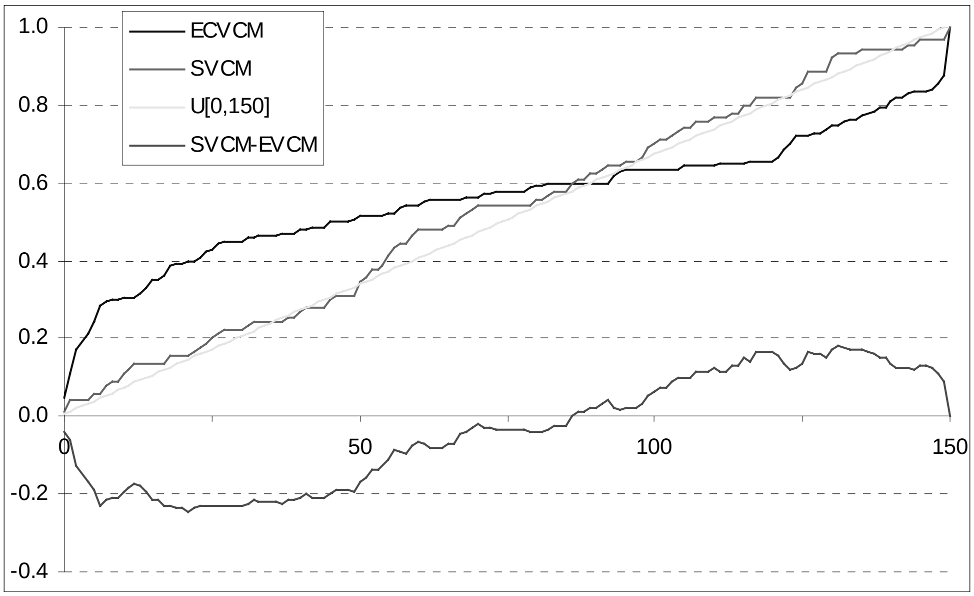

Figure 2. Accumulated relative frequencies of group-contributions

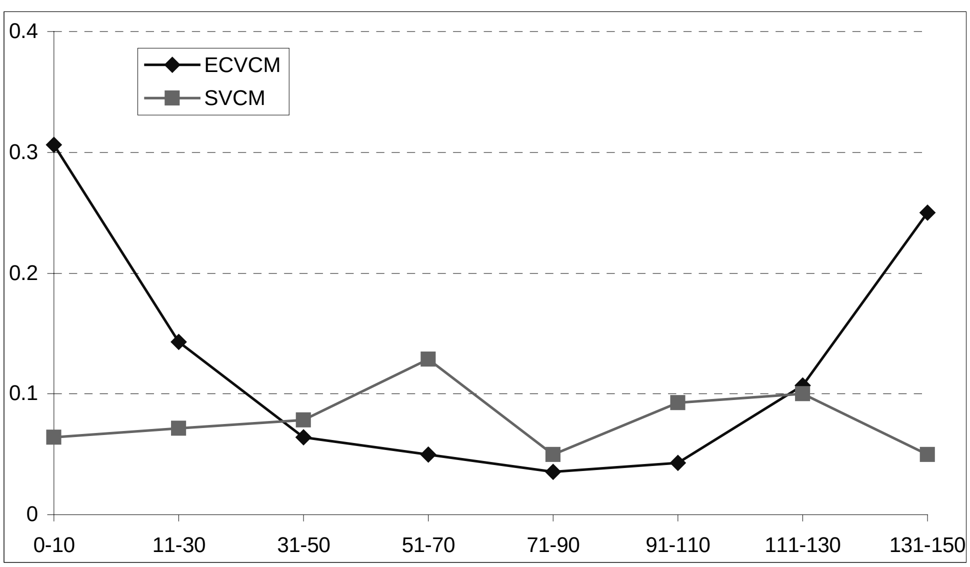

Figure 3. Group-contributions in intervals of 20p (relative frequencies)

distribution resulting in the SVCM with clock is stochastically dominated by the ECVCM distribution for low contributions ($p < .05$), while the former dominates the latter for high contributions ($p < .1$). A two-tailed Mann-Whitney test, nevertheless, does not reject the null hypothesis of equal distributions. The latter result indicates that the differences in the distributions of the mean group-contributions are huge at the extremities (for low and high levels of contributions), a fact that is further illustrated in Figure 3, where the resulting group-contributions are depicted in intervals of 20p.

The above findings deal only with mean contributions. We are, however, also interested in the behavioural regularities at the individual level and how they are affected by the ECVCM. A first interesting result comes from a comparison of individual choices in the first and final periods of both treatments. We find that contributions are significantly lower in the ECVCM than in the SVCM with clock in the first period while the opposite is true in the last period, where a significantly higher percentage of subjects contribute more to the public good in the ECVCM than in the SVCM with clock. These results derive from both a two-tailed Mann-Whitney test and a two-tailed Kolmogorov-Smirnov test: In the first period both tests return a significance level of $p < .05$; in the last period the Mann-Whitney test returns $p < .1$ and the Kolmogorov-Smirnov test $p < .005$. A particularly remarkable fact is that, in the last period, 60 percent of the subjects in the SVCM with clock choose $c_i \leq 1$, while in the ECVCM individual choices are more scattered over the whole strategy space. Nevertheless, 38 percent of the subjects in the ECVCM choose $c_i > 40$ in the final period.[12] Thus, subjects appear to achieve cooperation more easily in the ECVCM than in the SVCM with clock (where almost full free-riding emerges as the focal individual action).

The latter result is supported by the evolution of individual contributions over time. In the ECVCM, 9.5 percent of subjects have a constant contribution and 53 percent of the remaining subjects exhibit contributions positively correlated to time (16 percent significantly at the $p < .05$ level).[13] In contrast, in the SVCM with clock, no subject has a constant contribution and 89 percent of the subjects are found to decrease their

[12] In this regard, the final period is fully representative of the last five periods.

contributions over time (56 percent significantly at the $p < .05$ level). We conclude, therefore, that the ECVCM is more effective in raising individual contributions than the SVCM.

In order to test the presence of conditional cooperation as modelled in (2) we look at the distance of the highest from the lowest individual contribution in a same group.[14] A one-tailed Mann-Whitney test rejects the null-hypothesis of equal distances between the highest and the lowest individual contributions in the first period of the two treatments ($p < .01$), favouring the alternative hypothesis of significantly closer distances in the ECVCM. A similar result holds for the other nine periods of the experiment. We conclude that the information about the others' contributions matters, and thus that subjects behave conditionally cooperative. As a consequence, the differences in group members' payoffs are huge in the SVCM with clock, but not in the ECVCM. In the SVCM with clock, the subject with the lowest payoff in a group receives on average 128p less than the one with the highest payoff. In contrast, in the ECVCM, the average difference is 32p. The corresponding standard deviations are 93p in the SVCM with clock and 30p in the ECVCM. A two-tailed Mann-Whitney test rejects the null hypothesis that the distance from the lowest to the highest payoff in a group is equal in both treatments ($p < .01$), in favour of a more equal income distribution in the ECVCM.

In (2), it was claimed that conditional cooperative subjects care about contributing at least as much as the others. A possibility to investigate the appeal of this behavioural assumption in the SVCM is to analyse the cross periodical dynamics. Since the SVCM compares to the prisoners' dilemma, it seems reasonable to employ an analysis technique similar to that used in the related literature. Selten and Stoecker (1986) found that subjects' cross periodical dynamics fit the behavioural model of learning direction theory (henceforth LDT).[15] Applied to the SVCM, LDT induces the contribution claim that if

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[13] This is indicated by a one-tailed Spearman rank correlation test.

[14] If subjects behave conditionally cooperative, the information about the exact point at which their partners stop contributing should be relevant and we should observe that they keep on contributing until all the others do so, but the exit of one of the partners should induce them to stop contributions.

[15] LDT explains behavioural changes according to subjects' latest experience. It has been supported by experimental data from the repeated prisoners' dilemma, repeated bargaining, coordination games and market experiments.

subjects (upon observing the contributions of the others) perceive their latest contribution as too high (low) they tend to decrease (increase) their respective contributions in the next period. Let *t* be the index for the contribution of subject *i* in period *t* of the repeated public goods game. Following LDT, conditional cooperators' cross periodical behaviour should be explained by the *contribution change hypothesis*:[16]

$$1)\quad c_{i,t+1} \le c_{it} \ \text{ if } \ c_{i,t} > \underline{c}_{i,t}$$
$$2)\quad c_{i,t+1} \ge c_{it} \ \text{ if } \ c_{i,t} < \underline{c}_{i,t}\,.$$

Action / **Experience condition**	Previous contribution below The minimum of the others	Previous Contribution equal to the minimum of the others	Previous contribution above the minimum of the others	Column sum # *relative*
Contribution decreased	19 .19	3 .03	78 .78	100 .41
Contribution remained unchanged	11 .19	20 .39	28 .47	59 .24
Contribution Increased	34 .40	15 .19	35 .42	84 .35
Row sum	64 .26	38 .16	141 .58	243 1.00

Table 2a. SVCM: Number of contribution changes between periods under the three experience conditions

Action / **Experience Condition**	Previous contribution below the minimum of the others	Previous contribution equal to the minimum of the others	Previous contribution above the minimum of the others	Column sum # *relative*
Contribution decreased	26 .21	6 .05	92 .74	124 .33
Contribution remained unchanged	17 .13	79 .59	38 .28	134 .35
Contribution Increased	49 .41	4 .03	67 .56	120 .32
Row sum	92 .24	89 .24	197 .52	378 1.00

Table 2b. ECVCM: Number of contribution changes between periods under the three experience conditions

[16] In presenting the hypothesis, we follow Selten and Buchta (1999).

Table 2a and 2b summarise the observations from both treatments with respect to cross periodical changes: Subjects' experiences are displayed in columns, and their reactions in rows. Note that the contribution change hypothesis does not predict any action if *i*'s contribution was equal to the minimum of the others' contributions. However, as it can be read from the tables, subjects seem to be more concerned about changing their behaviour if their contribution did not match the minimum contribution of the others. Comparing the two treatments, we find that changes in individual contributions across periods are more severe in the SVCM with clock than in the ECVCM.

Eliminating the observations in which contributions remained unchanged and those in which subjects' contributions coincide with the minimum contribution of the others, we are able to test the directional changes in either treatment. The null hypothesis that contributions are independent of subjects' experience conditions can be rejected for both treatments on the basis of a one-tailed binomial test (in the SVCM with clock, $p = .027$ in case of an increase and $p < .0001$ in case of a decrease; the corresponding significance levels in the ECVCM are $p = .003$ and $p = .021$). The intensity of directional change indicated by the rejection levels shows again that the decreasing trend is more severe in the SVCM than in the ECVCM. We conclude that subjects' actions can be explained to a good extent by the behavioural model (2) and LDT.[17]

5 Conclusions

In this paper, we introduced the ECVCM and reported the data from a laboratory study in which the ECVCM was compared to the SVCM. In theory, the ECVCM is an ideal mechanism to raise funds if subjects are conditional cooperators as described in the behavioural model (2). As pointed out, even opportunistic agents would find it beneficial to contribute almost everything to the public good in presence of agents who behave conditionally cooperative.

[17] Only one subject (.04) in the SVCM and 4 subjects (.1) in the ECVCM changed the contribution across rounds more frequently in the opposite direction than predicted.

We found support for the proposed model in our data, e.g., subjects' decisions were influenced by the others' minimum contribution.[18] However, inter-periodical dynamics indicate that many subjects do not behave consistently with a specific type (opportunistic or conditional cooperative). Rather, most subjects change behaviour from one period to the next one according to LDT: Subjects who contributed less (more) than the minimum contribution increased (decreased) their contributions. While this behaviour might have helped to sustain a certain contribution level in the SVCM, in the ECVCM it induced noise, which slowed down the evolution of more cooperation.

Nevertheless, we provided evidence that participants in the ECVCM increased their contributions during the course of the experiment: 53 percent of the subjects exhibited contributions positively related to time, and 38 percent chose $c_i > 40$ in the final period. These data contrast with those observed in the SVCM with clock, where 85 percent of the subjects decreased their contributions over time and 60 percent chose $c_i \leq 1$ in the final period. Although average contributions in the two treatments were not significantly different, a more equal income distribution was achieved in the ECVCM than in the SVCM with clock, which would imply that in a society the costs of the public good are borne equally.

Further laboratory studies with the ECVCM must include variations in the parameters and in the subjects' pool. An application of the ECVCM to a different subjects' pool might induce contributions higher than those observed in this study: Parties who are directly connected with fund raising possibly will be very differently motivated than university students.

[18] Subjects reported this also in a post-experimental questionnaire.

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Appendix A: Written Instructions

What you have to do

1. You will participate in 10 Rounds of a Group Decision-Making Experiment, in which you will interact with (always the same) two partners, whose identity will not be revealed to you at any time.
2. In every Round you (as well as your partners) will receive an initial endowment of 50p, and you have to decide how much of this amount to contribute to a Group Fund and a remainder to an Individual Fund. Any pence contributed to the Group Fund will generate Payoff for you as well as for each other member of your group. The remainder of your endowment that you do not contribute to the Group Fund will be saved in your Individual Fund, which generates Payoff only to you.
3. Your payoff in a Round will be determined as follows:

   0.5 x Group Fund + your Individual Fund.
4. At the end of the experiment you will be paid the payoff you have accumulated plus a show-up fee of £2.

Note: Unless you reveal how much you have earned, no one will get to know.

How you interact with each other (in each of the 10 Rounds)

5. In every Round a clock will indicate the level of contribution to the Group Fund. It starts at 0p and stops at 50p, increasing in steps of 1p every second.
6. You have to decide your own Level of Contribution to the Group Fund.
7. The amount you contribute to the Group Fund is equal to the displayed Level Of Contribution at the moment you press the EXIT button on your screen.

Participants in the SVCM with clock read:

8. You will not be told when the other group members EXIT. However, at the end of every Round you will receive information about the sum of the other group members' contribution to the Group Fund.

Participants in the ECVCM read:

8. If one group-member exits (by pressing the button), it will be announced instantaneously on your screen as well as on those of the other group-members.
9. In any instant while the clock is running you and your partners will receive the same information:
   a. How many of you are not contributing the amount indicated by the clock, i.e., how many members of your group have exited below the indicated level of contribution.
   b. How much has been the lowest, the median, and the highest contribution of your group members to the Group Fund.

Appendix B: Raw Data

Group	Subject	Round 1	2	3	4	5	6	7	8	9	10
	1	30	50	50	50	50	50	50	0	0	0
1	2	50	50	50	50	50	50	15	20	40	10
	3	50	43	50	50	50	30	30	35	0	0
	4	40	39	15	50	5	45	6	30	2	50
2	5	35	10	17	35	37	36	36	28	3	2
	6	50	50	50	1	41	50	26	1	0	0
	7	50	50	40	38	38	43	36	38	39	0
3	8	50	42	42	38	41	41	39	38	46	5
	9	35	34	35	39	45	42	38	50	45	5
	10	50	50	50	50	0	50	35	40	50	0
4	11	35	5	40	1	31	34	37	26	0	7
	12	20	31	25	16	26	40	27	4	0	20
	13	50	50	50	0	20	50	30	0	1	0
5	14	50	30	36	38	20	20	26	50	5	15
	15	10	21	5	8	15	10	13	10	5	8
	16	40	50	49	2	1	45	33	31	30	0
6	17	2	45	5	3	45	3	20	21	25	1
	18	50	50	50	2	21	50	50	0	4	6
	19	38	27	4	22	0	16	6	0	0	0
7	20	20	40	33	10	45	7	1	25	1	0
	21	49	50	50	0	0	1	1	0	0	1
	22	20	23	15	30	1	5	7	0	0	1
8	23	39	1	5	1	2	1	1	0	0	0
	24	30	30	30	0	35	35	10	0	45	50
	25	1	0	0	0	0	1	1	0	0	0
9	26	5	15	25	0	0	5	5	0	50	1
	27	50	50	1	1	12	12	50	50	50	21

a) Individual contributions in the SVCM

Group	Subject	Round 1	2	3	4	5	6	7	8	9	10
	1	2	3	2	2	2	2	2	0	0	0
1	2	1	3	0	1	0	1	0	0	0	0
	3	3	2	3	3	2	3	0	1	1	0
	4	4	4	2	0	0	0	0	0	0	0
2	5	1	2	0	0	0	0	0	2	0	0
	6	0	0	0	0	0	0	0	0	0	0
	7	45	5	45	8	27	5	16	46	41	48
3	8	47	3	43	7	26	4	19	46	40	49
	9	44	18	44	8	29	6	15	45	41	47
	10	2	0	1	2	2	2	1	1	0	0
4	11	1	2	2	2	2	3	2	1	1	2
	12	2	2	0	1	0	10	0	0	0	0
	13	2	1	0	0	5	7	8	9	5	5
5	14	3	2	1	2	2	6	7	8	5	5
	15	20	3	1	1	0	5	6	7	4	4
	16	17	5	32	3	46	50	50	49	48	19
6	17	9	50	30	11	44	49	50	49	46	31
	18	19	50	33	4	50	50	49	50	49	29
	19	35	40	42	47	50	48	44	43	40	44
7	20	50	40	40	48	50	50	46	41	41	45
	21	50	41	41	46	49	49	40	43	41	44
	22	11	13	0	4	20	30	25	22	30	42
8	23	50	26	20	6	22	26	27	21	32	41
	24	10	10	17	3	16	24	21	19	31	40
	25	20	19	3	3	0	0	4	5	0	0
9	26	22	18	26	10	19	5	3	9	7	22
	27	19	20	2	2	7	1	12	4	3	5
	28	40	50	40	47	50	30	30	50	50	45
10	29	50	50	30	34	36	32	33	45	43	38
	30	50	50	41	48	38	31	31	46	45	39
	31	4	20	25	40	40	15	30	40	35	10
11	32	3	22	22	41	41	10	31	41	40	3
	33	10	15	21	43	49	30	32	43	41	11
	34	50	50	50	50	50	50	50	50	50	50
12	35	50	50	50	50	50	50	50	50	50	50
	36	50	50	50	50	50	50	50	50	50	50
	37	1	0	0	0	0	0	0	0	0	0
13	38	3	2	1	1	1	1	1	1	1	1
	39	41	40	1	1	0	0	0	0	0	1
	40	12	25	6	50	50	50	50	50	50	50
14	41	10	7	5	50	50	50	50	50	50	50
	42	11	8	6	50	50	50	50	50	50	48

b) Individual contributions in the ECVCM