Karlsruher Institut für Technologie

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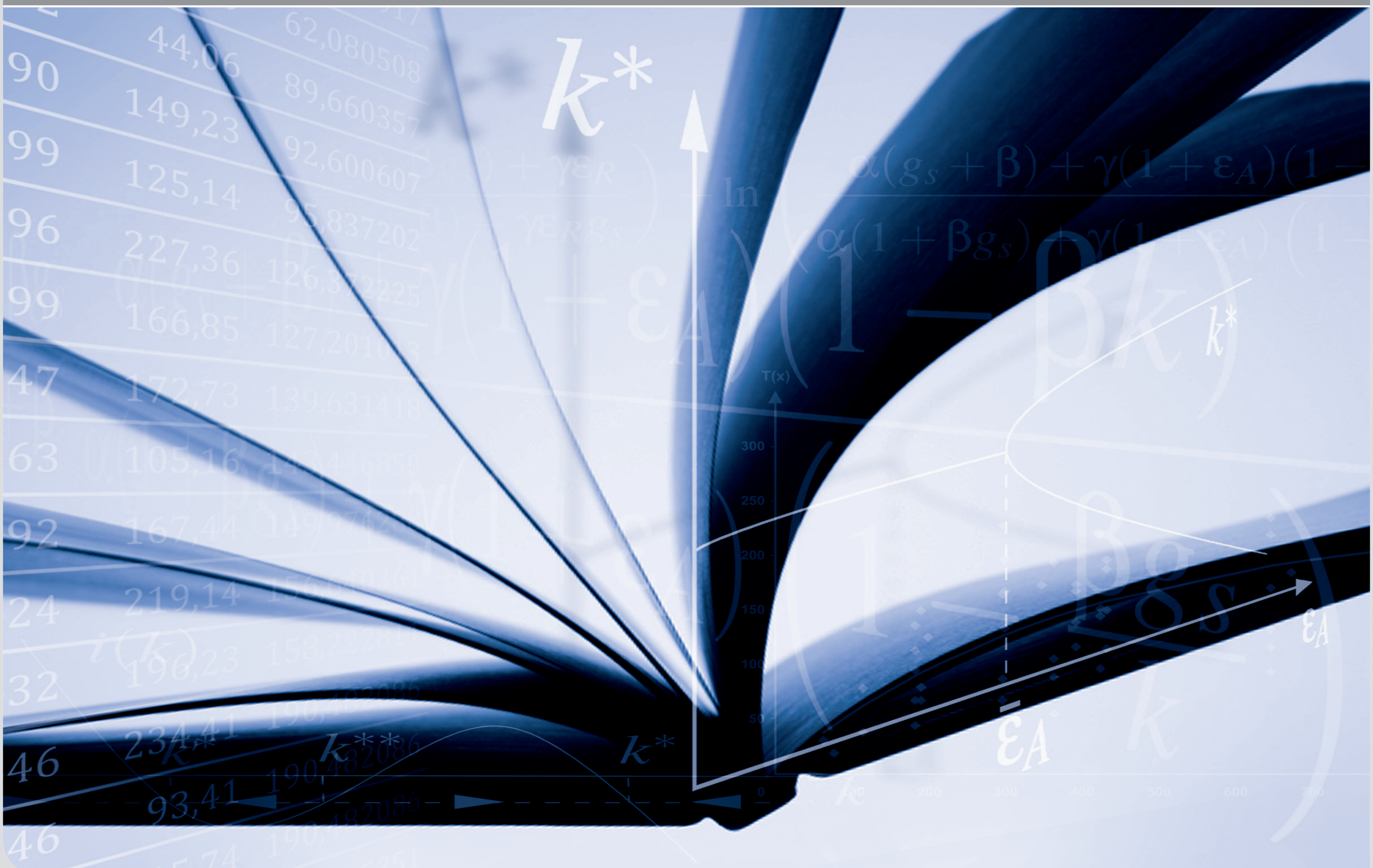
**No. 73** | NOVEMBER 2015

WORKING PAPER SERIES IN ECONOMICS



**Impressum**

Karlsruher Institut für Technologie (KIT)
Fakultät für Wirtschaftswissenschaften
Institut für Volkswirtschaftslehre (ECON)

Schlossbezirk 12
76131 Karlsruhe

KIT – Universität des Landes Baden-Württemberg und
nationales Forschungszentrum in der Helmholtz-Gemeinschaft

Working Paper Series in Economics
**No. 73**, November 2015

ISSN 2190-9806

econpapers.wiwi.kit.edu

# Voting and transfer payments in a threshold public goods game

Christian Feige[a,*], Karl-Martin Ehrhart[a]

[a] *Karlsruhe Institute of Technology (KIT), Institute of Economics (ECON), Neuer Zirkel 3, 76131 Karlsruhe, Germany*

**Abstract**

In a laboratory experiment, we investigate if groups consisting of two heterogeneous player types (with different marginal contribution costs) can increase their total contributions and payoffs in a threshold public goods game if transfer payments are possible among the players. We find that transfer payments are indeed used in many groups to shift contributions from high-cost players to low-cost players, thereby not only increasing social welfare, but also equalizing payoffs. In a repeated setting with individual voluntary contributions and transfers, this redistribution effect takes a few rounds to manifest and high-cost players benefit the most in terms of payoffs. The same beneficial effect of transfer payments can also be achieved in a one-shot setting by having the groups vote unanimously on contributions and transfers of all players.

*Keywords:* threshold public good, transfer payments, experimental economics, unanimous voting, committee, heterogeneity

*JEL:* C92, D71, H41

*Phone: +49 721 608 43383, fax: +49 721 608 45471

*Email addresses:* `christian.feige@kit.edu` (Christian Feige), `ehrhart@kit.edu` (Karl-Martin Ehrhart)

## 1. Introduction

Can redistribution affect allocative decisions and bring about welfare increases? This question has been approached in the past by Bös and Kolmar (2003) whose theoretical answer is affirmative, but not unconditionally so. In their example of two land-owners who can reallocate their properties (by a unanimous decision) to more efficiently utilize their assigned share of land, redistribution by means of voluntary transfer payments requires some kind of enforcement mechanism, or "constitution" as they call it. However, they also show that an infinitely repeated interaction of the two land-owners (and likely their descendants) can achieve a similarly efficient result, if such a societal rule does not exist.[1]

We experimentally investigate this theoretical result, by studying the effects of transfer payments in a threshold (or step-level) public goods game (see, e.g., Croson and Marks, 2000; Ledyard, 1995, for an overview) with players that have heterogeneous marginal contribution costs. This means that one unit of contribution is cheaper in terms of money for some of the players and more expensive for others, e.g., due to a difference in productivity. We find a beneficial effect of transfer payments on group payoffs in this context under two decision rules that are very similar to the enforcement mechanisms considered by Bös and Kolmar (2003):

1. A binding unanimous vote on contribution vectors and transfer payments at the same time.

[1] For additional literature on the associated concept of "anarchy" see also Bös and Kolmar (2003).

2. A repeated interaction of the same group of players employing individual voluntary contributions and transfer payments.

There is a broad range of examples for threshold public goods games in which contributions are chosen either collectively or individually and to which our results apply. This includes local or regional undertakings to collect support for a public project, like a public library or a new highway, and even extends to global challenges, like preventing climate change or cleaning up the oceans. Everybody benefits if the public good is provided, everybody can contribute in some form or another, but the most efficient solution is not necessarily for everybody to take a hand in a library's or highway's construction or to swim the Pacific to fish for plastic bottles. Accordingly, threshold public goods games pose a similar allocation problem to the land-owner example described by Bös and Kolmar (2003), because there are many ways to share the cost burden among the stakeholders, some of which may be more efficient than others. In the climate change example, higher contributions (in the form of efforts to reduce carbon emissions) by China and India have a large potential to increase overall efficiency (besides being essential to even reaching the global reduction target), but these countries are unwilling or unable to increase their efforts on their own (e.g., Duscha and Ehrhart, 2015). Here is where redistribution via transfer payments comes into play: If some contributors ought to increase their share in order to increase efficiency, they may need to be compensated by other contributors who are consequently able to reduce their own share.

If contributions are chosen collectively, transfer payments can be negotiated (and later implemented) at the same time as contributions. The council of a city, representing a community that demands a new bridge, may negotiate with a local construction company (also staffed with community members) that could be hired to build this bridge, but the company will likely expect an advance payment before it starts construction. As a part of the clean development mechanism (e.g., Olsen and Fenhann, 2008), transfers in the form of emission certificates are granted to Non-Annex I countries, including most importantly China and India, if these exceed their nationally appropriate mitigation actions (NAMAs) (see also Duscha and Ehrhart, 2015). These certificates can then be sold to Annex I countries, like the U.S. or European countries, which can use them to more easily fulfill their own reduction targets, meaning that both sides can profit from the arrangement.

On a local or regional level, compliance with any agreement is ensured by a higher authority, namely the "constitution" to which Bös and Kolmar (2003) refer as well. International treaties, which lack such a higher authority that enforces agreements, must instead be designed to induce compliance, i.e., be renegotiation-proof (Finus, 2001). Fortunately, this is easily achieved by implementing contributions and transfer payments simultaneously (or at least over a concurrent period of time), a possibility that Bös and Kolmar (2003) appear to overlook.

If contributions are instead chosen individually, our game relates to reward-based crowdfunding.[2] Here, the initiator of the crowdfunding campaign represents a (group of) player(s) with an idea for an interesting project, but high opportunity costs for investing their own money. Involving other contribu-

[2]See Mollick (2014) for an empirical study on crowdfunding platforms, like, e.g., www.kickstarter.com, last accessed on June 15, 2015.

tors in the project spreads the investment over many people, some of which may have lower opportunity costs. The heterogeneity in this context therefore exists in the marginal cost of providing money itself. In exchange for their contributions, the investors are promised rewards in proportion to their contribution. On the other hand, contributions are completely refunded if the funding goal is not reached. Although crowdfunding is mostly used to finance commercial products, the same principle is occasionally also employed to support communal undertakings, like for example a public library, which create positive externalities and can therefore be considered public goods. The Ocean Cleanup, a current project to remove plastic garbage from the Pacific Ocean, is even crowdfunded on an international level.[3] Since political negotiations among the affected countries are another way to bring about such international projects of public interest, our investigation may help in the decision which of the two decision rules to apply.

Note that heterogeneity with respect to marginal costs (or productivity) is a necessary requirement to achieve efficiency increases by means of redistribution. If the players have heterogeneous endowments (e.g., Rapoport and Suleiman, 1993; van Dijk et al., 1999; Bernard et al., 2014; Alberti and Cartwright, 2015) or heterogeneous valuations of the public good (e.g., van Dijk et al., 1999; Croson and Marks, 1999, 2001; Bernard et al., 2014) the allocation of the threshold does not affect the group's total payoff, because the total cost of the threshold contribution is the same no matter which player contributes.

The experimental literature on either individually or collectively chosen

[3]See www.theoceancleanup.com, last accessed on October 20, 2015.

contributions to public goods has so far produced few relevant results related to transfer payments. With respect to the case of individual voluntary contributions, we note that, although experimental investigations of transfer payments (in the form of zero-sum rewards) in linear public goods games have already repeatedly demonstrated such a beneficial effect on total payoffs (e.g., Walker and Halloran, 2004; Gürerk et al., 2006; Sefton et al., 2007; Sutter et al., 2010), this effect relies on incentives to raise total contributions (analogously to the punishment effect first reported by Fehr and Gächter, 2000).[4] Furthermore, rewards appear to wear out their use after some time, so that both total contributions and payoffs decrease again (e.g., Sefton et al., 2007). In contrast, total contributions in threshold public goods games remain comparatively stable over time if a full refund of contributions is granted in case the threshold is not reached (e.g., Croson and Marks, 2001). Accordingly, this variant is better suited to studying a possible redistribution effect of transfer payments, by which efficiency is increased without affecting contribution levels. Moreover, a previous study by Feige et al. (2014) reports a potential for efficiency increases in a threshold public goods game with heterogeneous marginal costs, but no refund. We accordingly adapt parts of their design for our own investigation.

Feige et al. (2014) also investigate a binding unanimous vote on contribution vectors, where they find a similar potential for efficiency increases through redistribution. Heterogeneous marginal costs are rarely investigated otherwise, with the exception of Margreiter et al. (2005) in whose study contributions to a common-pool-resource game are decided by a majority vote

[4]See Chauduri (2011) for a review of the literature on sanctions in public goods games.

(see also Walker et al., 2000). Other relevant studies with homogeneous players are Alberti and Cartwright (2011) – in which the players do not actually vote, but must coordinate on a multi-dimensional vector of contributions to the (threshold) public good – and Kroll et al. (2007) – in which binding and non-binding majority voting on contributions is contrasted in a linear public goods game.

To our knowledge, we are the first to analyze the effects of transfer payments in threshold public goods games, although there are a few studies that investigate a similar design. Cabrales et al. (2012) study a coordination game in which the players can first choose between a costly high effort and a costless low effort to earn payoffs and then vote on a redistribution of their earnings. Tyran and Sausgruber (2006) find that voting behavior to redistribute payoffs from "rich" to "poor" subjects is consistent with Fehr and Schmidt (1999) preferences of inequality aversion. A possible sanctioning effect of transfer payments (as rewards) on contributions in threshold public goods games can be compared to the effect of punishment in the same game. Here, Andreoni and Gee (2015) show that institutional punishment can also increase efficiency in threshold public goods games, although results from an earlier study by Guillen et al. (2006) indicate that their "hired-gun mechanism" is likely to be abolished in a collective decision by all group members.

As we directly integrate transfer payments into our experimental design and furthermore do not allow verbal communication among the subjects of any kind, we can avoid the problems[5] that have led Fiorina and Plott (1978,

[5]Most importantly, any side agreements, whose resolution is postponed until after the

p. 577) and other researchers to explicitly forbid their subjects the use of side-payments of any kind in treatments with face-to-face negotiation (incidentally, this also includes the use of physical threats, cf. Fiorina and Plott, 1978, p. 594).

The remainder of the paper is structured as follows. The theoretical model and its solutions are described in Section 2, followed by the experimental design and procedure in Section 3. Section 4 presents the results of our experimental investigation. Section 5 concludes with a brief discussion of our results.

## 2. Theoretical Model

### *2.1. Basic game*

The basic game consists in a two-stage decision process in which a group of four players 1) simultaneously choose their contributions to a public goods game with a contribution threshold and 2) simultaneously choose individual transfer payments to bestow upon their fellow players.

Each player $i = 1, \ldots, 4$ starts with the same endowment $e$ which he can spend on his contribution $q_i \in [0, \bar{q}]$ to the public good. The contribution vector $\mathbf{q} = (q_1, q_2, q_3, q_4)$ lists the individual contributions of all players in this group. There are two player types – one with high marginal contribution costs, $c_H$, and the other with low marginal costs, $c_L$, $c_H \geq c_L > 0$, which specifies the conversion rate from endowment to contribution. Each group contains two players of each type.

experiment, are beyond the control of the experimenter.

The total contribution given by $Q = \sum_{i=1}^{4} q_i$ must reach the threshold $T$, i.e., $Q \geq T$. Otherwise each player suffers a damage payment $d$ which is deducted from his remaining endowment.[6] The contributions are refunded in this case. We set $\bar{q} < T \leq 2\bar{q}$, so that one player alone cannot reach the threshold, but two players can. This means that low-cost players do not depend on high-cost players to be able to reach the threshold, and vice versa.[7] Furthermore, we assume $4d > c_H T$ to make sure that reaching the threshold is not only feasible, but also collectively profitable for all possible allocations of $T$ among the players.

If the total contribution reaches the threshold, each player $i$ can use his remaining endowment, i.e., $e - c_i q_i$, to make bilateral transfer payments $t_{ij}$ to every other player $j$, whose final payoff is then increased by the transferred amount. Although individual players $i$ can make (or receive) "net" transfer payments $t_i := \sum_{j \neq i} [t_{ji} - t_{ij}]$ that are different from zero, all net transfer payments sum to zero, i.e., $\sum_{i=1}^{4} t_i = 0$. This means that (unlike in punishment games) no welfare is lost in the process.

Player $i$'s payoff $\pi_i(\mathbf{q}, t_i)$ is therefore given by:

$$\pi_i(\mathbf{q}, t_i) = \begin{cases} e - c_i q_i + t_i & \text{if} \quad Q \geq T \\ e - d & \text{if} \quad Q < T \end{cases} \tag{1}$$

As, in this basic game, transfer payments to other players decrease a player's payoff with no additional benefit, all subgame-perfect Nash equilibria

[6]A reward of the same amount if the threshold is reached results in a theoretically equivalent game.

[7]This assumption is not critical to our theoretical results, but simplifies matters somewhat.

(SPNE) have $t_{ij} = 0$ for all $i$ and $j$. Apart from that, any feasible vector of individual contributions[8] that exactly reaches a total contribution of $Q = T$ in the first stage can be implemented as a SPNE if it is the result of strategies that make zero transfer payments in the second stage. In fact, the set of allocations that can be implemented as equilibria is identical to that in the game without transfers. Note that this involves a coordination problem because there are many ways in which this total contribution can be allocated among the players.

In addition to this large number of strict threshold equilibria,[9] there are also many combinations of weakly best responses which result in a Pareto inferior total contribution of $Q < T$, including also the zero-contribution vector $\mathbf{q^0} = (0, 0, 0, 0)$, also referred to as the status quo in the following. These equilibria are the direct result of the refund rule in case the threshold is not reached.

### *2.2. Welfare-maximizing allocations*

Due to the player heterogeneity with respect to marginal contribution costs, only a subset of the feasible threshold allocations will be socially optimal. In order to calculate these welfare-maximizing (WM) outcomes, assume that the contribution vector $\mathbf{q^{WM}} = (q_1^{WM}, \ldots, q_4^{WM})$ maximizes the groups welfare (or total payoff) given by $\Pi(\mathbf{q}) = \sum_{i=1}^{4} \pi_i(\mathbf{q}, 0)$. We call this vector $\mathbf{q^{WM}}$ socially optimal and refer to $Q^{WM} = \sum_{i=1}^{4} q_i^{WM}$ as the socially optimal

[8] A contribution vector is feasible if both $q_i \in [0, \bar{q}]$ and $q_i \leq {}^{d}/_{c_i}$ are satisfied for all players $i$.

[9] To be precise, "weak" threshold equilibria can also exist, in which a player $i$ is indifferent between contributing a share of $q_i = {}^{d}/_{c_i}$ and contributing zero.

total contribution. Given that $Q^{WM} = T$, it is both socially and individually optimal for the players to reach the threshold value. Among these threshold allocations, social welfare is maximized by any contribution vector $\mathbf{q^{WM}}$ that completely allocates $T$ among the low-cost players.

Two other threshold allocations of interest involve either equal contributions (EC) – i.e., for all $i, j$: $q_i = q_j = \frac{T}{4}$ – or equal payoffs (EP) – i.e., for all $i, j$: $\pi_i(\mathbf{q}, 0) = \pi_j(\mathbf{q}, 0)$. Most famously Schelling (1980) argues in favor of symmetric "focal" points to resolve equilibrium selection problems. Feige et al. (2014) indeed find in their experiment that the achieved outcomes are more consistent with equalizing payoffs than maximizing welfare. It is precisely this trade-off that leads to inefficient results. A preference for equal payoffs is also consistent with the concept of inequality aversion developed by Fehr and Schmidt (1999).

### *2.3. Transfer payments*

What about a potential redistribution by means of transfer payments, though? If the high-cost players were able to make a credible promise to share their earnings from the WM outcome, welfare maximization and equal payoffs could be achieved at the same time. We now present two variants of the basic game, which are able to sustain such a credible promise and also form the basis for our experimental treatments: a repeated interaction among the players by playing the basic game multiple times and a unanimous vote by which contributions and transfer payments are collectively decided at the same time.

*2.3.1. Transfer payments and repeated interactions*

Transfer payments should give low-cost players an additional incentive to contribute according to $\mathbf{q^{WM}}$, if they expect high-cost players to reciprocate their high contributions with generous transfers. As mentioned before, if the basic game is played only once, it is not individually optimal to pay a positive ex-post transfer, because there are no repercussions for not doing so. Such payments only reduce the transferring players' payoffs.

Yet matters are different if the players interact repeatedly. All equilibrium outcomes of the basic game can also be implemented as SPNEs of a finitely repeated game. In addition, the optional transfer payments create equilibria in which transfer payments are used to redistribute payoffs. In the light of the experimental evidence pointing to a preference for equal payoffs, the following subset of equilibria is of particular interest:

**Proposition 1.** *In a finitely repeated threshold public goods game with transfer payments, all feasible threshold allocations can be implemented as SPNEs that assign equal payoffs to all players if the damage payment $d$ is sufficiently large.*

Proof: See Appendix A.

This immediately gives us the following result for the special case of a welfare-maximizing (WM) threshold allocation.

**Corollary 1.** *In a finitely repeated threshold public goods game with transfer payments, any welfare-maximizing threshold allocation can be implemented as a SPNE that assigns equal payoffs to all players if the damage payment $d$ is sufficiently large.*

With respect to our experiment, these results yield the following hypothesis:

**Hypothesis 1.** *Transfer payments will be used in the repeated game to implement a welfare-maximizing allocation with equalized payoffs.*

*2.3.2. Transfer payments and collective decisions*

A second approach to incentivize transfer payments takes into account the fact that public good provision is often decided cooperatively, e.g., by a joint decision of the members of a committee representing the involved stakeholders. This committee may negotiate contributions and transfer payments at the same time, fixing the outcome in a binding contract. As long as compliance with this contract is ensured (a standard assumption in cooperative game theory), positive transfer payments and the associated redistribution of payoffs are now an optimal outcome.

For our voting scenario, we assume that the group needs to reach a unanimous agreement on a vector of individual contributions $\mathbf{q} = (q_1, \ldots, q_4)$ as well as on a vector of net transfer payments $\mathbf{t} = (t_1, \ldots, t_4)$, which must be zero-sum, i.e., $\sum_{i=1}^{4} t_i = 0$. We consider a voting procedure that consists of a finite maximum number of voting rounds, where this maximum number is the same as the number of repetitions assumed for the repeated game described above. This provides the subjects with the same number of interactions as in the repeated game.

In every voting round, each player first makes a proposal $(\mathbf{q}, \mathbf{t})$ for a contribution vector $\mathbf{q}$ and a transfer vector $\mathbf{t}$. All proposals are made simultaneously. Then each player votes for exactly one proposal. All votes are also cast simultaneously. Identical proposals are combined and their votes are added up. If there is no agreement among the players in a particular voting round, a new round starts with new proposals and votes. If no agreement is reached in the final voting round, the zero-contribution vector $\mathbf{q^0} = (0, 0, 0, 0)$ is used as the group's choice. This status quo outcome, which does not entail transfer payments, is always added as an additional proposal, as well. The subjects are fully informed about the players' types and the results of the previous voting rounds (individual proposals and votes).

Similarly to the repeated game, the set of SPNE of this voting game is rather large, because every allocation that constitutes a Pareto improvement to the status quo can be implemented as a SPNE. In particular, we can formulate the following proposition:

**Proposition 2.** *When employing a unanimous vote on contributions in a threshold public goods game with transfer payments, all feasible threshold allocations can be implemented as SPNEs.*

Proof: See Appendix A.

This specifically includes the welfare-maximizing contribution vector $\mathbf{q^{WM}}$, as well as an outcome "WM & EP" in which the welfare-maximizing payoffs are redistributed equally among all players by means of transfer payments. Accordingly, again assuming that the players are attracted to outcomes that result in equal payoffs to all players, we postulate a hypothesis similar to that for the repeated game:

**Hypothesis 2.** *Transfer payments will be used in the voting game to implement a welfare-maximizing allocation with equalized payoffs.*

Table 1: Investigated treatments and number of groups per treatment.

| | **Unanimous Vote (V)** | **Repeated Game (R)** |
|---|---|---|
| **No Transfer (NOTR)** | VNOTR (n = 9) | RNOTR (n = 9) |
| **Transfer (TR)** | VTR (n = 9) | RTR (n = 9) |

## 3. Experimental Design and Procedure

Based on the preceding theoretical sections, we implement the following experimental design:

A group consists of four players, each endowed with $e = 30$ ExCU ("Experimental Currency Units"). Every player can convert his endowment into up to $\bar{q} = 10$ CU ("Contribution Units") which are then collected in a public account (a common project).

In total, we consider four treatments which differ with respect to the decision rule (unanimous vote (V) vs. repeated game (R)) and with respect to the availability of transfer payments (transfer (TR) vs. no transfer (NOTR)), as displayed in Table 1.[10] Two of the four players in each group have high marginal costs of contribution, $c_H = 3\,{}^{\mathrm{ExCU}}/_{\mathrm{CU}}$, and the other two players have low marginal costs, $c_L = 1\,{}^{\mathrm{ExCU}}/_{\mathrm{CU}}$. Contributions can be made in steps of 0.01 CU, and costs are rounded to 0.01 ExCU. Unless the sum of contributions reaches a threshold value $T = 16$ CU, a damage payment of $d = 25$ ExCU is deducted from each player's payoff instead of the contribution costs. This means that high-cost players should rationally contribute at most

[10]The names used for the individual treatments in the following are simply a combination of these acronyms, for example RTR for "repeated game, transfer". The participant instructions to all treatments are included as a supplement.

$q_H = {}^{25}/_3$ CU $\approx 8.33$ CU.

In the voting treatment with transfers, proposals with a total contribution of 16 CU or more, i.e., those that reach the threshold, can be extended by four additional numbers (one for each player) indicating the net transfer this player is to receive. This number is a deduction for high-cost players (who pay the transfer) and an addition for low-cost players (who receive the transfer). In the repeated game, the two high-cost players in each group wait until after the individual contributions have been made, after which they can transfer part of their earnings to each of the low-cost players separately, but only if the threshold is reached. With the restriction that payments can only be transferred from high-cost to low-cost players, we reduce the complexity of the experiment. Most importantly, high-cost players in the repeated game can directly determine their own payoffs in this way, without having to anticipate returned payments from low-cost players. The repeated game consists of ten rounds with the same group of players (partner setting). At the end of the experiment, each player receives the payoff for a single randomly selected round. Ten rounds is also the maximum duration of the voting treatments, in which the payoffs are based on the final agreement.

Proposals, votes, individual contributions, and transfer payments are all publicly displayed immediately after the choice has been made, together with the IDs of the associated players (e.g., “Player C”). Furthermore, after the first round the subjects can call up the results from past rounds whenever they have to make a decision.

According to the theory presented above, all treatments are expected to lead to the same (optimal) total contribution of $Q^{WM} = 16$ CU. Table 2

Table 2: Individual contributions $q_H, q_L$, total group payoffs $\Pi(\mathbf{q})$, and individual payoffs $\pi_H(\mathbf{q}, t_H), \pi_L(\mathbf{q}, t_L)$, if total payoffs are redistributed equally, by player type (H or L) in three allocations of particular interest: welfare-maximizing contributions (WM), equal-payoff contributions (EP), and equal contributions (EC). In the repeated game this refers to the expected outcome in each round.

| | $q_H$ | $q_L$ | $\Pi(\mathbf{q})$ | $\pi_H(\mathbf{q}, t_H)$ | $\pi_L(\mathbf{q}, t_L)$ |
|---|---|---|---|---|---|
| **WM** | 0 CU | 8 CU | 104 ExCU | 26 ExCU | 26 ExCU |
| **EP** | 2 CU | 6 CU | 96 ExCU | 24 ExCU | 24 ExCU |
| **EC** | 4 CU | 4 CU | 88 ExCU | 22 ExCU | 22 ExCU |

lists possible allocations of this total, whereby it is assumed that players of the same type also make the same contribution. Allocation WM, in which $q_H = 0$ CU and $q_L = 8$ CU, maximizes welfare at a total payoff of 104 ExCU.[11] This is the outcome that we expect to be implemented by means of transfer payments (Hypotheses 1 and 2), resulting in equal payoff shares of 26 ExCU per player. The two other listed allocations result in equal payoffs (EP) or equal contributions (EC), whereby in the former case no redistribution is necessary to equalize payoffs.

During the experiment, the subjects are asked not to talk to each other and to turn off their cell phones. They are seated at computers, which are screened off from the other subjects by plastic screens. The instructions to the experiment are handed out to the subjects in written form as well as read aloud at the beginning of the experiment. Every subject has to complete a comprehension test consisting of 9 to 13 questions depending on the treatment. The experiment does not start until everybody has answered

[11] All payoffs given here are expected values for the repeated game where only a single randomly chosen round is paid.

every question correctly.

In order to rule out variations in the results due to varying fairness preferences, every treatment is followed by a questionnaire containing items on distributive justice (adapted from Konow, 1996, items 1I, 2B, and 5) and procedural justice (partially adapted from Folger and Konovsky, 1989, Table 1). The questionnaire also includes items related to general personal data (age, gender, experience with experiments).[12]

A total of 144 subjects (4 x 9 groups with four members each) were recruited via ORSEE (Greiner, 2015) from a student pool. The computerized experiment was conducted with z-Tree (Fischbacher, 2007). Together with a show-up fee of €3, the subjects earned on average €14.32 (roughly US$19.5 at the time of the experiment) in all four treatments. Table 3 shows the average subject payoffs by treatment in ExCU and €. The subjects spent between one hour and one and a half hours in the laboratory.

## 4. Results

First we show that transfer payments do not significantly affect success rates, i.e., the frequency with which the threshold is reached, compared to the NOTR benchmarks. Nevertheless, there is a significant difference with respect to total payoffs. This allows the conclusion that transfers are not (or at least not primarily) used as a reward for positive contributions in earlier rounds.

Success rates are high in all treatments, with all voting groups agreeing on

[12]The complete questionnaire is found in Appendix B. Its results show no treatment differences and are therefore omitted.

Table 3: Investigated treatments with average subject payoffs in ExCU (exchange rate: 2 ExCU = €1) and cluster-robust standard errors (in brackets) by player type.

| | Player type | Vote (V) | Repeated game (R) (only rounds paid) | All |
|---|---|---|---|---|
| **NOTR** | both | 24.00 (0.00) | 19.20 (1.72) | 21.60 (1.04) |
| | $c_L = 1$ | 24.00 (0.00) | 19.33 (1.79) | 21.66 (1.07) |
| | $c_H = 3$ | 24.00 (0.00) | 19.06 (2.22) | 21.53 (1.28) |
| **TR** | both | 25.67 (0.23) | 21.62 (1.36) | 23.64 (0.84) |
| | $c_L = 1$ | 25.67 (0.23) | 23.46 (1.07) | 24.56 (0.62) |
| | $c_H = 3$ | 25.67 (0.23) | 19.78 (2.25) | 22.73 (1.35) |
| **All** | | 24.83 (0.23) | 20.41 (1.14) | 22.62 (0.69) |

Table 4: Absolute frequency of equal-payoff (EP), and welfare-maximizing (WM) outcomes (with associated total payoffs in ExCU) in groups that successfully reach the threshold value. Success rates are given in brackets.

| | | Unsuccessful (20 ExCU) | EP (96 ExCU) | WM (104 ExCU) | Other | Total |
|---|---|---|---|---|---|---|
| **VNOTR** | | 0 | 9 | 0 | 0 | 9 of 9 (100%) |
| **VTR** | | 0 | 1 | 7 | 1 | 9 of 9 (100%) |
| **RNOTR** | Rd 1 | 2 | 1 | 0 | 6 | 7 of 9 (77.8%) |
| | Rd 10 | 2 | 3 | 0 | 4 | 7 of 9 (77.8%) |
| | All Rds | 18 | 23 | 0 | 49 | 72 of 90 (80.0%) |
| **RTR** | Rd 1 | 2 | 0 | 0 | 7 | 7 of 9 (77.8%) |
| | Rd 10 | 0 | 1 | 4 | 4 | 9 of 9 (100%) |
| | All Rds | 12 | 6 | 14 | 58 | 78 of 90 (86.7%) |

a threshold allocation, and the slight difference between the repeated-game

(R) treatments (80.0% and 86.7% over all ten rounds for RNOTR and RTR, respectively, see also Table 4) is not statistically significant.[13]

**Result 1.** *Success rates are not significantly higher if transfer payments are possible.*

In the following analysis of total payoffs, we restrict our sample to the successful groups, because transfer payments to redistribute these payoffs are only possible if the threshold value has been reached. Table 4, which takes up the categorization into equal-pay (EP) and welfare-maximizing (WM) outcomes,[14] shows that only groups in the two transfer treatments are able to maximize welfare. In fact, seven out of nine group in the voting treatment with transfers (VTR) agree on a socially optimal outcome. In contrast, the uniquely relevant outcome in the voting treatment without transfers (VNOTR) is the threshold allocation that equalizes payoffs (EP), chosen unanimously by all nine groups. Despite the higher variance of outcomes in the repeated-game (R) treatments, a similar pattern emerges: Groups that employ transfers frequently maximize welfare, whereas groups that do not employ transfers largely focus on payoff-equalizing contributions.

By the end of the experiment (i.e., Round 10 in the repeated game and the final choice in the unanimous vote), there are significant differences between the RNOTR treatment and the RTR treatment with respect to the achieved

[13] Fisher's exact test comparing the number of groups that provide at least 16 CU in RNOTR and RTR treatments: $p = 0.3174$ (all rounds, $n = 90$ each), $p = 0.4706$ (Round 10, $n = 9$ each).

[14] Meaning contributions of $q_H = 2$ CU and $q_L = 6$ CU for EP as well as $q_H = 0$ CU and $q_L = 8$ CU for WM, see Table 2. Equal contributions (EC) outcomes, with $q_H = q_L = 4$ CU, did not result in any of the treatments and therefore play no further role in this analysis.

welfare level. None of the seven successful groups in the repeated game without transfer payments (RNOTR), but four of the nine successful groups with transfers (RTR) contribute in a socially optimal way.[15] Furthermore, all seven successful groups in the RNOTR treatment earn a total payoff of at most 96 ExCU, while seven out of nine groups in the RTR treatment make use of the transfer mechanism and as a consequence earn *more* than 96 ExCU.[16] These results correspond to Hypothesis 1.

Similarly, while none of the voting groups without transfers (VNOTR) manage to maximize their total payoff,[17] voting groups with transfer payments (VTR) predominantly do so and agree on WM outcomes.[18] The two VTR groups that do not maximize welfare agree on an EP outcome (96 ExCU) and, respectively, on contribution of $q_L = 7$ CU and $q_H = 1$ CU (100 ExCU). This corroborates Hypothesis 2.

**Result 2.** *Only groups in the transfer (TR) treatments maximize welfare.*

Figure 1 shows average total payoffs for successful groups on a round-by-round basis. For voting groups, the data are based on average proposals until agreement is reached. Afterwards the contribution vectors that the groups agree on are used instead where possible. Groups that employ transfer payments clearly earn higher total payoffs in voting treatments. Although this

[15]Fisher's exact test comparing the number of WM allocations chosen by successful groups in RNOTR ($n = 7$) and RTR ($n = 9$) treatments: $p = 0.088$.

[16] Fisher's exact test comparing the number of successful groups with a total payoff higher than 96 ExCU in RNOTR ($n = 7$) and RTR ($n = 9$) treatments: $p = 0.0032$.

[17]All groups in this treatment in fact agree on an equal-payoff outcome with a total payoff of 96 ExCU.

[18]Fisher's exact test comparing the number of WM allocations chosen by successful groups in VNOTR ($n = 9$) and VTR ($n = 9$) treatments: $p < 0.001$.

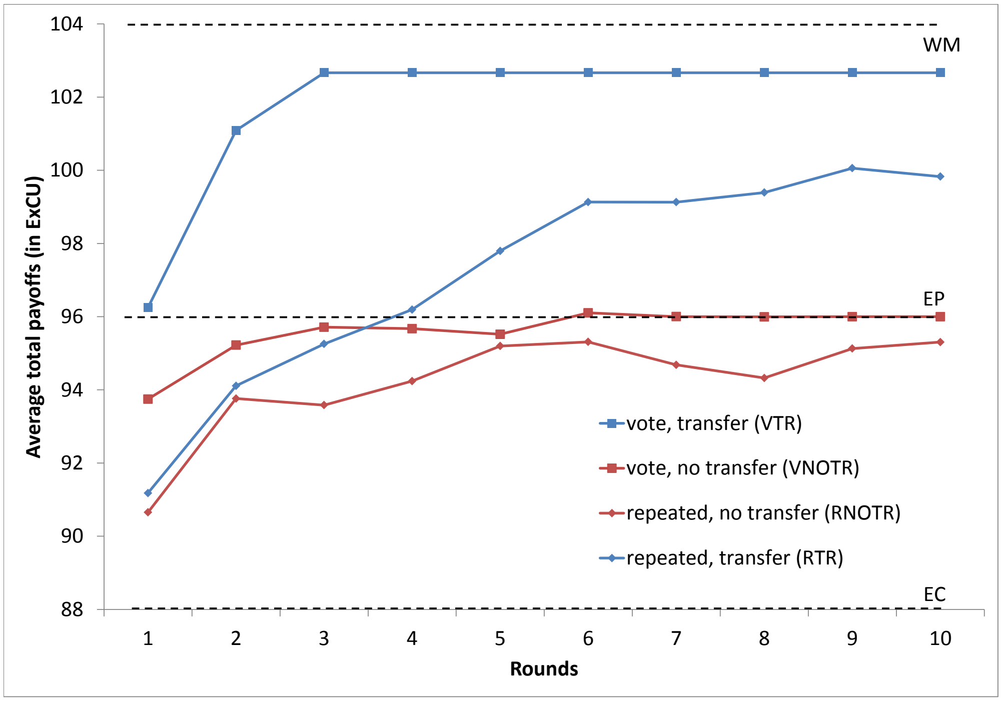



Figure 1: Average total payoffs of groups who successfully reach the threshold value. The benchmarks for welfare-maximizing (WM), equal-pay (EP), and equal-contribution (EC) outcomes are included as reference points. Data for voting treatments are based on average proposed total payoffs in early rounds, and the final outcome in later rounds once a group reaches agreement.

difference takes a few rounds to develop in the repeated game, the efficiency level in the transfer treatment (RTR) continuously increases and exceeds the level of the treatment without transfer (RNOTR). Statistically, this effect is supported by the OLS regression of average total payoffs given in Table 5, according to which the transfer treatments result in significantly higher total payoffs both in the repeated game with voluntary contributions (dummy variable "Transfer") and under a binding unanimous vote (dummy variable "Vote x Transfer"). The highest total payoffs are achieved by a combination of voting and transfer payments.

Table 5: OLS regression for total payoffs. The considered data of the repeated-game treatments are average total payoffs for each group, whereby the average is taken only over those rounds in which the threshold is reached successfully by the group.

| **Variable** | **Coefficient** | **Std. Err.** |
|---|---|---|
| Vote | $1.983^{\dagger}$ | 1.039 |
| Transfer | $3.636^{**}$ | 1.039 |
| Vote x Transfer | $3.031^{*}$ | 1.469 |
| Intercept | $94.017^{**}$ | 0.735 |
| N | 36 | |
| $R^2$ | 0.704 | |
| $F_{(3,32)}$ | 25.36 | |

Significance levels : † : 10% $*$ : 5% $**$ : 1%

As total contributions do not differ significantly among treatments with and without transfer payments, with most groups exactly reaching a total contribution of 16 CU, the observed differences in total payoffs must reflect in the choice of individual contributions and thus the threshold allocation on which the subjects (at least tacitly) agree.

**Result 3.** *Total payoffs are significantly higher if transfer payments are possible.*

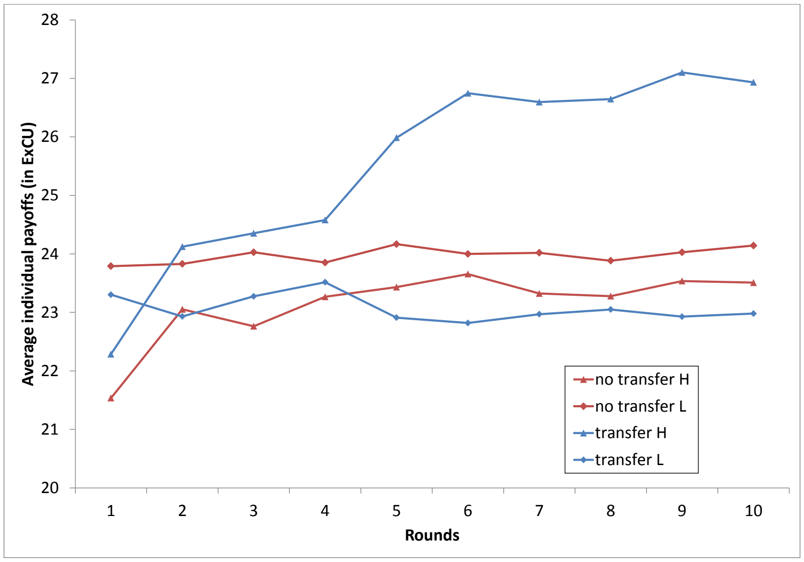
Next, we compare the payoffs of the two player types in order to investigate the extent of redistribution. In the voting treatment with transfer payments, a redistribution effect is rather obvious. All groups that agree on an outcome with a total payoff higher than 96 ExCU (the social optimum without transfers) also agree on an payoff-equalizing redistribution of this outcome by means of transfer payments. Seven of the nine groups in the voting treatment with transfers (VTR) agree on a "WM & EP" outcome. Compared to the voting treatment without transfers (VNOTR), the payoffs of both player types are at least as high in all cases (and usually strictly higher).[19] Even without a statistical test, this result is immediately obvious: All VNOTR groups agree on the equal-payoff allocation, with an individual payoff of 24 ExCU as a benchmark. Every single VTR group exceeds or at least matches this benchmark. In seven groups, which choose allocation WM and then share equally, all players earn 26 ExCU. Another groups agrees on allocation EP without redistribution, yielding 24 ExCU each. In the final group, both low-cost players contribute 7 CU, leaving 1 CU each for the high-cost players and payoffs of 25 ExCU each after redistribution. Since in all voting groups with and without transfer payments the payoffs are split equally, a statistical test for payoff differences is meaningless: There are none.

**Result 4.** *In the voting treatments, transfer payments significantly increase the individual payoffs for each player type.*

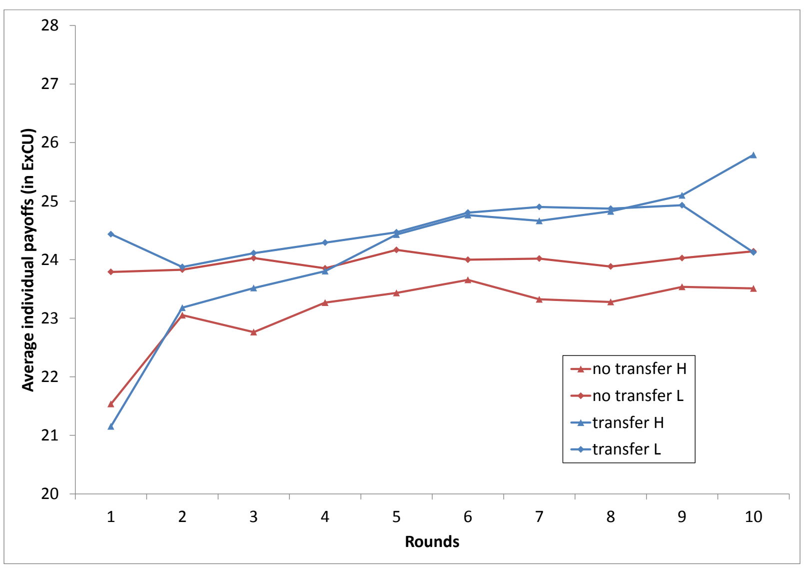
**Result 5.** *In the voting treatments, all subjects in the same group receive the same payoff. If necessary, the subjects employ transfer payments to achieve this outcome.*

In the repeated game with transfers (RTR), the greater variance of outcomes makes it slightly more difficult to discover a redistribution effect. Fig-

[19]Wilcoxon rank-sum test comparing average individual payoffs in successful groups of treatments VTR ($n = 9$) and VNOTR ($n = 9$): $z = 3.618$, $p < 0.001$ (type H, type L, and both types combined). The test is applied to group averages (to account for clustering), which are however identical to the individual payoffs in all cases.




(a) before transfer payments




(b) after transfer payments

Figure 2: Average individual payoffs before and after transfer payments over ten rounds for the repeated-game (R) treatments, differentiated by cost type and using only successful groups.

ure 2 shows average individual payoffs by player type in successful groups in the repeated-game treatments, before and after transfer payments in transferring groups. Comparing the payoffs only the basis of contributions (Subfigure a)), we find a significant difference between high-cost and low-cost players in the transfer treatment (RTR).[20]

Including transfer payments (Subfigure b)), the payoff differences between high-cost and low-cost players disappear.[21] This is also related to the development of the average amount of transfer payments over time in the RTR treatments as displayed in Figure 3. Although transfer payments drop in Round 10 (from an average of about 4.00 ExCU in Round 9 to only 2.28 ExCU), the fact that some high-cost players still pay transfers at all at this point indicates a willingness to reciprocate for selecting the welfare-maximizing allocation.

**Result 6.** *In the repeated-game treatments, transfer payments are used to significantly reduce the difference between the two player types with respect to individual payoffs.*

The high-cost players in treatment RTR start out on a payoff level similar

[20] Wilcoxon signed-rank test comparing individual payoffs of high-cost (H) and low-cost (L) players in the same group before transfer payments are applied: $z = 2.192$, $p = 0.0284$. For each of the nine groups the test is applied to average payoffs for both players of the same type earned (again on average) in rounds in which the group successfully provides the public good, yielding nine observations for each type. Average payoffs (excluding transfers) over all groups and rounds: 25.82 ExCU (H) vs. 23.00 ExCU (L).

[21] Wilcoxon signed-rank test comparing individual payoffs of high-cost (H) and low-cost (L) players in the same group after transfer payments are applied: $z = -1.362$, $p = 0.1731$. For each of the nine groups the test is applied to average payoffs for both players of the same type earned (again on average) in rounds in which the group successfully provides the public good, yielding nine observations for each type. Average payoffs (including transfers) over all groups and rounds: 24.29 ExCU (H) vs. 24.54 ExCU (L).

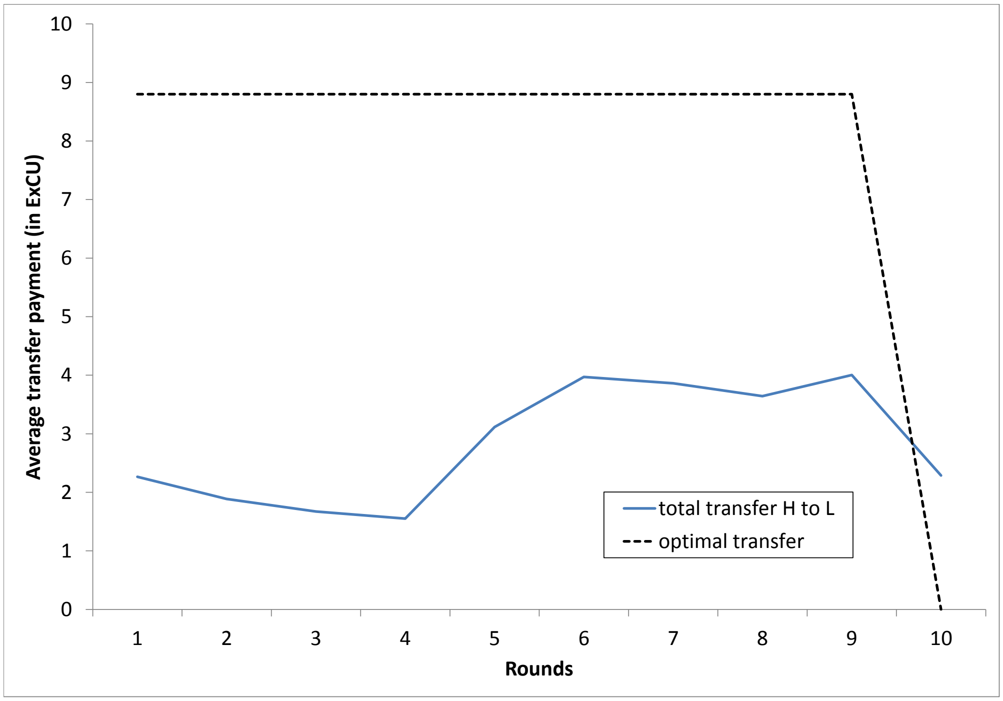



Figure 3: Average total transfer payments from high-cost to low-cost players over ten rounds in the RTR. The benchmark assumes that the group coordinates on a WM outcome in each round and transfers a total of 8.8 ExCU each round in Rounds 1 to 9 to achieve equality of payoffs only in regard to the expected payoff over all ten rounds.

to their RNOTR counterparts, but quickly achieve a relative improvement of their average payoffs. The average individual payoff over all rounds of 24.29 ExCU of high-cost players in treatment RTR is accordingly significantly higher than the 23.09 ExCU earned by the same player type in the treatment without transfers.[22] The average improvement of individual payoffs due to transfer payments is less pronounced for low-cost players, with

[22]Wilcoxon rank-sum test comparing individual payoffs of high-cost players (average value for each group taken only over successful rounds) in RTR and RNOTR treatments ($n = 9$ in each case): $z = 2.693$, $p = 0.0071$.

averages of 23.92 ExCU (RNOTR) and 24.53 ExCU (RTR), but still statistically significant.[23]

**Result 7.** *In the repeated-game treatments, transfer payments significantly increase the individual payoffs of both player types.*

## 5. Discussion and conclusion

Our study shows that redistribution by means of transfer payments can indeed achieve an increase of social welfare in a threshold public goods game and works in a similar way as theoretically predicted by Bös and Kolmar (2003). Furthermore, this result holds for both tested decision rules, unanimous voting and voluntary contributions in a repeated game, although groups in the latter setting have more difficulties employing transfer payments efficiently. In contrast with the experimental literature on reward payments in linear public goods games, in which this instrument is predominantly used myopically to reciprocate past contribution behavior and loses its potency after a few rounds (see, e.g., Sefton et al., 2007; Sutter et al., 2010), transfer payments in our study sustain cooperation until the end of the experiment. The observed preference for equal-payoff allocations furthermore speaks in favor of redistribution instead of reciprocity as a prime motivation to use transfer payments.

We should, however, also point out a few possible limitations of our work. In order to attain comparability between voting and repeated-game groups,

[23] Wilcoxon rank-sum test comparing individual payoffs of low-cost players (average value for each group taken only over successful rounds) in RTR and RNOTR treatments ($n = 9$ in each case): $z = 2.075$, $p = 0.0380$.

we have restricted the experiment to (up to) ten rounds of interactions. While this may have already been too long for some of the voting groups, ten rounds is rather short to achieve coordination just by repeated interaction. Consequently, some players in the repeated-game treatment with transfer payments may not have been able to understand this mechanism well enough to employ transfers efficiently. Nevertheless, our results at least provide proof of concept, because most groups indeed increase their total payoffs.

Moreover, the results in the voting treatments are driven by the decision process, which requires the agreement of all group members and therefore obviously favors equal-payoff outcomes. However, using something corresponding to a unanimity rule is rather common, because this (or rather the "consensus" rule) is the default procedure until other rules can be agreed upon (e.g., Buchanan and Tullock, 1962). Of course, an attempt to reproduce our results under different voting rules may be worthwhile. If anything, one might criticize our choice of the non-agreement outcome or status quo. In Bös and Kolmar (2003) this fallback outcome (the initial allocation of the land) is determined randomly, which in the context of a threshold public goods game carries the risk of placing the status quo among the threshold allocations, however, and thus eliminating any possibility of a Pareto improvement.

## Appendix A. Proof of propositions

**Proposition 1** *In a finitely repeated threshold public goods game with transfer payments, all feasible threshold allocations can be implemented as SPNEs that assign equal payoffs to all players if the damage payment $d$ is sufficiently large.*

Proof: In order to equalize the payoffs which the players earn from contributing an arbitrary threshold allocation, it is usually[24] necessary to redistribute payoffs by means of transfer payments. When using backward induction and starting in the final round, transfer payments are not individually optimal (just like in the one-shot game). However, there are multiple equilibria in this round, including $\mathbf{q^0}$, and therefore multiple outcomes to which this subgame may be reduced in the subsequent analysis of the preceding round, making it possible to condition this final choice on the actions taken in earlier rounds (cf. Benoit and Krishna, 1985).

Payoff-equalizing transfer payments can accordingly be implemented by using the status quo (zero contributions) as a threat point in a trigger strategy. This requires that, for every player $i$ who has to make a positive transfer payment in order to balance payoffs, this player's cumulative transfer payment is less than the payoff reduction suffered if the status quo is triggered. It is sufficient to consider the last two rounds of the game and any feasible threshold allocation $\hat{\mathbf{q}}$ to find a condition for $d$ which satisfies the proposition: Player $i$ faces the choice between paying the transfer payment in the second-to-last round, which results in the same threshold allocation $\hat{\mathbf{q}}$ in the final round without this transfer payment, or not paying the transfer payment, which triggers the status quo in the final round. Player $i$ should choose paying the transfer if

$$\sum_{j \neq i} t_{ij} < \pi_i(\hat{\mathbf{q}}, 0) - \pi_i(\mathbf{q^0}, 0) = d - c_i \hat{q}_i,$$

[24] The only exception is the unique threshold allocation that already results in equal payoffs.

which is fulfilled for all $i$ if the damage payment $d$ is sufficiently large. $\square$

**Proposition 2** *When employing a unanimous vote on contributions in threshold public goods game with transfer payments, all feasible threshold allocations can be implemented as SPNEs.*

Proof: Feige et al. (2014) already show that proposing and then voting for every contribution vector $\mathbf{q}$ that constitutes a Pareto improvement to $\mathbf{q^0}$ is a SPNE of the voting game without transfer payments, arguing that, if all others players already vote for $\mathbf{q}$, the remaining player faces a decision between his payoff for $\mathbf{q}$ and his payoff for $\mathbf{q^0}$ of which he will choose the former if and only if it is strictly greater. The same reasoning also applies to vectors of the form $(\mathbf{q}, \mathbf{t})$, which include transfer payments in addition to contributions. The set of feasible threshold allocations is a subset of this set of Pareto improvements over $\mathbf{q^0}$, i.e., which result in individual payoffs greater than $e - d$, whether these payoffs are generated directly via contributions or result from a redistribution with transfer payments. $\square$

## Appendix B. Questionnaire

*The questionnaire used for the most part items from English-language sources which were translated into German as literally as possible. Here, however, we reprint the original English version of these items. Since several of the items on procedural justice had to be slightly changed to fit the context of our experiment, we provide both the original item and our changed version (translated from German) in these cases.*

Please answer the following questions completely. As this is about personal attitudes, there are neither "right" nor "wrong" answers.

**Question 1 (Konow, 1996, item 1I)**

Bob and John are identical in terms of physical and mental abilities. They become shipwrecked on an uninhabited island where the only food is bananas. 10 bananas per day fall to their feet on land while others fall into the ocean. They can collect as many bananas as they want by climbing up a tree, picking them before they fall into the ocean and throwing them into a pile. In this way Bob picks 7 bananas per day and John picks 3 per day. Thus, there are a total of 20 bananas per day on the island. If you could decide the distribution of bananas and wanted to be fair, which of the following would you choose?

A. Bob gets 10 bananas, the 7 that he picked plus 3 which fell, and John gets 10, the 3 which he picked plus 7 which fell.

B. Bob gets 12 bananas, the 7 that he picked plus 5 which fell, and John gets 8, the 3 which he picked plus 5 which fell.

C. Bob gets 14 bananas, the 7 that he picked plus 7 which fell, and John gets 6, the 3 which he picked plus 3 which fell.

**Question 2 (Konow, 1996, item 2B)**

Smith and Jones work in identical office jobs at a large company and have the same experience, seniority and past performance records. Smith chooses to work 40 hours per week and gets paid $800 while Jones chooses to work 20 hours per week and gets paid $400.

1. Very fair
2. Fair
3. Unfair
4. Very unfair

**Question 3 (Konow, 1996, item 5)**

Bill and Sam manage a small grocery store at different times and on different days. The manager's duties are always the same and the days and times which each work vary pretty much randomly, but Bill works 40 hours per week while Sam works 20 hours per week. Suppose the manager's salary for a 60 hour week is $1200. Which of the following is the most fair division of this salary?

A. Bill gets $600 and Sam gets $600.

B. Bill gets \$700 and Sam gets \$500.
C. Bill gets \$800 and Sam gets \$400.

**Question 4**

Please rate the decision mechanism used in this experiment on the provided scale (strongly agree, agree, disagree, strongly disagree). The mechanism ...

1. ... gave you an opportunity to express your side. (Folger and Konovsky, 1989, Table 1, item 2)
2. ... used consistent standards in evaluating your behavior. [originally: ... to evaluate your performance.] (Folger and Konovsky, 1989, Table 1, item 3)
3. ... gave you feedback that led you to reevaluate you decisions. [originally: ... gave you feedback that helped you learn how you were doing.] (Folger and Konovsky, 1989, Table 1, item 5)
4. ... was honest and ethical in dealing with you. (Folger and Konovsky, 1989, Table 1, item 1)
5. ... was designed to achieve a fair result. [originally: ... showed a real interest in trying to be fair.] (Folger and Konovsky, 1989, Table 1, item 7)
6. ... led to a result with which you were not satisfied. (own item)
7. ... allowed personal motives to influence the result. [originally: ... allowed personal motives or biases to influence recommendation.] (Folger and Konovsky, 1989, Table 1, item 25)
8. ... gave you the opportunity to significantly influence the other players' payoff. (own item)

**Socio-demographic questions:**

- Age:
- Gender (female, male):
- How often did you participate in an economic experiment? (never, once, two to five times, more than five times)

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**Supplement – Experimental instructions**

The following experimental instructions were translated from German. Please note that the instructions are only translations for information; they are not intended to be used in the lab. The instructions in the original language were carefully polished in grammar, style, comprehensibility, and avoidance of strategic guidance.

*Treatment VNOTR*

## Welcome to the experiment!

You are now participating in a scientific experiment. Please read the following instructions carefully. Here you will be told everything that you need to know for the participation in the experiment. Please also note the following:

From now on as well as during the entire experiment **no communication** is permitted. Please turn off your cell phones. If you have any questions, please raise your hand. All **decisions are made anonymously**, meaning that none of the other participants learns the identity of those who made a particular decision.

**For showing up on time you receive an amount of €3** Over the course of the experiment you can earn an additional amount of up to €15. The precise amount is influenced by the decisions of the other participants. The total amount will be paid to you **in cash** at the end of the experiment. The **payment occurs anonymously, too**, meaning that no participant will known another participant's payoff. This experiment uses the currency "Experimental Currency Units" (ExCU).

**Two Experimental Currency Units are equal to €1.**

## Experimental Procedure

In the experiment you form **a group with three other players**. The composition of this group is determined randomly at the beginning of the experiment and will not change throughout the entire experiment.

*THE PROJECT.* Your task in this experiment is to choose your and your fellow players' contributions to a project. Your decision consists in a **vote on the individual contributions of all players in a group**. The contributions of all players in a group are added up to a **total contribution**. **For the project to be successful, your group's total contribution must reach a minimum**

**contribution.** If the project is **not successful**, the contributions of all players are refunded just as if nobody had made any contribution. Instead of the contributions, the players then must make a **fixed payment**.

*PROCEDURE OF THE DECISION.* In the experiment, you and your fellow players vote on the **individual contributions of all group players to a project.** This happens in **up to ten voting rounds** and proceeds as follows:

1. Proposals for contributions to the project
2. Unanimous vote on the proposals
3. Result: project successful?

If there is **no unanimous agreement**, Steps 1. and 2. are repeated, i.e., **new proposals** are made and **new votes** are cast. After the tenth unsuccessful voting round, the **status quo** is implemented, which means that nobody contributes anything.

*DETAILS OF THE PROCEDURE.*

1. <u>Proposals for contributions to the project</u>
   At the beginning of the experiment, each player has an **endowment of 30 Experimental Currency Units (ExCU).**
   **Each player's contribution is measured in Contribution Units (CU).** Each player can provide **up to 10 Contribution Units** by investing Experimental Currency Units from his endowment. The group's total contribution can therefore amount to up to 40 Contribution Units.
   **The costs per provided Contribution Unit differ among the players:**

   | | |
   |---|---|
   | **Players A and B** | 1 Contribution Unit costs 1 Experimental Currency Unit **(1 CU = 1 ExCU)** |
   | **Players C and D** | 1 Contribution Unit costs 3 Experimental Currency Units **(1 CU = 3 ExCU)** |

   At the beginning of the experiment you will be told which player you are (A, B, C, D). This is determined randomly.
   **Each player makes a proposal for the contribution of every single player. All players make their proposals individually and at the same time.** In order to do this, each player chooses an amount between 0 and 10 Contribution Units (in steps of 0.01 CU). **The individual contributions from each proposal are automatically summed up to a total contribution.**
   By clicking on **"Calculate values"** you can make the program display the total contribution, as well as each player's contribution costs and earnings in Experimental Currency Units.

The proposals (that is, contribution costs, total contribution, and resulting earnings) are shown to all players in a list (see Table 1). Among these is also a proposal called **"status quo"**. This proposal means that each player makes a contribution of 0 Contribution Units (total contribution 0 CU). Next to each proposal there is a list of the player(s) who made this proposal. Identical proposals are displayed only once, together with all players who made this proposal. Including the status quo, there can accordingly be up to five different contribution proposals.

2. Unanimous vote on the proposals
   **At the same time as all of the other players in his group, each player casts a vote for exactly one of these proposals.** In order to vote for a proposal please click on "Accept" in the column directly to the right of the proposal. Each player then learns the result of the vote, i.e., the number of votes for each proposal as well as which player has voted for which alternative.
   (a) **Unanimous decision** (all four players vote for the same proposal): The experiment ends with the calculation of earnings and payoffs.
   (b) **No unanimous decision:**
   **Rounds 1 to 9:** New proposals are made (see above, 1.), on which new votes are then cast.
   **Round 10:** The **status quo** (each player makes a contribution of 0 Contribution Units, total contribution of 0 Contribution Units, individual earnings of 5 Experimental Currency Units) is used for the calculation of payoffs.
3. Result: project successful?
   In the experiment the provided contributions must reach a **minimum contribution of 16 Contribution Units.** If the minimum contribution is *not* reached, each player must make a **payment in Experimental Currency Units**, which is deducted from his endowment. The provided contributions are **refunded** in this case, so that except for the payment not additional costs are incurred.
   **The payment if the minimum contribution is not reached is the same for all players:**
   **Players A, B, C, D** Payment of **25 ExCU**
   (a) Total contribution **greater than or equal to** 16 CU
   Every player pays his contribution costs.
   **Earnings = your endowment (in ExCU) − your contribution costs (in ExCU)**
   (b) Total contribution **less than** 16 CU
   Every player pays 25 ExCU
   **Earnings = your endowment (in ExCU) − 25 ExCU**

Table 1: Reproduction of screenshot for voting decision in treatment VNOTR.

**Voting round 2 of up to 10**

You are Player B

Please accept one of the following proposals!

If the total contribution is smaller than 16.00 CU, every player must make a payment of 25 ExCU **instead** of the contributed amount.

Every player has an **endowment of 30 ExCU.**

Results Round 1 | Back to decision

| **Proposal** | | **Player A** | **Player B** | **Player C** | **Player D** | **Total Contribution (CU)** | |
|---|---|---|---|---|---|---|---|
| **Player A** | Contribution (CU) | 1.60 | 2.20 | 4.40 | 3.60 | 11.80 | Accept |
| **Player C** | Payment (ExCU) | -25.00 | -25.00 | -25.00 | -25.00 | | |
| | Earnings (ExCU) | 5.00 | 5.00 | 5.00 | 5.00 | | |
| **Player B (your** | Contribution (CU) | 5.80 | 3.50 | 4.60 | 2.40 | 16.30 | Accept |
| **proposal)** | Contribution Costs (ExCU) | -5.80 | -3.50 | -13.80 | -7.20 | | |
| | Earnings (ExCU) | 24.20 | 26.50 | 16.20 | 22.80 | | |
| **Player D** | Contribution (CU) | 9.00 | 3.80 | 5.40 | 4.90 | 23.10 | Accept |
| | Contribution Costs (ExCU) | -9.00 | -3.80 | -16.20 | -14.70 | | |
| | Earnings (ExCU) | 21.00 | 26.20 | 13.80 | 15.30 | | |
| **Status quo** | Contribution (CU) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | Accept |
| | Payment (ExCU) | -25.00 | -25.00 | -25.00 | -25.00 | | |
| | Earnings (ExCU) | 5.00 | 5.00 | 5.00 | 5.00 | | |

*YOUR PAYOFF.* In order to calculate the total payoff at the end of the experiment, the obtained earnings are converted into euros **(2 ExCU = €1)** and added to your show-up fee (€3).

**Example for the procedure of a voting round:**

A total of five proposals for the group players' individual contributions:

(See Table 1)

The proposal "1.60 CU, 2.20 CU, 4.40 CU, 3.60 CU" with a total contribution of 11.80 CU has been made twice, but only counts as a single alternative. As the minimum contribution is missed with this proposal, each player must make a payment of 25 ExCU instead of contribution costs.

The proposal "5.80 CU, 3.50 CU, 4.60 CU, 2.40 CU" with a total contribution of 16.30 CU exceeds the minimum contribution of 16 CU. Each player must therefore pay his contribution costs.

All four players vote for "B". The other three different proposals ("Status quo", "A, C", "D") do not receive any votes this time.

The voting procedure ends in this example with the selection of proposal "B" and a total contribution of 16.3 CU.

**Examples for the calculation of earnings:**

Example 1:

The players in a group provide the following individual contributions which add up to a **total contribution of 11.4 CU:**

- Player A: 1.2 CU (1.2*1 ExCU = 1.2 ExCU)
- Player B: 3.4 CU (3.4*1 ExCU = 3.4 ExCU)
- Player C: 4.5 CU (4.5*3 ExCU = 13.5 ExCU)
- Player D: 2.3 CU (2.3*3 ExCU = 6.9 ExCU)

The minimum contribution of 16 CU is **missed** in this case. Each player is refunded the contributions he provided. Instead each player is deducted a payment of 25 ExCU, because the minimum contribution has not been reached. Accordingly, each player receives earnings of 5 ExCU.

Example 2:

The players in a group provide the following individual contributions which add up to a **total contribution of 16.3 CU:**

- Player A: 5.8 CU (5.8*1 ExCU = 5.8 ExCU)

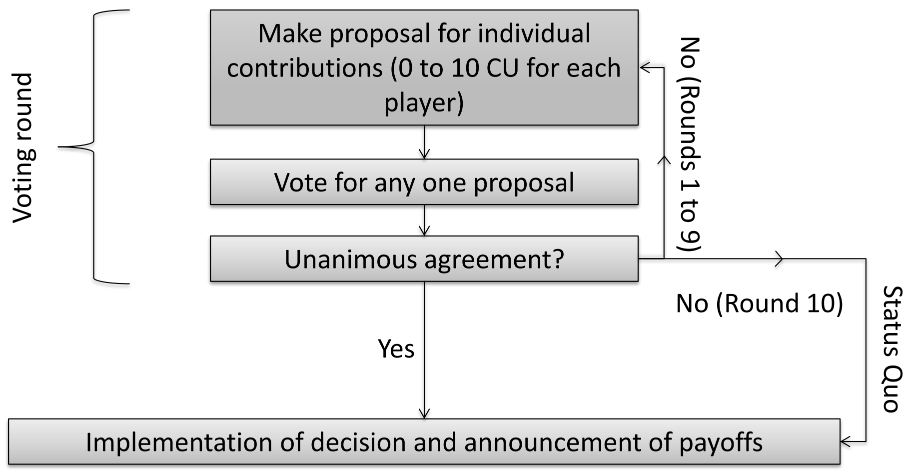


Figure 1: Experimental procedure of treatment VNOTR.

- Player B: 3.5 CU (3.5*1 ExCU = 3.5 ExCU)
- Player C: 4.6 CU (4.6*3 ExCU = 13.8 ExCU)
- Player D: 2.4 CU (2.4*3 ExCU = 7.2 ExCU)

The minimum contribution of 16 CU is **reached** in this case. Player A (contribution costs of 1 ExCU per invested CU) therefore receives earnings of 30 ExCU − 5.8 ExCU = 24.2 ExCU. A payment of 25 ExCU is not incurred in this case, because the minimum contribution has been reached.

Please note that, with the beginning of the second voting round, you may recall the **results from preceding rounds** during each decision by clicking on the button "Result Round X" for the respective Round X. By clicking on the button "Back to Decision" you can return to the current voting round.

*ADDITIONAL REMARKS.* Please think carefully about all of your decisions, because they determine your payoff at the end of the experiment. Before the actual experiment can begin, you must answer a few questions which ensure that you have understood the procedure of the experiment and your task. You find the questions on the left side of the screen, and you can enter your answers on the right side. Please enter decimal numbers with a point instead of a comma (that is, e.g., 12.34 instead of 12,34).

If you have any questions of your own during the experiment, please remain seated quietly and raise your hand. Please wait until the experimenter has come to your seat and then ask your question as quietly as possible. In any event, you should only ask questions about the instructions and not about strategies! Furthermore, please not that the game only continues after all players have made their decisions.

Feel free to use the last sheet of these instructions for your own notes.

*END OF THE EXPERIMENT.* After the experiment, we will ask you to fill in a questionnaire. Please remain seated after completing the questionnaire until we call up your place number. Take your instructions with you to the front desk. Only then will you be able to receive your payoff.

*Treatment RNOTR*

**Welcome to the experiment!**

You are now participating in a scientific experiment. Please read the following instructions carefully. Here you will be told everything that you need to know for the participation in the experiment. Please also note the following:

From now on as well as during the entire experiment **no communication** is permitted. Please turn off your cell phones. If you have any questions, please raise your hand. All **decisions are made anonymously**, meaning that none of the other participants learns the identity of those who made a particular decision.

**For showing up on time you receive an amount of €3** Over the course of the experiment you can earn an additional amount of up to €15. The precise amount is influenced by the decisions of the other participants. The total amount will be paid to you **in cash** at the end of the experiment. The **payment occurs anonymously, too**, meaning that no participant will known another participant's payoff. This experiment uses the currency "Experimental Currency Units" (ExCU).

**Two Experimental Currency Units are equal to €1.**

## Experimental Procedure

In the experiment you form **a group with three other players**. The composition of this group is determined randomly at the beginning of the experiment and will not change throughout the entire experiment, that is, in all **ten rounds**.

*THE PROJECT.* Your task in each of the ten rounds is to choose your contribution to a project. At the same time, all other players in your group also choose their own contributions to this project. The contributions of all players in a group are added up to a **total contribution**. **For the project to be successful, your group's total contribution must reach a minimum contribution.** If the project is **not successful**, the contributions of all players are refunded just as if nobody had made any contribution. Instead of the contributions, the players then must make a **fixed payment**.

*PROCEDURE OF THE DECISION.* In the experiment, you and your fellow players each choose **your own contribution to a project.** This occurs repeatedly in a total of **ten decision rounds**, which all proceed as follows:

1. Choice of contributions to the project
2. Result: project successful?

The experiment consists of a **total of ten such independent decisions** in a total of ten rounds. **Only one of these rounds is relevant for your payoff, however.** Which of these rounds is paid will be determined at the end of the experiment, individually for each player. In doing so, each of the ten rounds has the same probability of being chosen.

*DETAILS OF THE PROCEDURE.*

1. Choice of contributions to the project
   At the beginning of each round, each player has an **endowment of 30 Experimental Currency Units (ExCU).**
   **Each player's contribution is measured in Contribution Units (CU).** In every single round, each player can provide **up to 10 Contribution Units** by investing Experimental Currency Units from his endowment. The group's total contribution in each round can therefore amount to up to 40 Contribution Units.
   **The costs per provided Contribution Unit differ among the players:**

   | | |
   |---|---|
   | **Players A and B** | 1 Contribution Unit costs 1 Experimental Currency Unit **(1 CU = 1 ExCU)** |
   | **Players C and D** | 1 Contribution Unit costs 3 Experimental Currency Units **(1 CU = 3 ExCU)** |

   At the beginning of the experiment you will be told which player you are (A, B, C, D). This is determined randomly.
   **At the same time as all of the other players in his group, each player chooses his own contribution to the project.** In order to do so, he chooses an amount between 0 and 10 Contribution Units (in steps of 0.01 CU). By clicking on **"Calculate values"** you can make the program display the corresponding amount in Experimental Currency Units, as well. **The individual contributions of all players are automatically summed up to a total contribution.**
2. Result: project successful?
   In each round the provided contributions must reach a **minimum contribution of 16 Contribution Units.** If the minimum contribution is *not* reached in a particular round, each player must make a **payment in Experimental Currency Units**, which is deducted from his earnings in the respective round. The provided contributions are **refunded** in this case, so that except for the payment not additional costs are incurred.
   **The payment if the minimum contribution is not reached is the same for all players:**

   | | |
   |---|---|
   | **Players A, B, C, D** | Payment of **25 ExCU** |

(a) Total contribution **greater than or equal to** 16 CU
Every player pays his **individual contribution costs**.
**Earnings**= your endowment (in ExCU) − your contribution costs (in ExCU)

(b) Total contribution **less than** 16 CU
Every player pays 25 ExCU
**Earnings = your endowment (in ExCU) − 25 ExCU**

After all players in your group have made their contribution choice, all players are shown the total contribution of their group as well as the resulting earnings of all players. The contributions and contribution costs of the other players in the group are displayed, too.

*YOUR PAYOFF.* In order to calculate the total payoff at the end of the experiment, one of the ten rounds is selected at random. All rounds have the same probability of being selected. **This means that you receive only the final earnings of a single round.** The results of the remaining rounds are no longer relevant for your payoff, no matter whether or not the minimum contribution was reached in these rounds. The earnings obtained in the randomly selected round are converted into euros **(2 ExCU = €1)** and added to your show-up fee (€3).

**Example for the procedure of a round:**
Example 1:
The players in a group provide the following individual contributions in this round which add up to a **total contribution of 11.4 CU:**

- Player A: 1.2 CU (1.2*1 ExCU = 1.2 ExCU)
- Player B: 3.4 CU (3.4*1 ExCU = 3.4 ExCU)
- Player C: 4.5 CU (4.5*3 ExCU = 13.5 ExCU)
- Player D: 2.3 CU (2.3*3 ExCU = 6.9 ExCU)

The minimum contribution of 16 CU is **missed** in this case. Each player is refunded the contributions he provided. Instead each player is deducted a payment of 25 ExCU, because the minimum contribution has not been reached. Accordingly, each player receives earnings of 5 ExCU in this round.

Example 2:
The players in a group provide the following individual contributions in this round which add up to a **total contribution of 16.3 CU:**

- Player A: 5.8 CU (5.8*1 ExCU = 5.8 ExCU)
- Player B: 3.5 CU (3.5*1 ExCU = 3.5 ExCU)
- Player C: 4.6 CU (4.6*3 ExCU = 13.8 ExCU)
- Player D: 2.4 CU (2.4*3 ExCU = 7.2 ExCU)

The minimum contribution of 16 CU is **reached** in this case. Player A (contribution costs of 1 ExCU per invested CU) therefore receives earnings of 30 ExCU − 5.8 ExCU = 24.2 ExCU in this round. A payment of 25 ExCU is not incurred in this case, because the minimum contribution has been reached.

Please note that, with the beginning of the second round, you may recall the **results from preceding rounds** during each decision by clicking on the button "Result Round X" for the respective Round X. By clicking on the button "Back to Decision" you can return to the current round. After choosing your contribution (Button "Confirm Choice") you have one additional opportunity to correct this choice if necessary. As soon as you click the button "Confirm Choice and Continue", your choice is final.

*ADDITIONAL REMARKS.* Please think carefully about all of your decisions, because they determine your payoff at the end of the experiment. Before the actual experiment can begin, you must answer a few questions which ensure that you have understood the procedure of the experiment and your task. You find the questions on the left side of the screen, and you can enter your answers on the right side. Please enter decimal numbers with a point instead of a comma (that is, e.g., 12.34 instead of 12,34).

If you have any questions of your own during the experiment, please remain seated quietly and raise your hand. Please wait until the experimenter has come to your seat and then ask your question as quietly as possible. In any event, you should only ask questions about the instructions and not about strategies! Furthermore, please not that the game only continues after all players have made their decisions.

Feel free to use the last sheet of these instructions for your own notes.

*END OF THE EXPERIMENT.* After the experiment, we will ask you to fill in a questionnaire. Please remain seated after completing the questionnaire until we call up your place number. Take your instructions with you to the front desk. Only then will you be able to receive your payoff.

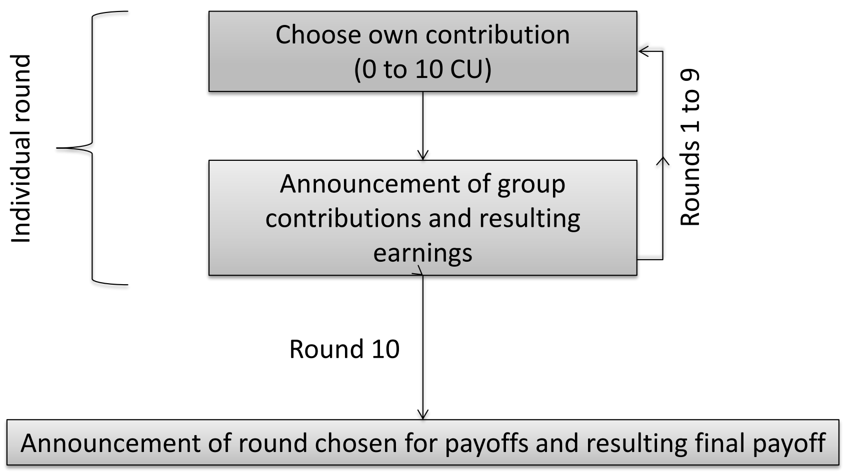


Figure 2: Experimental procedure of treatment RNOTR.

*Treatment VTR*

**Welcome to the experiment!**

You are now participating in a scientific experiment. Please read the following instructions carefully. Here you will be told everything that you need to know for the participation in the experiment. Please also note the following:

From now on as well as during the entire experiment **no communication** is permitted. Please turn off your cell phones. If you have any questions, please raise your hand. All **decisions are made anonymously**, meaning that none of the other participants learns the identity of those who made a particular decision.

**For showing up on time you receive an amount of €3** Over the course of the experiment you can earn an additional amount of up to €15. The precise amount is influenced by the decisions of the other participants. The total amount will be paid to you **in cash** at the end of the experiment. The **payment occurs anonymously, too**, meaning that no participant will known another participant's payoff. This experiment uses the currency "Experimental Currency Units" (ExCU).

**Two Experimental Currency Units are equal to €1.**

## Experimental Procedure

In the experiment you form **a group with three other players**. The composition of this group is determined randomly at the beginning of the experiment and will not change throughout the entire experiment.

*THE PROJECT.* Your task in this experiment is to choose your and your fellow players' contributions to a project. Your decision consists in a **vote on the individual contributions of all players in a group**. The contributions of all players in a group are added up to a **total contribution**. **For the project to be successful, your group's total contribution must reach a minimum contribution. In the case of success, transfer payments** can be made subsequently. If the project is **not successful**, the contributions of all players are refunded just as if nobody had made any contribution. Instead of the contributions, the players then must make a **fixed payment**.

*PROCEDURE OF THE DECISION.* In the experiment, you and your fellow players vote on the **individual contributions of all group players to a project.** Together with the individual contributions, you also vote on **transfer payments between the group players.** This happens in **up to ten voting rounds** and proceeds as follows:

1. Proposals for contributions to the project and for transfer payments between the players
2. Unanimous vote on the proposals
3. Result: project successful?

If there is **no unanimous agreement**, Steps 1. and 2. are repeated, i.e., **new proposals** are made and **new votes** are cast. After the tenth unsuccessful voting round, the **status quo** is implemented, which means that nobody contributes anything.

*DETAILS OF THE PROCEDURE.*

1. <u>Proposals for contributions to the project and for transfer payments between the players</u>
   At the beginning of the experiment, each player has an **endowment of 30 Experimental Currency Units (ExCU).**

**Each player's contribution is measured in Contribution Units (CU).** Each player can provide **up to 10 Contribution Units** by investing Experimental Currency Units from his endowment. The group's total contribution can therefore amount to up to 40 Contribution Units.

**The costs per provided Contribution Unit differ among the players:**

| | |
|---|---|
| **Players A and B** | 1 Contribution Unit costs 1 Experimental Currency Unit **(1 CU = 1 ExCU)** |
| **Players C and D** | 1 Contribution Unit costs 3 Experimental Currency Units **(1 CU = 3 ExCU)** |

At the beginning of the experiment you will be told which player you are (A, B, C, D). This is determined randomly.

**If the minimum contribution of 16 CU is reached, Players C and D make transfer payments to Players A and B.** In doing so, the sum of transfer payments **paid** by C and D must correspond to the sum of transfer payments **received** by A and B. Players C and D may each provide a **maximum of 30 ExCU minus contribution costs** as transfer payments.

**Each player makes a proposal for the contribution of every single player. All players make their proposals individually and at the same time.** In order to do this, each player chooses an amount between 0 and 10 Contribution Units (in steps of 0.01 CU). **The individual contributions from each proposal are automatically summed up to a total contribution.**

**If the proposed total contribution is greater than or equal to the minimum contribution of 16 CU, you can also propose transfer payments between the players.** In addition to the four contribution values, the proposal then contains four additional numbers: the respective transfer payments paid by Players C and D and the respective transfer payments received by Players A and B.

By clicking on **"Calculate values"** you can make the program display the total contribution, as well as each player's contribution costs and earnings in Experimental Currency Units.

The proposals (that is, contribution costs, total contribution, transfer payments, and resulting earnings) are shown to all players in a list (see Table 2). This proposal means that each player makes a contribution of 0 Contribution Units (total contribution 0 CU) , so that no transfer payments are possible. Next to each proposal there is a list of the player(s) who made this proposal. Identical proposals are displayed only once, together with all players who made this proposal. Including the status quo, there can accordingly be up to five different contribution proposals.

2. Unanimous vote on the proposals
   **At the same time as all of the other players in his group, each player casts a vote for exactly one of these proposals.** In order to vote for a proposal please click on "Accept" in the column directly to the right of the proposal. Each player then learns the result of the vote, i.e., the number of votes for each proposal as well as which player has voted for which alternative.
   (a) **Unanimous decision** (all four players vote for the same proposal): The experiment ends with the calculation of earnings and payoffs.
   (b) **No unanimous decision:**
   **Rounds 1 to 9:** New proposals are made (see above, 1.), on which new votes are then cast.
   **Round 10:** The **status quo** (each player makes a contribution of 0 Contribution Units, total contribution of 0 Contribution Units, no transfer payments, individual earnings of 5 Experimental Currency Units) is used for the calculation of payoffs.
3. Result: project successful?
   In the experiment the provided contributions must reach a **minimum contribution of 16 Contribution Units.** If the minimum contribution is *not* reached, each player must make a **payment in Experimental Currency Units**, which is deducted from his endowment. The provided contributions are **refunded** in this case, so that except for the payment not additional costs are incurred.
   **The payment if the minimum contribution is not reached is the same for all players:**
   **Players A, B, C, D** Payment of **25 ExCU**
   (a) Total contribution **greater than or equal to** 16 CU
   Every player pays his contribution costs.
   **Earnings = your endowment (in ExCU) − your contribution costs (in ExCU)**
   Players A and B:
   **Earnings = your endowment (in ExCU) − your contribution costs (in ExCU) + received transfers (in ExCU**
   Players C and D:
   **Earnings = your endowment (in ExCU) − your contribution costs (in ExCU) − paid transfers (in ExCU**
   (b) Total contribution **less than** 16 CU
   Every player pays 25 ExCU
   All players:
   **Earnings = your endowment (in ExCU) − 25 ExCU**

Table 2: Reproduction of screenshot for voting decision in treatment VTR.

**Voting round 2 of up to 10**

You are Player C

Please accept one of the following proposals!

If the total contribution is smaller than 16.00 CU, every player must make a payment of 25 ExCU **instead** of the contributed amount.

Every player has an **endowment of 30 ExCU.**

Results Round 1 | Back to decision

| **Proposal** | | **Player A** | **Player B** | **Player C** | **Player D** | **Total Contribution (CU)** | |
|---|---|---|---|---|---|---|---|
| **Player A** | Contribution (CU) | 1.60 | 2.20 | 4.40 | 3.60 | 11.80 | Accept |
| **Player C (your proposal)** | Payment (ExCU) | -25.00 | -25.00 | -25.00 | -25.00 | | |
| | Transfer (ExCU) | 0.00 | 0.00 | -0.00 | -0.00 | | |
| | Earnings (ExCU) | 5.00 | 5.00 | 5.00 | 5.00 | | |
| **Player B** | Contribution (CU) | 5.80 | 3.50 | 4.60 | 2.40 | 16.30 | Accept |
| | Contribution Costs (ExCU) | -5.80 | -3.50 | -13.80 | -7.20 | | |
| | Transfer (ExCU) | 2.40 | 3.90 | -2.80 | -3.50 | | |
| | Earnings (ExCU) | 26.60 | 30.40 | 13.40 | 19.30 | | |
| **Player D** | Contribution (CU) | 9.00 | 3.80 | 5.40 | 4.90 | 23.10 | Accept |
| | Contribution Costs (ExCU) | -9.00 | -3.80 | -16.20 | -14.70 | | |
| | Transfer (ExCU) | 5.30 | 6.00 | -7.30 | -4.00 | | |
| | Earnings (ExCU) | 26.30 | 32.20 | 6.50 | 15.30 | | |
| **Status quo** | Contribution (CU) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | Accept |
| | Payment (ExCU) | -25.00 | -25.00 | -25.00 | -25.00 | | |
| | Transfer (ExCU) | 0.00 | 0.00 | -0.00 | -0.00 | | |
| | Earnings (ExCU) | 5.00 | 5.00 | 5.00 | 5.00 | | |

*YOUR PAYOFF.* In order to calculate the total payoff at the end of the experiment, the obtained earnings are converted into euros **(2 ExCU = €1)** and added to your show-up fee (€3).

**Example for the procedure of a voting round:**

A total of five proposals for the group players' individual contributions:

(See Table 2)

The proposal "1.60 CU, 2.20 CU, 4.40 CU, 3.60 CU" with a total contribution of 11.80 CU has been made twice, but only counts as a single alternative. As the minimum contribution is missed with this proposal, each player must make a payment of 25 ExCU instead of contribution costs. Transfer payments are not possible in this case.

The proposal "5.80 CU, 3.50 CU, 4.60 CU, 2.40 CU" with a total contribution of 16.30 CU exceeds the minimum contribution of 16 CU. Each player must therefore pay his contribution costs. In addition Players C and D make transfer payments to Players A and B.

All four players vote for "B". The other three different proposals ("Status quo", "A, C", "D") do not receive any votes this time.

The voting procedure ends in this example with the selection of proposal "B" and a total contribution of 16.3 CU.

**Examples for the calculation of earnings:**

Example 1:

The players in a group provide the following individual contributions which add up to a **total contribution of 11.4 CU:**

- Player A: 1.2 CU (1.2*1 ExCU = 1.2 ExCU)
- Player B: 3.4 CU (3.4*1 ExCU = 3.4 ExCU)
- Player C: 4.5 CU (4.5*3 ExCU = 13.5 ExCU)
- Player D: 2.3 CU (2.3*3 ExCU = 6.9 ExCU)

The minimum contribution of 16 CU is **missed** in this case. Each player is refunded the contributions he provided. Instead each player is deducted a payment of 25 ExCU, because the minimum contribution has not been reached. Accordingly, each player receives earnings of 5 ExCU.

Example 2:

The players in a group provide the following individual contributions which add up to a **total contribution of 16.3 CU:**

- Player A: 5.8 CU (5.8*1 ExCU = 5.8 ExCU)
- Player B: 3.5 CU (3.5*1 ExCU = 3.5 ExCU)
- Player C: 4.6 CU (4.6*3 ExCU = 13.8 ExCU)
- Player D: 2.4 CU (2.4*3 ExCU = 7.2 ExCU)

The minimum contribution of 16 CU is **reached** in this case. Player A (contribution costs of 1 ExCU per invested CU) therefore receives earnings of 30 ExCU − 5.8 ExCU = 24.2 ExCU. A payment of 25 ExCU is not incurred in this case, because the minimum contribution has been reached.

**Example for a transfer payment**

In the above Example 2, the following transfer payments are now made:

Paid transfers:

- Player C: 2.8 ExCU Sum of paid transfers (C and D) = **6.3 ExCU**
- Player D: 3.5 ExCU

Received transfers:

- Player A: 2.4 ExCU Sum of received transfers (A and B) = **6.3 ExCU**
- Player B: 3.9 ExCU

Player A (contribution costs of 1 ExCU per invested CU) therefore receives earnings including transfer payments of 30 ExCU − 5.8 ExCU + 2.4 ExCU = 26.6 ExCU.

Please note that, with the beginning of the second voting round, you may recall the **results from preceding rounds** during each decision by clicking on the button “Result Round X” for the respective Round X. By clicking on the button “Back to Decision” you can return to the current voting round.

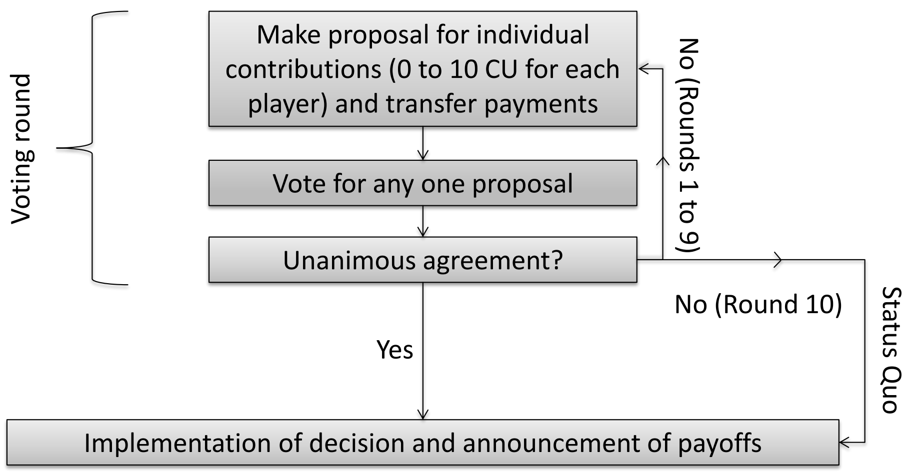


Figure 3: Experimental procedure of treatment VTR.

*ADDITIONAL REMARKS.* Please think carefully about all of your decisions, because they determine your payoff at the end of the experiment. Before the actual experiment can begin, you must answer a few questions which ensure that you have understood the procedure of the experiment and your task. You find the questions on the left side of the screen, and you can enter your answers on the right side. Please enter decimal numbers with a point instead of a comma (that is, e.g., 12.34 instead of 12,34).

If you have any questions of your own during the experiment, please remain seated quietly and raise your hand. Please wait until the experimenter has come to your seat and then ask your question as quietly as possible. In any event, you should only ask questions about the instructions and not about strategies! Furthermore, please not that the game only continues after all players have made their decisions.

Feel free to use the last sheet of these instructions for your own notes.

*END OF THE EXPERIMENT.* After the experiment, we will ask you to fill in a questionnaire. Please remain seated after completing the questionnaire until we call up your place number. Take your instructions with you to the front desk. Only then will you be able to receive your payoff.

**Thank you very much for your participation and good luck!**

*Treatment RTR*

**Welcome to the experiment!**

You are now participating in a scientific experiment. Please read the following instructions carefully. Here you will be told everything that you need to know for the participation in the experiment. Please also note the following:

From now on as well as during the entire experiment **no communication** is permitted. Please turn off your cell phones. If you have any questions, please raise your hand. All **decisions are made anonymously**, meaning that none of the other participants learns the identity of those who made a particular decision.

**For showing up on time you receive an amount of €3** Over the course of the experiment you can earn an additional amount of up to €15. The precise amount is influenced by the decisions of the other participants. The total amount will be paid to you **in cash** at the end of the experiment. The **payment occurs anonymously, too**, meaning that no participant will known another participant's payoff. This experiment uses the currency "Experimental Currency Units" (ExCU).

**Two Experimental Currency Units are equal to €1.**

## Experimental Procedure

In the experiment you form **a group with three other players**. The composition of this group is determined randomly at the beginning of the experiment and will not change throughout the entire experiment, that is, in all **ten rounds**.

*THE PROJECT.* Your task in each of the ten rounds is to choose your contribution to a project. At the same time, all other players in your group also choose their own contributions to this project. The contributions of all players in a group are added up to a **total contribution**. **For the project to be successful, your group's total contribution must reach a minimum contribution. In the case of success, transfer payments** can be made subsequently. If the project is **not successful**, the contributions of all players are refunded just as if nobody had made any contribution. Instead of the contributions, the players then must make a **fixed payment**.

*PROCEDURE OF THE DECISION.* In the experiment, you and your fellow players each choose **your own contribution to a project.** This occurs repeatedly in a total of **ten decision rounds**, which all proceed as follows:

1. Choice of contributions to the project and for transfer payments between the players

2. Preliminary result: project successful?
3. Choice of transfer payments
4. Final result

**Attention! Steps 3. and 4. are *not* carried out, if the project was *not* successful (see below).**

The experiment consists of a **total of ten such independent decisions** in a total of ten rounds. **Only one of these rounds is relevant for your payoff, however.** Which of these rounds is paid will be determined at the end of the experiment, individually for each player. In doing so, each of the ten rounds has the same probability of being chosen.

*DETAILS OF THE PROCEDURE.*

1. Choice of contributions to the project
   At the beginning of each round, each player has an **endowment of 30 Experimental Currency Units (ExCU).**
   **Each player's contribution is measured in Contribution Units (CU).** In every single round, each player can provide **up to 10 Contribution Units** by investing Experimental Currency Units from his endowment. The group's total contribution in each round can therefore amount to up to 40 Contribution Units.
   **The costs per provided Contribution Unit differ among the players:**

   | | |
   |---|---|
   | **Players A and B** | 1 Contribution Unit costs 1 Experimental Currency Unit **(1 CU = 1 ExCU)** |
   | **Players C and D** | 1 Contribution Unit costs 3 Experimental Currency Units **(1 CU = 3 ExCU)** |

   At the beginning of the experiment you will be told which player you are (A, B, C, D). This is determined randomly.
   **At the same time as all of the other players in his group, each player chooses his own contribution to the project.** In order to do so, he chooses an amount between 0 and 10 Contribution Units (in steps of 0.01 CU). By clicking on **"Calculate values"** you can make the program display the corresponding amount in Experimental Currency Units, as well. **The individual contributions of all players are automatically summed up to a total contribution.**
2. Preliminary result: project successful?
   In each round the provided contributions must reach a **minimum contribution of 16 Contribution Units.** If the minimum contribution is *not* reached in a particular round, each player must make a **payment in Experimental Currency Units**, which is deducted from his earnings in the

respective round. The provided contributions are **refunded** in this case, so that except for the payment not additional costs are incurred.
**The payment if the minimum contribution is not reached is the same for all players:**

**Players A, B, C, D** Payment of **25 ExCU**

(a) Total contribution **greater than or equal to** 16 CU
Every player pays his **individual contribution costs**.
**Earnings before transfers = your endowment (in ExCU) − your contribution costs (in ExCU)**

(b) Total contribution **less than** 16 CU (no transfer payments!)
Every player pays 25 ExCU
**Final Earnings = your endowment (in ExCU) − 25 ExCU**

After all players in your group have made their contribution choice, all players are shown the total contribution of their group as well as the resulting earnings of all players. The contributions and contribution costs of the other players in the group are displayed, too

3. Choice of transfer payments
If the minimum contribution of 16 CU is reached, Players C and D subsequently make individual transfer payments to Players A and B. **Players C and D choose their transfer payments at the same time.** Each of the two players makes two separate payments, one directed at Player A and one directed at Player B. In doing so, the sum of transfer payments to A and B by the transferring player (C or D) may not exceed the preliminary earnings of this player (30 ExCU minus contribution costs) in this round. The sum of transfer payments **paid** by C or D, respectively, corresponds to the sum of transfer payments **received** by A and B.

4. Final result
After Players C and D have chosen their transfer payments, each player is informed about these decisions and the resulting final earnings for this round.
**Final earnings after transfer payments:**

(a) Total contribution **greater than or equal to** 16 CU
Players A and B: **Final earnings = your endowment (in ExCU) − your contribution costs (in ExCU) + received transfers (in ExCU)**
Players C and D: **Final earnings = your endowment (in ExCU) − your contribution costs (in ExCU) − paid transfers (in ExCU)**

(b) Total contribution **less than** 16 CU
**Final earnings = 30 ExCU − 25 ExCU = 5 ExCU**

*YOUR PAYOFF.* In order to calculate the total payoff at the end of the experiment, one of the ten rounds is selected at random. All rounds have the same probability of being selected. **This means that you receive only the final earnings of a single round.** The results of the remaining rounds are no longer relevant for your payoff, no matter whether or not the minimum contribution was reached in these rounds. The earnings obtained in the randomly selected round are converted into euros **(2 ExCU = €1)** and added to your show-up fee (€3).

**Example for the procedure of a round:**

Example 1:

The players in a group provide the following individual contributions in this round which add up to a **total contribution of 11.4 CU:**

- Player A: 1.2 CU (1.2*1 ExCU = 1.2 ExCU)
- Player B: 3.4 CU (3.4*1 ExCU = 3.4 ExCU)
- Player C: 4.5 CU (4.5*3 ExCU = 13.5 ExCU)
- Player D: 2.3 CU (2.3*3 ExCU = 6.9 ExCU)

The minimum contribution of 16 CU is **missed** in this case. Each player is refunded the contributions he provided. Instead each player is deducted a payment of 25 ExCU, because the minimum contribution has not been reached. Accordingly, each player receives earnings of 5 ExCU in this round. Transfer payments are *not* possible in this case, because the minimum contribution has not been reached.

Example 2:

The players in a group provide the following individual contributions in this round which add up to a **total contribution of 16.3 CU:**

- Player A: 5.8 CU (5.8*1 ExCU = 5.8 ExCU)
- Player B: 3.5 CU (3.5*1 ExCU = 3.5 ExCU)
- Player C: 4.6 CU (4.6*3 ExCU = 13.8 ExCU)
- Player D: 2.4 CU (2.4*3 ExCU = 7.2 ExCU)

The minimum contribution of 16 CU is **reached** in this case. Player A (contribution costs of 1 ExCU per invested CU) therefore receives earnings before transfers of 30 ExCU − 5.8 ExCU = 24.2 ExCU in this round. A payment of 25 ExCU is not incurred in this case, because the minimum contribution has been reached.

**Example for a transfer payment**

Assume that the minimum contribution has been reached and the **Player C** has **earnings before transfers of 16.2 ExCU** after paying his contribution costs. From this amount he pays **0.9 ExCU to Player A** and **1.9 ExCU to Player B**. After transfer payments, Player C therefore has 16.2 ExCU − 0.9 ExCU − 1.9 ExCU = 13.4 ExCU.

Please note that, with the beginning of the second round, you may recall the **results from preceding rounds** during each decision by clicking on the button “Result Round X” for the respective Round X. By clicking on the button “Back to Decision” you can return to the current round. After choosing your contribution (Button “Confirm Choice”) you have one additional opportunity to correct this choice if necessary. As soon as you click the button “Confirm Choice and Continue”, your choice is final.

*ADDITIONAL REMARKS.* Please think carefully about all of your decisions, because they determine your payoff at the end of the experiment. Before the actual experiment can begin, you must answer a few questions which ensure that you have understood the procedure of the experiment and your task. You find the questions on the left side of the screen, and you can enter your answers on the right side. Please enter decimal numbers with a point instead of a comma (that is, e.g., 12.34 instead of 12,34).

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**Thank you very much for your participation and good luck!**

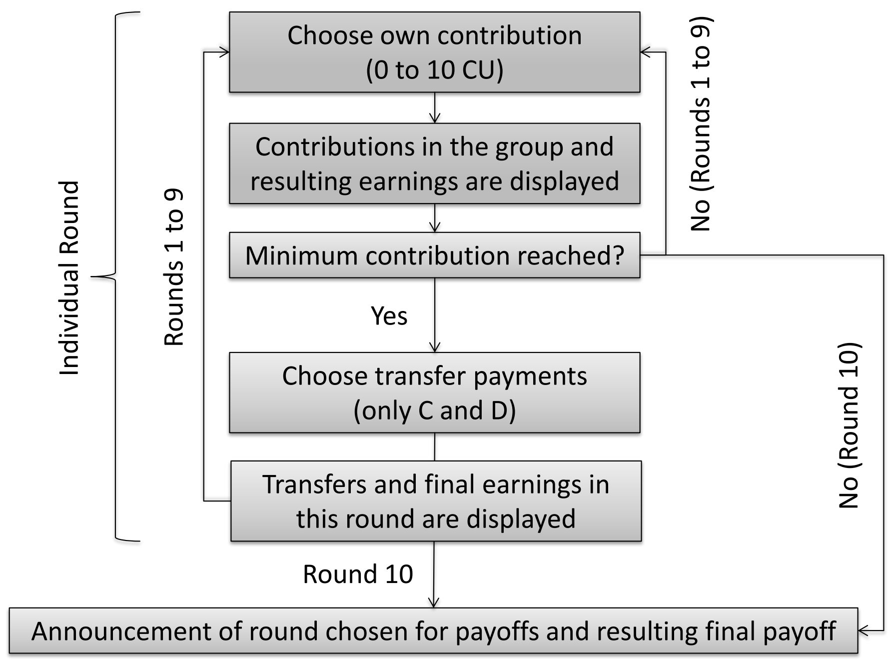


Figure 4: Experimental procedure of treatment RTR.

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