Are groups less cooperative than individuals?
Groups as likely as individuals to help an outgroup
if it is economically beneficial, but not under resource inequality.

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Abstract

Cooperation between groups has been largely ignored in the studies of common pool resources. However, examples of intergroup cooperation taking the form of reciprocal grazing agreements, livestock transfers, or exchanges of harvests are common and well-documented. The question arises over reasons why groups cooperate, with the ethnographic literature suggesting social concerns (reciprocity), redistributive motives (inequality aversion), and economic benefits (risk-sharing) as alternative explanations. We design a common pool resource experiment to examine which of these explanations are more likely, depending on whether individuals or small groups act as decision-makers. The experiment consists of a two-stage game. In the first stage, individuals harvest resources from the common pool of resources. In the second stage, they can send some of their harvests to augment resources in the common pool of the outgroup. Hence, the second stage of our experiment closely relates to trust and gift-exchange games. In the 'baseline', group members decide individually on how much of the harvest to donate to the outgroup. In treatments where groups act as decision-makers, subjects vote on how much everyone should donate to the outgroup. One vote is subsequently selected and is binding for everyone in the group. We find that groups as decision makers are less likely to share resources with an outgroup, but if they do, they donate more than individuals. Our experiment reveals a dark side of group voting. When combined with unequal resources, voting increases the probability of resource exhaustion. The relatively less affluent groups overharvest resources in expectation of donations from the outgroup to compensate for their "bad behavior" (overharvesting).

1. Introduction

The empirical importance of altruism towards in- and out-group members is well established. The mechanisms behind why someone could sacrifice own payoffs to benefit fellow members of own group have been subjected to systematic investigation in natural and social sciences (Fehr and Fischbacher, 2003; Nowak, 2006; Choi and Bowles, 2007). The evolution of intragroup cooperation has achieved far less attention, although it is theoretically more puzzling. Helping an outgroup lowers one's payoffs without benefiting own group directly. Yet, the ethnographic and archaeological record indicates that cooperation between groups plays an important role in many societies (Hilbdebrand, 2017). The examples of exchange practices vary from the Kula exchange of the Trobriand Islanders (Malinowski, 1922); the Potlatch among native Americans (Piddocke, 1965); or the Moka gifts in Papua New Guinea. These practices involve exchanges of food, livestock and other possessions by members of different tribes or representatives of their collectives. For instance, tribes of the Northwest Pacific Coast engaged in mutual exchanges of harvests of salmon (Johnsen, 2009), while livestock transfers either in the form of loans of cows for breeding, where offspring would remain indefinitely in the receiver's herd, or transfers of cattle that involve a transfer of ownership rights, are common among pastoralists in West Africa (Moritz, 2013).

Resource exchanges have been explained by reciprocity, social status, or strategic benefits (Malinowski, 1922; Mauss, 1967). For instance, livestock transfers have been considered important for preventing conflicts over scarce resources, or for rebuilding herds after natural disasters. Alternatively, they may be seen as informal taxation, redistributing wealth between tribes (McPeak, 2006). Most empirical studies focus on a small number of cases where exchange practices have been established, and thus may provide only partial explanation why some societies exchange resources. In addition, multiple and overlapping transfers make it difficult to measure them and compare across societies (Moritz, 2013). Finally, existing studies ignore how decisions to help an outgroup originate from individual behaviour. We design a common pool resource experiment to examine in a controlled laboratory environment the role of strategic (economic), social and redistributional motives behind intergroup cooperation, depending on whether individuals or small groups act as decision-makers.

Formally, we conduct a mixed-design experiment with three intergroup factors: (1) group voting; (2) unequal resources; and (3) matching donations; and with one within-group factor (30 replications). Each treatment consists of two stages. In the first stage, individuals harvest resources from the common pool of resources. Each group has access to its own renewable resource. Groups are matched in pairs, to which we refer to as the partner groups, and in which they interact over the entire experiment. In the second stage, group members can send some of their harvests to augment resources in the common pool of the outgroup. The reader may think of this as a form of livestock transfers between groups. In the 'baseline' treatment, each subject decides independently how much of his/her harvest to donate to the outgroup. If the groups act as decision-makers (‘vote’ treatment), the participants first vote on whether to share harvests with the outgroup. If the majority agrees, they vote on the size of a donation. One vote is subsequently selected and is binding for everyone in the group. In the ‘matching’ treatment, donations are being doubled before augmenting the resources of the outgroup. In all treatment, groups start the experiment with the same level of resources with the exception of the ‘inequality’ treatment, where partner groups have access to unequal resources.

From the theoretical perspective, altruism towards out-group members is unlikely to survive the selection pressure within groups. Donating resources to an outgroup reduces not only one’s payoffs, but also of donor’s own group. On the one hand, group members may share resources with an outgroup expecting their donations to be reciprocated. However, if individuals act as imperfect cooperators and always share less than they have received, sharing between groups would cease over time. On the other hand, receiving a transfer of resources benefits a group-as-a-whole, which creates an incentive to free-ride on donor’s efforts within groups, and is unlikely to evolve under individual selection. As a result, we expect that the exchange of resources between groups should not occur in the ‘rational equilibrium’ in the ‘baseline’ treatment. Yet, we report that resource transfers are common if individuals, but not groups, act as decision makers.

To examine how economic benefits affect the probability of groups forming stable partnerships, we compare the frequency of intergroup sharing in the presence of matching donations to the ‘baseline’. Matching donations, referred also in the literature as a matching gift, is a conditional commitment by the donor(s) to match the contributions of others at a given rate (Eckel and Grossman, 2003; Meier, 2007; Kotani et al., 2010; Rondeau and List, 2008). The design of this treatment closely relates to the trust and gift-exchange games conducted in the context of repeated interactions. In the trust games, individuals are asked to send some of their endowments to a receiver (Berg et al., 1995). The amount is multiplied by a positive constant, and subsequently the receiver is asked to return some of the money. The standard prediction is that the responder will not send any money back, while anticipating this, the sender will give nothing. The results of the experiments have been largely inconsistent with this theory. Typically, participants share half of their endowments with respondents, while responders send back 30% of the money received (Camerer, 2003). There are important differences between the classical trust game and our design. First, we examine the evolution of trust in the context of repeated interactions, whereas so far most results come from the one-shot game. Moreover, our design allows us to study the evolution of a combined in-group and out-group cooperation, including the trade-off between the two that underlies many social dilemmas. In turn, most existing studies focus on within-group cooperation (see for an overview Fehr and Fischbacher, 2003) or between-group cooperation (Cox, 2002; Kugler et al., 2007) separately.

We find that the frequency of resource transfers in the presence of matching donations substantially exceeds its frequency in the 'baseline', suggesting a strategic motive as a key factor fostering intergroup cooperation. The design of the 'matching' treatment allows groups to increase their resources exponentially if both partner groups harvest (nearly) all resources each period and share them with an outgroup. However, only one pair of groups has solved this social dilemma, which required overcoming mistrust within and between groups, and achieved a payoff-maximizing solution.

The difference in donations between equal and unequal groups is of special interest to us. The 'inequality' treatment comes closest to the natural environment of intergroup interactions. It can shed light on how an inequality in resources affects the patterns of intergroup sharing and in-group behavior (harvesting). In particular, we examine whether members of more affluent groups are willing to compensate outgroup members for "bad luck", i.e. being assigned to a group with relatively fewer resources. In the 'inequality' treatment, one group starts the experiment with resources of the same size as groups in the 'baseline'. Its partner has access to a substantially larger resource. We find that a redistributive motive plays a negligible role in explaining intergroup cooperation. In particular, we do not observe significant differences in the frequency of sharing and total donations between the 'inequality' and 'baseline' treatments.

Finally, we compare the impact of binding voting on the probability that groups will establish stable resource exchanges. Binding voting has been shown to increase cooperation in public good dilemmas (Putterman et al., 2011) and resources appropriate game (Walker and Gardner, 1992). We find that group voting substantially decreases the frequency of resource transfers between groups. In fact, most groups have failed to share any resources with an outgroup if groups acted as decision-makers. The only exception concerns the 'matching and vote' treatment, where the frequency of resource transfers does not differ from the 'matching' treatment, thus in case individuals and groups act as decision-makers. Our experiment reveals another dark side of group voting. When combined with unequal resources, voting increases the probability of resource exhaustion. Poor groups overharvest resources in expectation of donations from the affluent outgroup to compensate for their "bad behavior" (overharvesting). Yet, voting reduces the likelihood that affluent groups would donate their harvest to the poorer outgroup. The reminder of this paper is as follows: in Section 2, we provide a brief overview of the literature. Section 3 discusses the experiment design and theoretical predictions, followed by the results in Section 4. Section 5 offers the conclusion.

2. Literature review

In CPR experiments, individuals exploit the resources within groups, but typically without any intergroup spillovers. For instance, in common pool dilemmas with replenishable resources, where resources in one round do not depend on the availability of resources in the past rounds, subjects are asked to allocate a fixed amount of endowment between private and group funds (Walker and Gardner, 1992; Blanco et al., 2015; 2016a,b). The allocation of funds to the private account generates private benefits, but at a cost of the degradation of the value of a shared group fund. In turn, in the CPR experiments with renewable resources, resources change dynamically over time, which better captures the important aspects of the dynamics of renewable resources like groundwater systems, fisheries, and forests (Botelho et al., 2014). In particular, resources are diminished by total harvests, and then re-grow according to a logistic function, depending on the resources in the common pool after harvesting (Schaefer, 1957; Brown, 2000; Chermak and Krause, 2002). The model predicts that resources are exhausted in the non-cooperative equilibrium as selfish agents will harvest above the socially-optimum level of harvesting (Antoniadou et al., 2013). In empirical studies, subjects have shown altruistic restraint in exploitation, but typically not enough to achieve the social optimum (Fischer et al., 2004).

Intergroup interactions have been largely neglected in common pool-resource dilemmas. This is surprising as most of Africa's water resources are composed of large river basins that are shared between several countries (Ashton, 2002). Conflicts over water or fishing camps between communities (Pomeroy et al., 2007; Mwiturubani, 2010; Downing et al., 2014), or cooperation taking the form of reciprocal grazing agreements or food exchanges (McAllister et al., 2006; Johnsen, 2009; Pisor and Gurven, 2016) are common and well-documented. In this paper, the design of the 'baseline' treatment builds upon an experimental design proposed by Safarzynska (2017), who introduced intergroup sharing to the CPR experiment so as to examine whether it can prevent resource collapse in the presence of climatic shocks destroying resources. The author finds that groups, which establish long lasting resource exchanges, are also successful in preventing resource exhaustion, but only in the absence of shocks. A combination of shocks and sharing made subjects overharvested resources, which resulted in a higher probability of resource exhaustion. Our goal differs from the preceding study. In particular, the author examines whether the intergroup sharing could act as an insurance mechanism against unforeseen events (climatic shocks). In this paper, we introduce the 'matching' and 'inequality' treatments to study the role of economic benefits and inequality aversion in fostering intergroup cooperation, moreover depending on whether individuals or groups act as decision-makers.

Our study relates to the literature on voting in public goods games and common pool resources (Walker et al., 2000; Kroll et al., 2007; Gillet et al., 2009; Bernard et al., 2013). Typically, studies compare the performance of groups and individuals in treatments, where participants decide collectively on their strategy in face-to-face discussions (see Bornstein and Yaniv, 1998; Cason and Mui, 1997; Cox, 2002; Bornstein et al., 2004); or communicating via computer chat (Luhan et al., 2009; Kocher and Sutter, 2009; Müller and Tan, 2013). Alternatively, groups can reach a decision by anonymous voting. It has been shown that, in public good games, formal sanctions agreed by groups can eliminate or reduce the problem of freeriding and the anti-social punishment associated with peer punishment (Tyran and Feld, 2006; Putterman et al., 2011). Kroll et al. (2007) show that non-binding voting, in itself, does not increase cooperation unless combined with punishment. In CPRs, voting on appropriation rules has been suggested as a solution to overcome the tragedy of the commons. For instance, in the experiment by Walker et al. (2000), participants anonymously propose appropriation levels, which if selected, are binding for everyone in the group. Subsequently, they vote anonymously on the proposed rules. The authors show that majority and unanimity voting substantially increase efficiency relative to the 'baseline', where participants extract resources individually. In the experiment by Bernard et al. (2013), allowing group members to vote on appropriation levels, or delegating the extraction decision to leaders who can decide for a group as a whole, reduces extraction and brings resources closer to the social optimum.

3. Experiment design

In the experiment, a total group of 324 students, recruited at the University of Warsaw, participated in 18 sessions. There were 133 male participants and 191 female participants with an average age of 25.10 (±5.35). Subjects earned on average about PLN 47.40 (±22.93), which corresponds to € 11.29 (±5.46) per experiment, using the conversion rate PLN 4.2 = € 1 (see Table 1). The experiment was programmed and conducted using the software z-Tree (Fischbacher, 2007).

In each session, participants were randomly seated in front of computers with partitions between them. The identities of group members were never revealed to participants. Each session was divided into three parts. In the first part, subjects were asked to answer some questions in a pre-experiment questionnaire. This includes: the IQ test; hypothetical trust and dictator games; and the risk elicitation task (see Appendix C for the pre-experiment questionnaire). The answers from the IQ test were incentivized. In the dictator game, subjects are asked to split PLN 5 between themselves and another (hypothetical) player in the room. In the trust game, players are asked to split PLN 5, after being informed that the experimenter will double the amount sent to another (hypothetical) player, while the receiver will have a chance to give them some money back. To measure risk preferences, we ask subjects how much of PLN 5 they are willing to invest in a risky project, where with a probability of 40% the amount is tripled, otherwise is lost.

In the second part, students were given the opportunity to learn the dynamics of the harvesting game in 5 rounds of training, i.e. in the absence of sharing. In particular, the subjects were asked to harvest resources repeatedly for 5 periods. The initial level of resources was equal to 45. After harvesting, the resource re-grew according to the logistic equation $R_{t+1} = R_t + rR_t(1 - R_t/K) - X_t$, where r=*0.1* captures is the intrinsic growth rate of resources; K=80 is its carrying capacity; $rR_t(1 - R_t/K)$ is a re-growth of resources, while X_t are total harvests in the group. In the actual experiment, subjects harvest resources in groups of three. In the rounds of training, the decisions of other two group members were chosen randomly by a computer.

The rounds of training were followed by the third part, i.e. the actual experiment. During this part, students were divided into groups of three. Afterwards, the groups were matched into pairs, which we refer to as partner groups. The composition of groups and partner groups stayed the same over the entire experiment. Each group had access to its own renewable resource, equal to 45 tokens, just as in the rounds of training. The players were asked to harvest resources repeatedly from the common pool. Players obtained information about harvests of each co-player, appearing in a random order on the screen after each round. This meant that they could not track who harvested how much over time. The maximum extraction by each player could not exceed 1/3 of tokens in the common pool. This assumption does not affect the Nash-Markov equilibrium prediction.

The actual experiment lasted at most 30 periods. Subjects were not informed about the exact number of rounds, only that the experiment would not exceed in total 1.5 hours. This way we avoided the end-of-round effect. The condition of an infinitely repeated game is often induced in the lab by having a random continuation rule, i.e. after each round the computer decides whether to finish the repeated game. However, introducing the continuation probability, which stops the game at any time, would prevent us from assessing how long it takes for groups to exhaust resources.

The experiment had six treatments, each conducted in 3 separate sessions, which can be thought of as a 2x2 variation in the 'inequality' and 'vote', and a 2x2 variation in 'vote' and 'matching' (see Appendix B for instructions). In each treatment, subjects harvest resources repeatedly from the common pool of resources. In the 'baseline' treatment, after harvesting, the participants are asked whether they would like to donate some of their harvests to augment the resource of the partner group. Each person selects how many tokens she wishes to donate, which are then deducted from their payoffs, and are added to the resource stock of the partner group. After sharing, subjects are informed about the total amount of tokens send by their group members to the outgroup, and the tokens received.

In the 'vote' treatment, subjects decide collectively on how much resources to donate to the outgroup in a two-stage procedure. In the first stage, subjects vote on whether to donate harvests. If the majority opts for sharing, in the second stage, each member then votes on the size of the donation. A random vote is selected and is binding for everyone. This value is subtracted from the harvests of each group member, and the sum of the individual donations is added to the common pool resources of the partner group. We use here an incentive compatible mechanism called the Random Dictator rule, which implies that everyone has the same chance of dictating the outcome (e.g. Rutstrom and Williams, 2000). This allows us to study individual preferences over how much subjects believe group members should share with the out-group, eliminating incentives for strategic considerations.

In all treatments, groups start with the same level of resources with the exception to the 'inequality' treatment, where groups which are matched in pairs start the experiment with unequal resources. In particular, one group has access to the same level of resources as groups in the 'baseline' treatment ($K=80$, $R_0=45$), while its partner group has access to a larger pool of tokens ($K=100$, $R_0=55$). The participants are informed in the beginning of the third part of the experiment that they will interact with a group which has less/more resources than their own. In the 'inequality and vote' treatments, group voting is combined with unequally distributed resources. Finally, we conduct two additional treatments where donations are being matched by the experimenter. In particular, in the 'matching' treatment, the donation is doubled before augmenting the resource stock of the outgroup. In the 'matching and vote' treatment, matching donations and group voting are combined.

If the number of tokens in the common pool falls below one, a group exhausts its resource and subjects lose all their payoffs accumulated up to the moment of resource exhaustion. This creates a strong incentive to conserve resources. We introduce this assumption as, in the standard CPR experiment, the unique subgame perfect Nash equilibrium, the resource is depleted immediately (Noussair et al., 2015). By providing subjects with strong incentives to conserve resources, we are able to study the evolution of resource-sharing over time. In fact, the majority of groups have diminished resources substantially in the early (five) rounds of the experiment. Unharvested resources did not provide any value to the participants. Regardless of the outcome of the experiment, students retained a show-up fee of PLN 10 (~ € 2.4), and the money earned in the pre-experiment questionnaire.

3. Theoretical predictions

To derive theoretical predictions, we extend a formal model of common-pool resources proposed by Safarzynska (2017), which builds upon Antoniadou et al. (2013), by intergroup sharing.[1] We examine formally the conditions under which sending resources to an outgroup can be welfare-improving.

In each group, n individuals i decide simultaneously how much resources to harvest from the common-pool resource R_t. Individuals are allowed to harvest up to $x_{it} < R_t/n$, where x_i are harvests by individual i. The duration of the game is determined endogenously by collective decisions. In particular, the game ends in case resources become exhausted.

Total harvests X_t is defined as a sum of harvests by n individuals: $X_t = \sum_i x_{it} \leq R_t$.

Resource dynamics follow the logistic curve:

$$R_{t+1} = R_t + rR_t(1 - R_t/K\ ) - X_t + bf(Y_t), \tag{1}$$

[1] The model of common pool resources by Safarzynska (2017) includes climatic shocks, which we ignore in the analysis.

where $0<r<1$ is the intrinsic growth rate of resources; K is its carrying capacity; $\dot{R}_t = rR_t(1 - R_t/K)$ captures the natural growth or regeneration of resources.

After harvesting, subjects decide how many tokens y_{it} to donate to the partner group to augment its resource ($Y_t = \sum_i y_{it}$). Sending resources to the outgroup constitutes a payoff loss, unless donations are being reciprocated. The expression $bf(Y_t)$ captures the amount of resources, which individuals expect to receive in return to their donation ($f(.)>0$ and $f'(.)>0$), where b=1 with the exception to treatments with matching donations, where $b=2$ to indicate that donations are being doubled.

The utility of individual i at time t depends on his/her harvests x_{it} and the amount of harvests send to the outgroup y_{it}:

$$u_{it} = ln(x_{it} - y_{it}). \tag{2}$$

Subjects maximize the cumulative payoffs over time:

$$V(R_t) = max_{x,R_{t+1}} \sum_{t=0}^{\infty} \beta^t \, ln(x_{it} - y_{it}), \tag{3a}$$

$$\text{s.t. } R_{t+1} = R_t + rR_t(1 - R_t/K) - X_t + bf(Y_t), \tag{3b}$$

given the initial level of resources R_0, where parameter β is the discount rate.

Equation 3(a) can be written as the Bellman equation with the state variable R_t, and the control variables x_{it} and y_{it}:

$$V(R_t) = u_{it}(x_{it}, y_{it}) + p_t(R_t, X_t)\beta E[V(R_{t+1})], \tag{4}$$

$$\text{s.t. } R_{t+1} = R_t + rR_t(1 - R_t/K) - X_t + bf(Y_t),$$

where $p_t(R_t, X_t)$ is the probability that the game will continue to the next period (resources will not fall below 1). This is motivated by the fact that in our experimental design, subjects lose all their payoffs accumulated up to the moment of resource exhaustion if a group runs out of resources ($R_t<1$). This creates a strong incentive to conserve resources.

The optimal solution to problem (4) satisfies first-order conditions:

$$u_y(x_{it}, y_{it}) = -u_x(x_{it}, y_{it}) * bf'(Y_t) \tag{5a}$$

$$u_x(x_{it}, y_{it}) = \beta p_t E[\frac{\partial V(R_{t+1})}{\partial R_{t+1}}] \tag{5b}$$

By Envelope Theorem differentiating $V(R_{t+1})$ with respect to R_t gives:

$$V'(R_t) = u_{it}'(x_{it}, y_{it}) \frac{\partial(R_t + \dot{R}_t)}{\partial R_t}. \tag{6}$$

The model can be reduced to the system of equations:

$$x_{t+1} = (x_t - y_t)\beta p_t \left(1 + r - 2r\frac{R_{t+1}}{K}\right) + y_{t+1}, \tag{7a}$$

$$R_{t+1} = R_t + rR_t(1 - R_t/K) - X_t + bf(Y_t)). \tag{7b}$$

The symmetric equilibrium of the above system (X_t=$3x_{it}$, Y_t=$3y_{it}$) can be derived (we omit subscripts t), using conditions: 5(a), $R_{t+1} = R_t$, $X_{t+1} = X_t$, and $y_{t+1} = y_t$,. We assume a functional form of $f(Y_t) = (Y_t)^u$, where u captures the returns to donations.

There are three solutions to this problem. In two solutions, individuals send all their harvests to the outgroup x^*=y^*, at resources equal to $R^* = \frac{K}{2} \mp \sqrt{K/r}\sqrt{Kr - 12y + 4 * 3^u \mathrm{b} y^u}$. We are interested in the third solution, where:

$$x^* = \frac{K\left(2\beta+\beta^2(-1+r^2)-1\right)}{12\beta^2 r} + \frac{bf(3*y^*)}{3}, \quad (8a)$$

$$R^* = \frac{K(\beta(1+r)-1)}{2r} \quad (8b)$$

$$y^* = (3^{\mathrm{u}} bu)^{\frac{1}{1-u}}. \quad (8c)$$

In the absence of intergroup sharing, the social optimum requires that resources remain at their half capacity *K/2*, while group members consume the renewal rate of the resource ($X = \frac{rK}{4} = 2$). This translates into group members harvesting 2/3=0.66 tokens per person. Our model predicts the tragedy of commons. In particular, according to eqn. 8(a), in the absence of intergroup sharing, the participants are expected to harvest x^* =0.48 tokens at the level of resources equal to R^* =18.95. These numerical values are calculated using K, r as in the experiment, and for β=0.95.

How does intergroup sharing affect these predictions? We expect that there will be no differences in resources between treatments. This is motivated by the fact that according to eqn. 8(b), resources in the equilibrium do not depend on the transfer of resources between groups. However, intergroup sharing affects harvests. In particular, group members are expected to harvest more compared to the extraction in the absence of sharing by a donation received from an outgroup ($\frac{bf(3*y^*)}{3}$ in eqn. 8(a)). Our model predicts that the donation, as well as harvests, will be larger in the 'matching' treatment (b=2) compared to the 'baseline' (b=1).

Hypotheses:

The standard game-theoretic analysis of the trust game, under the assumption of full rationality of players, starts with the observation that the responder will not send back any money, hence the return is zero (Kugler et al., 2007). Anticipating this, the sender will choose a zero transfer. This prediction applies both to individuals as well as groups in the role of either sender or responder. In both cases, it has been inconsistent with empirical evidence. In particular, it has been shown that individuals in the role of senders share on average 50% of their endowments, while recipients return 30% of the money received (Camerer, 2003; Johnson and Mislin, 2011). In case of groups, the amounts send by groups in the role of senders are smaller than amounts send by individuals, but still substantial (Kugler et al., 2007). As a result, we also expect to observe resource transfers, with the theoretical expectations depending on different treatments.

H0: We expect no sharing to occur in the 'baseline' treatment in the rational equilibrium, regardless of the expectations of the reciprocity (u). This follows from the fact that if participants act as imperfect cooperators and share slightly less than they have received ($f(Y_t)<Y_t$), sharing would reduce individual payoffs even if it is reciprocated. However, based on the findings from the preceding studies in social psychology and anthropology, there are reasons to expect that sharing may occur in the 'baseline' treatment, despite reducing individual payoffs. In particular, abundant evidence reports tribes exchanging harvests, food, livestock and other resources (see Malinowski, 1922; Mauss, 1967; Johnsen, 2009; Pisor and Gurven, 2016; 2018). It has been suggested that exchange practices may be explained by reciprocity, other-regarding preferences, and inequality aversion (Fehr and Schmidt, 1999, Charness and Rabin, 2002; Falk and Fischbacher, 2006).

H1: Based on evidence from economic games played between individuals and groups, we expect to observe differences in the patterns of sharing between treatments, where individuals and groups act as decision makers. In particular, the vast majority of studies finds that the decisions taken by groups differ systematically from individual decisions. The review of results from many economic games played between groups and individuals has shown that group behavior was closer to rational and selfish (game-theoretic) predictions than individual behavior (Kugler et al., 2012). The group's selfishness can be explained by the fact that group members provide each other support to act in a selfish manner, refereed also to as the "discontinuity effect" (Schopler and Insko, 1992; Kugler et al., 2007). In our study, we expect to observe larger donations per person in the presence of binding voting than in treatments, where individuals decide autonomously on donations. This is motivated by the fact that binding voting by the design overcomes mistrust within groups. If individuals act as decision makers and believe they will be the only donor in their group, this reduces the donation in the equilibrium from $y^* = (\mathrm{b}3^{\mathrm{u}}u)^{\frac{1}{1-u}}$ to: $y^*_{ind} = (bu)^{\frac{1}{1-u}}$. The latter is derived using condition 7(a-b) and assuming $Y_t=y_{it}$ instead of $Y_t=3y_{it}$ assumed in the symmetric equilibrium.

H2: We expect no significant differences in the size of donations between the 'inequality' and 'baseline' treatments. This is motivated by the fact that the donation in the equilibrium (y^*) does not depend on the level of resources or harvests, but only on the expected returns to donations. As an alternative hypothesis we will examine whether inequality aversion can explain the differences in patterns of sharing between the 'inequality' and 'baseline' treatments (Falk and Fischbacher, 2006). Empirical evidence indicates that wealth inequalities play an important role in explaining livestock transfers among West African pastoralists.

For instance, Moritz (2013) finds that the households with smaller herds are more likely to receive a livestock transfer. However, in-depth interviews with pastoralists revealed that helping the poor conflicted with pastoralists' strategic goal of increasing their own herd size. The design of the 'inequality' treatment allows us to examine the trade-off between these two objectives.

H3: If donations are being reciprocated, matching donations make resource transfers economically beneficial in the equilibrium. In particular, we can derive a condition, under which the net benefits from receiving a transfer of resources in return after donating y* is positive, as: $\frac{2f(3*y^{*})}{3} > y^{*}$ for $0<u<1/3$.[2] As a result, our model predicts that in the 'matching' treatment, the participants will donate on average between 0 tokens (for $u=0$) to 0.94 token (for $u=1/3$), depending on the expected returns to donations (u).

H4: In the presence of matching donations, achieving a payoff-maximizing solution requires overcoming mistrust between groups. In particular, payoffs are maximized if both partner groups harvest nearly all resources, donating them to the outgroup. This would allow resources to grow exponentially over time. Participating this solution, we informed participants before the experiment that their total monetary payoffs from this part of the experiment cannot exceed PLN 100 (€ 24) regardless of their performance.[3]

4. Results

In this section, we discuss the experimental results. Our aim is to shed some light on the factors conductive to resource-transfers observed in pastoral societies. Formally, we study how binding voting affects donations to the outgroup in the presence and absence of matching donations and an unequal distribution of resources. Table 1(a-b) summarizes the mean statistics from all treatments. In particular, Table 1(a) provides mean statistics computed at the partner-group level, while Table 1(b) of selected variables calculated only over partner groups that established resource-exchanges, i.e. shared resources at least once. We assess if differences between treatments are statistically significant using non-parametric tests. In particular, we report the results from the Mann-Whitney tests comparing medians of variables summarized in Table 1(a) in Appendix A1. In turn, the results from non-parametric tests corresponding to the variables in Table 1(b) are summarized in Table 1(c). As Table 1(b) reports the results using data only from groups that established resource exchanges, we could not assess statistical significance between all pairs of treatments. This can be explained by the fact that in some treatments too few groups exchanged resources,

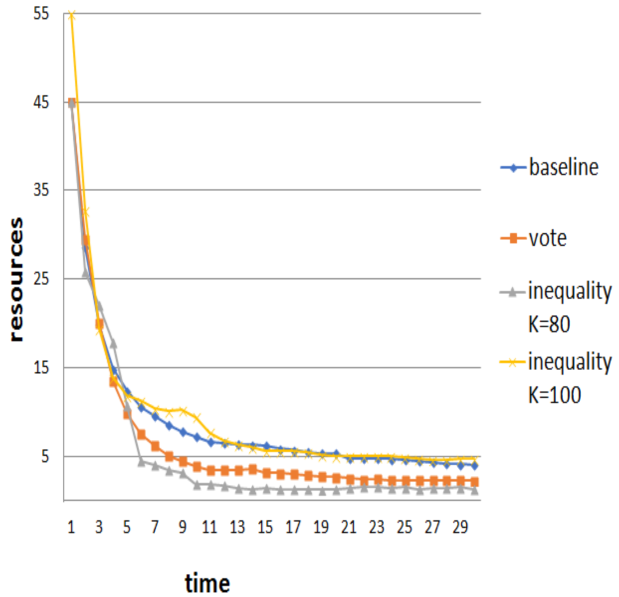
[2] The condition that the benefits from intergroup sharing exceed its cost require that $b((3*3^{u}bu)^{\frac{1}{1-u}})^{u}/3>(3^{u}bu)^{\frac{1}{1-u}}$, which is fulfilled for $u<1/3$.

[3] One pair of groups achieved this payoff-maximizing solution. Their members would have earned on average above € 400, which exceeds substantially payoffs in economic experiments, if we did not place a cap on payoffs.

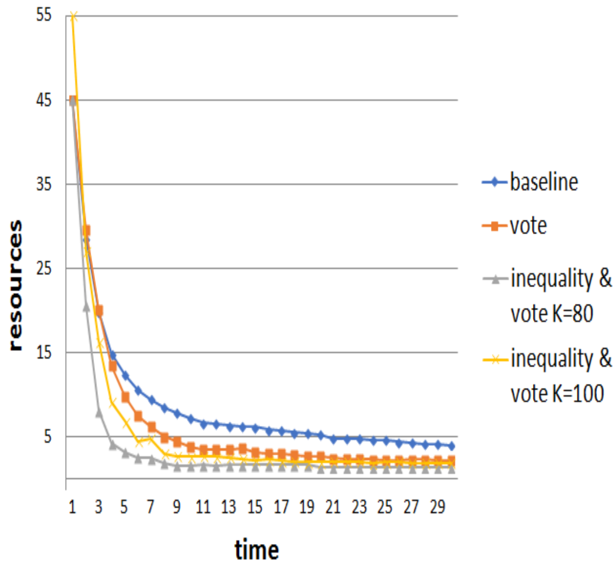
resulting in too few observations to run non-parametric tests. In particular, 14 out of 18 groups did not share any resources with the outgroup in the ‘vote’ treatment, while 13 out of 16 groups refrained from sharing in the ‘inequality and vote’ treatment (Table 1(a)).

We find that most groups substantially overharvested resources in the first 5 rounds of the experiment, confirming Hardin’s (1968) “tragedy of commons” predictions (see panels in Appendix A4 depicting resources per group). Only one group in the ‘baseline’ treatment succeeded to maintain resources at the individually-optimal level, i.e. equal to about 20. Figure 1(a) illustrates mean resources over time, per treatment, in the ‘baseline’, ‘vote’ and ‘inequality’ treatments. In case of the latter, we depict separately resources in poor (K=80) and affluent groups (K=100). In turn, Figure 1(b) shows the results from the ‘inequality and vote’ treatment for poor and affluent group separately, and compares them to the ‘baseline’. It appears that resources are the most exhausted by the relatively poor groups in the ‘inequality and vote’ treatment.

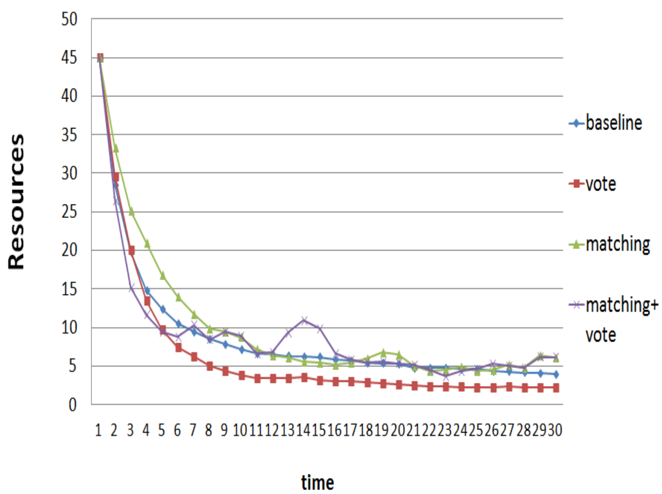
Finally, Figure 1(c) compares the mean resources over time in the ‘baseline’, ‘vote’, ‘matching’, and ‘matching and vote’ treatments. We excluded one pair of groups, when computing means per treatment in the ‘matching’ treatment, which is discussed separately (Figure 3). In the excluded pair, the subjects solved the public good dilemma. We refer to this pair of groups as “the successful pair of groups” in Table 1(a) and (b), where we provide the summary statistics including and excluding this pair. This is motivated by the fact that members of these groups harvested nearly all the resources in the common pool each period, donating most of them to the outgroup. As a result, both groups ended up with resources exceeding 8000 tokens, whereas the mean size of resources in the last round in other groups in this treatment was equal to 5.23 (±4.66).



(a) ‘Inequality’ treatment



(b) ‘Inequality and vote’ treatment



(c) ‘Matching and ‘matching and vote’ treatments

Figure 1. Resources over time, per period.

Table 1(a). Main statistics – means are computed at the partner group level unless otherwise specified

	Baseline	Vote	Inequality	Inequality and vote	Matching	Matching and vote
Number of participants	54	54	66	48	54	48
Mean fraction of harvested resources	0.21 (0.13)	0.21 (0.07)	0.21 (0.10)	0.29 (0.12)	0.37 (0.18)	0.31 (0.13)
Mean resources in the last period excluding the successful pair of groups	6.30 (10.21)	2.01 (1.06)	3.96 (2.92)	2.04 (0.53)	924.07 (2756.55) 5.23 (4.66)	5.63 (5.56)
The number of periods before resource collapse	28.38 (4.83)	26.83 (5.02)	26.68 (5.70)	18.44 (6.67)	27.88 (4.04)	28.56 (3.65)
Mean harvests over time excluding the successful pair of groups	4.40 (7.25)	2.55 (1.25)	3.47 (2.19)	4.91 (2.49)	95.25 (272.99) 4.26 (1.43)	4.24 (2.29)
Number of groups, which have not shared resources	2/18	14/18	2/22	13/16	0/18	3/16
Mean donation to the outgroup excluding the successful pair of groups	0.83 (0.66)	1.61 (0.62)	1.08 (0.46)	5.25 (3.18)	72.19 (212.56) 1.53 (1.07)	2.38 (1.73)
Statistics calculated at the group level						
Prob. of resource exhaustion	0.06	0.17	0.14	0.31	0.17	0.13
Statistics calculated at the individual level						
Mean payoffs	18.09 (5.49)	15.29 (7.22)	17.77 (7.77)	13.77 (9.81)	23.91 (17.58)	25.86 (20.79)

Note: standard deviation in brackets

Table 1(b). Main statistics – means are computed over groups, which shared resources at least once

	Baseline	Vote	Inequality	Inequality and vote	Matching	Matching and vote
Statistics calculated over groups, which shared resources with the outgroup at least once						
Total transfer of resources	3 (1.80)	6.95 (9.83)	5.05 (6.35)	6.75 (5.30)	2151 (6365.83)	33.36 (35.26)
excluding the successful pair of groups					19.06 (8.46)	
The number of transfers	5 (3.82)	3 (4.33)	3.81 (3.67)	1 (0.71)	20.28 (8.71)	12 (11.41)
The frequency of intergroup sharing (=no. of transfers/ no. of periods both groups existed)	0.16 (0.13)	0.10 (0.14)	0.20 (0.18)	0.05 (0.01)	0.75 (0.22)	0.44 (0.36)
excluding the successful pair of groups					0.72 (0.22)	
The mean size of group donation	0.83 (0.66)	2.46 (0.48)	1.20 (0.42)	6.75 (1.06)	72.19 (212.01)	3.04 (2.11)
excluding the successful pair of groups					1.52 (1.07)	
Statistics calculated at the group level, over periods in which a donation to the outgroup was positive						
The mean size of individual donation	0.51 (0.99)	0.77 (0.54)	1.13 (1.59)	2.25 (1.30)	56.77 (20.26)	0.93 (1.30)
K=80			0.85 (1.06)	2 (0)		
K=100			1.39 (1.94)	3 (0)		
excluding the successful pair of groups					0.93 (1.27)	
The mean vote (when positive)		0.75 (0.59)		1.93 (0.81)		0.84 (1.07)
The total transfer of resources to the outgroup	3 (2.65)	10.43 (9.56)	5.55 (6.71)	9 (3)	2151.18 (6188.57)	41.05 (35.99)
K=80			4.43 (5.92)	9 (4.24)		
K=100			6.47 (7.45)	9 (0)		
excluding the successful pair of groups					29.25 (27.77)	

Note: standard deviation in brackets

Table 1(c). Mann-Whitney U tests based on ranks with pairwise comparisons of medians of selected variables among groups which shared resources at least once, by treatment

	Treatments		z-statistics
Total donation	Baseline	Inequality	-0.08
	Baseline	Matching	-2.10**
	Baseline	Matching and vote	-3.12***
	Matching	Matching and vote	0.68
Mean donation	Baseline	Inequality	-1.48
	Baseline	Matching	-1.93*
	Baseline	Matching and vote	-2.63***
	Matching	Matching and vote	-1.06
Frequency of sharing	Baseline	Inequality	-0.21
	Baseline	Matching	-3.24***
	Baseline	Matching and vote	-1.26
	Matching	Matching and vote	1.83**
	Matching[1]	Matching and vote	1.58

[1] excluding the pair of successful groups

Note: *** indicates variables significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level

Result 1. A high frequency of groups, which members donated harvests to the outgroup in the 'baseline' treatment, contradicts theoretical predictions that sharing should not occur in the 'rational' equilibrium.

We observe a high percentage of groups equal to 89%, which members donated resources to the outgroup in the 'baseline'. This contrast with 78% groups, which have not donated any harvests in the 'vote' treatment (Table 1(a)). A similar pattern can be observed in the presence of unequal resources: only 9% of groups donated resources to the outgroup in the 'inequality and vote' treatment, compared to 81% in the 'inequality' treatment. In turn, in the presence of matching donations, nearly all groups engaged in frequent exchanges of harvests with the outgroup, regardless whether individuals or groups acted as decision-makers. In particular, only three groups have failed to donate any harvests to the outgroup in the 'matching and vote' treatment.

Result 2. Most groups exchanged resources with the partner group when donations were decided by individuals, but not by groups as collectives. In particular, groups are less cooperative than individuals, unless there are economic benefits to cooperation (matching donations).

The results in Table 1(b) indicate that the mean donation per person is larger in case of donations decided by groups compared to individuals, which confirms our expectations. On average, when making decisions autonomously, individuals donated 0.51(±0.99) token in the 'baseline', compared to the mean donation per person equal to 0.77(±0.54) token, when it was decided collectively in the 'vote' treatment. In the ‘inequality’ treatment, mean donation is equal to 1.13(±1.59) token, which is also less than 2.25(±1.30) tokens in the ‘inequality and vote’ treatment. This does not come as a surprise as binding voting overcomes mistrust within groups that other group members would donate nothing to the outgroup. As players knew that if their vote was accepted, it would be binding for everyone, they voted for higher donations than they would be willing to make themselves in the ‘baseline’. Interestingly, the mean donation to the outgroup does not depend on whether individuals or groups act as decision makers in the presence of matching donations. In both: ‘matching’ and ‘matching and vote’ treatments, the mean donation equals to 0.93 token per person (Table 1(b)).[4] This confirms our theoretical predictions according to which the participants were expected to donate on average between 0 to 0.94 tokens, depending on the expected returns to donations (u).

Result 3. The frequency of groups that exhausted resources in the ‘inequality and vote’ treatment is significantly higher compared to the ‘baseline’ treatment. This can be explained by the fact that the combination of inequality and group voting makes individuals overharvest resources.

The frequency of resource exhaustion is the lowest in the ‘baseline’ treatment, where only 6% of groups exhausted resources. In other treatments, it varies between 13-17% percent. To assess if differences in the frequency of resource collapse are significant at group level, we regress dummies corresponding to different treatments on these variables, with no constant and error terms clustered at the opponent-group level. Subsequently, we test whether the coefficients corresponding to different treatment dummies are significantly different from each other for each pair of treatments. The corresponding F-statistics are summarized in Appendix A3 (Table A3.1). The results indicate that there are no statistically significant differences in the frequency of groups, which exhausted resources, between treatments. The only exception concerns the ‘inequality and vote’ treatment, where 31% of groups exhausted resources by the end of experiment, which is significantly more compared to the ‘baseline’ treatment ($F(1,36)=6.12$, $p<0.02$). Interestingly, none of the affluent groups ($K=100$) exhausted resources in the ‘inequality and vote’ treatment. Instead, 63% of groups with relatively less resources in the common pool ($K=80$) at the beginning of the experiment exhausted resources. This exceeds 10 times the probability of resource exhaustion in the ‘baseline’ treatment (6%), thus of groups which had access to the same amount of resources.

The evidence in Table 2 sheds some light on why unequal resources combined with group voting increase the probability of resource exhaustion. In particular, Table 2 summarizes the results from the panel

[4] In the presence of matching, the mean donation equals 0.93(±1.27) if individuals act as decision makers, and 0.93 per person (±1.30) if groups decide on donations. The mean from the ‘matching’ treatment excludes the successful one pair of groups.

regressions with the dependent variable equal to the fraction of harvested resources by subjects. Models 1-3 in the table present the results from regressions run on the sample of data pooled from 'baseline', 'inequality', 'vote' and 'inequality and vote' treatments; Model 4 summarizes the results from the 'baseline' and 'inequality' treatments; while Model 5 from the 'vote' and 'vote and inequality' treatments. In turn, Models 6-7 present the results from regressions using data pooled from the 'baseline', 'matching', 'vote' and 'matching and vote' treatments.

We include the following as independent variables: the total donation from the outgroup in the past round, the lagged value of the standard deviation of harvests within a group, how many tokens subjects donated to the outgroup at t-1, treatment dummies, and the variable capturing how many group members voted for sharing in the treatments with collective decision-making. As additional control variables, we include also age, a dummy taking the value of 1 if a subject is female and 0 otherwise, and the outcomes of the pre-experiment questionnaire. In particular, the variables 'trust' and 'divide' measure the fraction of PLN 5 (€ 1.2), which subjects are willing to give to another person in the dictator and trust games respectively. 'Risk' indicates a fraction of PLN 5, which subjects are willing to invest in the risky project, while total IQ measures the number of correct answers in the cognitive test. The coefficients corresponding to these control variables turned out to be statistically insignificant in most regressions in Table 2.

We report the results from the random-effect regressions to capture the impact of time invariant variables on harvests (Models 1, 2, 6 and 7), where we cluster errors at the partner-group level. In Model 3, we introduce AR(1) disturbances to control for serial correlation. In particular, the Wooldridge test indicates that our data suffers from this problem ($F(1,215)=3.16$). However, the model does not allow errors to be clustered at the partner group level. Finally, Models 4, 5 and 8 present the results from the regression using the Hausman-Taylor estimator, which accounts for the endogeneity of harvests and donations. We specify the following as endogenous variables in this regression: a lagged value of the standard deviation of harvests and a lagged value of the tokens sent to the outgroup at time t-1. The results gathered in Table 2 show that our findings are robust for a variety of estimation techniques.

The results in Table 2 support that the combination of inequality and group voting makes subjects harvest more resources. In favor of this, the coefficient corresponding to the 'inequality and vote' treatment dummy has a statistically significant and positive impact on the fraction of harvested resources in all Models 1-3. In addition, its size exceeds the size of coefficients corresponding to other treatments dummies. Interesting, the transfers of resource received from, as well as shared with, an outgroup have a positive and statistically significant impact on the fraction of harvested resources in all reported regressions. This supports our theoretical predictions that intergroup sharing affects harvests but not resources in the equilibrium. In particular, the results of the Mann-Whitney test indicate that there are no statistically significant differences in resources in the last period between treatments (Table A1.1 and A2.1 in the

Appendix). The only exception concerns the 'inequality and vote' treatment, where resources are significantly lower compared to the 'inequality' treatment (z=1.74, p<0.1), because of relatively poor groups overharvesting resources in the presence of group voting.

Table 2. The fraction of harvested resources by subjects. We cluster errors at the partner group level. The sample only includes data in case both groups have positive resources.

	Model 1 (Baseline, Inequality, Vote, 'Inequality and vote') Random effect	Model 2 (Baseline, Inequality, Vote, 'Inequality and vote') Random effect	Model 3 (Baseline, Inequality, Vote, 'Inequality and vote') AR(1)	Model 4 (Baseline and Inequality treatments) Hausman-Taylor estimator	Model 5 (Vote and 'Inequality and vote' treatments) Hausman-Taylor estimator	Model 6 (Baseline, matching, vote, and 'matching and vote' treatments) Random effect	Model 7 (Baseline and matching treatments) Random effect	Model 8 (Vote and 'Matching and vote' treatments) Hausman-Taylor estimator
Donation from the outgroup at t-1		0.01*** (0.003)	0.01*** (0.001)	0.01*** (0.002)	0.01*** (0.002)	0.01*** (0.001)	0.01*** (0.002)	0.01*** (0.001)
Individual donation to the outgroup at t-1		0.01*** (0.002)	0.01*** (0.001)	0.01*** (0.003)		0.01*** (0.002)	0.01** (0.03)	0.01*** (0.02)
Standard deviation of harvests at t-1		0.02*** (0.003)	0.02*** (0.001)	0.02*** (0.001)	0.03*** (0.002)	0.02*** (0.002)	0.02*** (0.003)	0.03*** (0.001)
Risk		0.02 (0.02)	0.02** (0.01)	-0.01 (0.01)	-0.01 (0.03)	0.01* (0.01)	0.01 (0.01)	-0.01 (0.02)
Trust		0.003 (0.01)	0.004 (0.01)	-0.03** (0.01)	-0.02 (0.02)	0.001 (0.01)	-0.01 (0.01)	-0.01 (0.02)
Divide		-0.002 (0.01)	-0.004 (0.01)	-0.001 (0.01)	-0.01 (0.03)	-0.03** (0.01)	-0.03** (0.01)	-0.04** (0.02)
IQ		-0.02* (0.01)	-0.02* (0.01)	-0.03** (0.01)	-0.05** (0.02)	-0.01 (0.01)	-0.02 (0.01)	-0.02 (0.02)
Female		0.003 (0.01)	0.003 (0.01)	-0.01 (0.01)	-0.004 (0.01)	0.003 (0.01)	0.001 (0.01)	0.0002 (0.001)
Age		0.001* (0.001)	0.001** (0.001)	-0.002*** (0.001)	-0.004* (0.002)	-0.0001 (0.001)	-0.001 (0.001)	-0.003*** (0.001)
Dummy Inequality	0.02 (0.02)	0.01 (0.01)	0.01 (0.01)	-0.01 (0.01)				
Dummy Vote	0.01 (0.04)	0.02*** (0.01)	0.02** (0.01)			0.01** (0.01)		
Dummy 'Inequality and vote'	0.06*** (002)	0.04*** (0.02)	0.04*** (0.01)		0.02* (0.01)			
Dummy Matching						0.04*** (0.01)	0.04*** (0.01)	
Dummy 'Matching and vote'						0.03*** (0.01)		-0.002 (0.10)
How many voted for sharing at t-1					0.001 (0.001)			0.01*** (0.002)
Constant	0.06*** (0.01)	-0.004 (0.03)	0.004 (0.02)	0.16*** (0.04)	0.20*** (0.09)	0.05*** (0.02)	0.07** (0.01)	0.16*** (0.04)
N obs N individuals	4746 222	4524 216	4524 216	2868 114	1656 102	5034 198	2556 96	2478 102
R2 within between overall Wald statist	0.00 0.09 0.02 W(3)=9.03	0.17 0.44 0.18 W(12)=577	0.17 0.43 0.18 W(13)=671	W(6)=662.9	W(11)=290	0.19 0.45 0.29 W(12)=548	0.15 0.53 0.29 W(10)=290	W(10)=772

Note: standard errors in brackets; *** indicates variables significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level

Result 4. We do not find evidence that intergroup sharing is motivated by inequality aversion.

We do not find any evidence in favor that inequality of resources promotes intergroup cooperation. First, there are no statistically significant differences in the frequency of intergroup sharing and the mean donation between the ‘baseline’ and ‘inequality’ treatment (Table 1(b)). The frequency of intergroup sharing, indicating how often groups exchange resources during the experiment, is equal to 0.16 in the ‘baseline’ compared to 0.2 in the ‘inequality’ treatment (Table 1(b)). This difference is not statistically significant, according to the Mann Whitney test (z=-0.21, p>0.5). Second, the differences in mean and total donations between the ‘baseline’ and ‘inequality’ treatments are statistically insignificant (Table 1(c)). The lack of significant differences in the size of donations cannot be explained by the fact that donations from more affluent groups are larger, while from poorer groups lower, than the donation in the ‘baseline’, with two effects cancelling each other out. In fact, we observe that less affluent groups in the ‘inequality’ treatment donated on average more harvests to the outgroup compared to the ‘baseline’, despite of the fact that they are of the same size initially. In particular, in the ‘inequality’ treatment, individuals in the less affluent groups donate on average 0.85 token, which is more than the mean donation per person equal to 0.55 token in the ‘baseline’ (Table 1(b)). Subsequently, the total donation by less affluent groups in the ‘inequality’ treatment (4.43±5.92 tokens) exceeds on average the total transfers of resources between groups in the ‘baseline’ (3±2.65 tokens).

To examine if inequality of resources unfolding over time because of groups harvesting resources at different rates promotes intergroup cooperation, Table 3 presents the results from the mixed-level logit panel regressions with the dependent variable taking 1 if a subject shared some of his/her harvest with outgroup members in treatments, where individuals acted as decision makers (Table 3(a)), or voted for sharing in treatments with groups acting as decision makers (Table 3(b)). We present the results from regressions conduced on the sub-samples of different treatments separately. Data at the individual level is nested within groups, and then within partner groups, and finally within sessions in the analysis. The sample only includes data in case the resources in the group and in the partner group are larger than 1. Most control variables are the same as in the regressions presented in Table 2. We include as additional variables: a fraction of harvested resources at time t; carrying capacity (K); and a dummy ‘ratio’ equal to 1 if resources in one’s own group (R_{jt}) exceed resources in the partner group (R_{it}), and 0 otherwise.

The results in Tables 3 support that the initial size of resources (K) is insignificant in explaining decisions to donate harvests to an outgroup (Models 1 and 3 in Table 3(a)) or to vote for sharing (Models 1 and 3 in Table 3(b)). Thus, members assigned to relatively ‘affluent’ groups are not willing to donate harvests to the outgroup so as to compensate their members for “bad luck”. In addition, the inequality of resources that unfolds over time does not affect intergroup sharing. In particular, the dummy 'ratio', indicating whether a group has relatively more resources than its partner at a given time, is insignificant in most treatments (Models 2-4 in Tables 3(a) and (b)). The only exception concerns the regression run on the sub-sample of data from 'matching and vote' treatment, where the coefficient corresponding to the dummy 'ratio' is positive and significant (Model 4). This indicates that subjects in this treatment are more likely to vote for donating harvests to the outgroup if their group has relatively more resources than the partner group. However, this does not translate into the actual transfers. In particular, Figure 2 compares the number of resource transfers depending on the relative size of resources between partner groups at the moment of sharing. The figure illustrates that there are no substantial differences in the number of donations in case groups have more or less resources than their partner group at the moment of sharing.

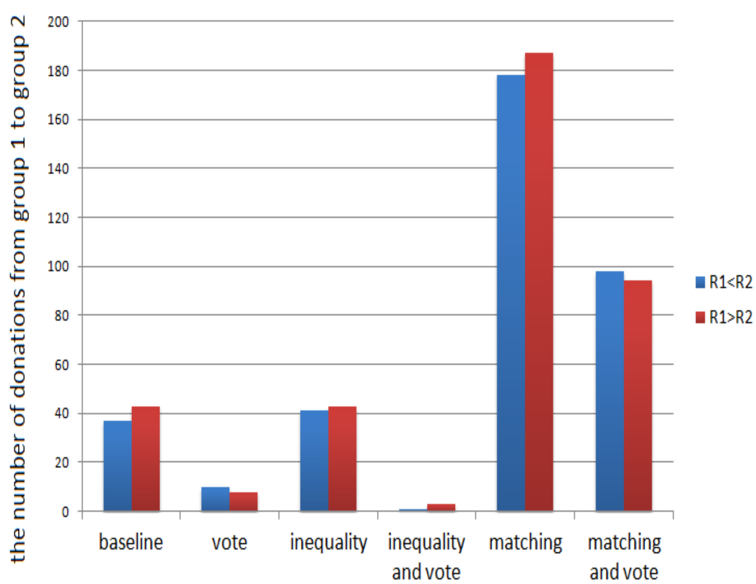


Figure 2. The number of intergroup transfers, depending on the size of relative resources between partner groups at the moment of sharing

Table 3(a). The results from the mixed-level logit panel regressions with the dependent variable taking 1 if a subject shared some of his/her harvest with outgroup members, and 0 otherwise. Data at the individual level is nested within groups, and then within partner groups, and finally within sessions in the analysis. The sample only includes data if resources in the group and the partner group are larger than 1.

	Model 1 (the sample of baseline, inequality and matching treatments)	Model 2 (the baseline treatment)	Model 3 (the inequality treatment)	Model 4 (the matching treatment)
Donation from the outgroup at t-1	0.34*** (0.04)	0.36** (0.36)	0.35*** (0.09)	0.35*** (0.05)
Dummy ratio of resources > 1	0.29** (0.13)	0.43 (0.36)	0.19 (0.31)	0.28 (0.18)
Fraction of harvested resources at time t	5.76*** (0.72)	5.40*** (1.63)	7.76*** (1.56)	5.83*** (1.00)
Risk	-0.46 (0.26)	-0.83 (0.45)	0.86 (0.71)	-0.71* (0.37)
Trust	-1.13*** (0.23)	0.02 (0.03)	0.23 (0.63)	-1.77*** (0.30)
Divide	1.40*** (0.25)	-0.64 (0.55)	0.16 (0.56)	2.75*** (0.37)
IQ	-1.08*** (0.27)	0.69 (0.73)	-2.74*** (0.66)	-0.29 (0.41)
Female		0.53 (0.45)	0.17 (0.37)	-0.71*** (0.18)
Age	0.05*** (0.01)	0.02 (0.03)	0.03 (0.05)	0.03* (0.02)
K	-0.001 (0.02)		-0.01 (0.03)	
Dummy Inequality	-0.12 (0.51)			
Dummy Matching	2.35*** (0.48)			
Constant	-3.74** (1.79)	-4.92*** (1.09)	-3.90 (2.89)	-1.14 (0.72)
N obs	4032	1392	1476	1164
Wald statist Chi2(11)	W(12)=252.23	W(9)=25.77	W(10)=72.33	W(9)=149.81

Note: standard errors in brackets; *** indicates variables significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level

Table 3(b). The results from the mixed-level logit panel regressions with the dependent variable taking 1 if a subject voted for sharing, and 0 otherwise. Data at the individual level is nested within groups, and then within partner groups, and finally within sessions in the analysis. The sample only includes data if resources in the group and the partner group are larger than 1.

	Model 1 (the sample of vote, 'inequality and vote' and 'matching and vote' treatments)	Model 2 (the vote treatment)	Model 3 (the 'inequality and vote' treatment)	Model 4 (the 'matching and vote' treatment)
Donation from the outgroup at t-1	0.18*** (0.03)	0.67*** (1.26)	0.27 (0.18)	0.09*** (0.87)
Dummy ratio of resources > 1	0.34** (0.14)	0.15 (0.27)	0.79 (0.18)	0.32* (0.18)
Fraction of harvested resources at time t	1.01 (0.65)	2.17* (1.26)	-2.91 (3.36)	0.36 (0.87)
Risk	1.52*** (0.25)	2.69*** (0.51)	55.12 (49.89)	-0.25 (0.38)
Trust	1.32*** (0.20)	2.76*** (0.41)	-30.70 (26.09)	0.33 (0.31)
Divide	-0.99*** (0.32)	0.41 (0.58)	3.29 (4.05)	-2.11*** (0.48)
IQ	1.05*** (0.26)	3.15*** (0.56)	-3.13 (4.06)	-0.22 (0.38)
Female	-0.17 (0.14)	-0.51* (0.28)	-0.07 (2.64)	-0.04 (0.21)
Age	0.10*** (0.02)	0.07** (0.03)	-0.25 (0.34)	0.14*** (0.02)
K (carrying capacity)	0.02 (0.05)		0.004 (0.15)	
Dummy 'Inequality and vote'	-2.12*** (0.79)			
Dummy 'Matching and vote'	1.84*** (0.51)			
Constant		-8.79*** (1.17)	-22.83 (20.16)	-3.11*** (0.81)
N obs	2910	1244	432	1254
Wald statist Chi2(11)	W(12)=216.10	W(9)=-414.68	W(10)=6.02	W(9)=77.19

Note: standard errors in brackets; *** indicates variables significant at the 1 percent level, ** at the 5 percent level, and * at the 10 percent level

Result 5. The majority of groups have established frequent exchanges of resources in the presence of matching donations. However, only one pair of groups has achieved a payoff-maximizing solution.

In the presence of matching donations, almost all groups have established frequent exchanges of resources with the partner group. In particular, only 3 groups in the 'matching and vote' treatment have not donated any harvests to the outgroup. In case individuals acted as decision makers, the frequency of sharing, computed as the number of periods in which donations took place divided by the number of periods before both groups exhausted resources, reaches 75%. The frequency of transfers is less than this in the 'matching and vote' treatment, where transferred occurred in 44% of rounds on average. Yet, the difference in the frequency of sharing between these treatments is statistically insignificant (Table 1(c)). Interestingly, only one pair of groups have achieved a payoff-maximizing solution, which required to harvest nearly all resources each period, donating most of them to the outgroup. Figure 3 depicts resources in groups, which solved the public good dilemma in the 'matching' treatment. Here, the subjects harvested on average 87% of the resources each period, donating most of it to the outgroup. To compare, the mean fraction of harvested resources was equal to 32% (±12%) in the 'matching' treatment, while in the 'baseline' it was 21% (±20%).

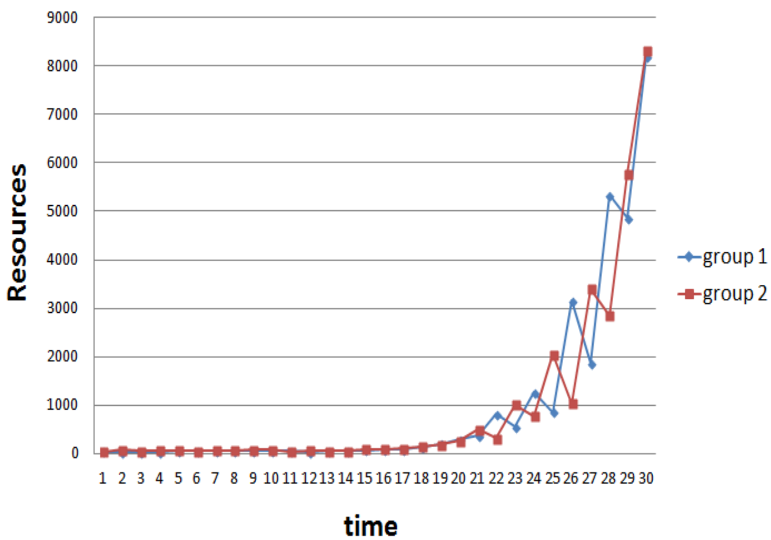


Figure 3. A pair of groups which solved the public good dilemma in the 'matching' treatment

5. Discussion and Conclusions

In this paper, we report the results from the common pool resource experiment, where we study factors conducive to intergroup cooperation in a two-stage repeated game. In the first stage, subjects harvest resources within groups. Each group has access to its own renewable resource. Groups are matched in pairs, to which we refer to as partner groups. Group members observe resources in their group as well as in the partner group. In the second stage, subjects can decide, after harvesting, whether they would like to donate some of their harvests to the outgroup. The donation augments the resources of the partner group, which can be considered as a form of livestock transfers. We compare donations depending on whether individuals and groups act as the decision-makers. In addition, we examine the role of economic benefits and inequality aversion in explaining patterns of intergroup sharing. In particular, in the 'matching' treatment, donations are being doubled before they augment the resource of an outgroup. In the ‘inequality’ treatment, partner groups start the experiment with unequal resources.

Assuming the rationality of players, resource transfers should not occur in the equilibrium as group members would expect to receive nothing in return. However, the participants in the large majority of groups donated harvests to the outgroup in the ‘baseline’ treatment. These exchanges cannot be explained by economic benefits to intergroup cooperation. In particular, donating own harvests to an outgroup reduces individual payoffs, while potential benefits from receiving a donation in return benefit a group-as-a-whole. This creates an incentive to free-ride on donations by others in the group. Moreover, if only one person donates harvests to an outgroup, which in fact happened in the majority of cases in the ‘baseline’, the cost of sharing exceeds its benefits.

Similarly, inequality aversion does not seem to explain sharing between groups. In the ‘baseline’ treatment, all groups start the experiment with the same resources. In turn, in the ’inequality’ treatment, groups that are matched in pairs start the experiment with unequal resources. Resources in the relatively poor groups are the same as in the ‘baseline’ initially, whereas resources in the relatively rich groups are 22% greater. We do not find evidence that inequality of resources, which unfolds over time because of partner groups harvesting resources at different rates, affects the probability that subjects would donate harvests to an outgroup. Surprisingly, also inequality in the distribution of resources does not affect patterns of sharing. In particular, we observe no statistically-significant differences in the frequency of sharing and the total transfers of resources between the ‘baseline’ and ‘inequality’ treatments.

Instead, we find that matching donations overcome mistrust between groups. Nearly all groups established frequent resource exchanges in its presence, which lasted until the end of the experiment, regardless of whether individuals or groups acted as decision-makers. So far, most experiments comparing the performance of groups and individuals have been conducted in the context of sequential two-stage games, in which individuals and groups interact only once. As one of a few exceptions, Muller and Tan (2013) study the behavior of individuals and teams in a Stackelberg game and compare the results from the one-shot game and repeated sessions. They find that the behavior of groups is more distant from the sub-game perfect equilibrium of the stage game than that of individuals. In our experiment, we study the behavior of groups and individuals in a repeated game which lasts 30 rounds. We do not find statistically significant differences in behaviors of individuals and groups in the presence of matching donations. This concerns resources in the last round, the amount of tokens donated to the outgroup or the frequency of intergroup sharing. In turn, in the absence of matching donations, thus economic benefits to intergroup sharing, we observe significant differences in how groups and individuals behave. Most groups shared some resources with the partner group in the ‘baseline’ and ‘inequality’ treatments, where individuals acted as decision makers. In turn, if donations were decided by groups as collectives in the ‘vote’ and ‘inequality and vote' treatments, the large majority of groups have not donated any harvests to an outgroup. This can be indicative of groups being less cooperative and more rational than individuals, thus confirming previous findings from a variety of economic games (Kugler et al., 2012).

Finally, our results reveal a dark side of voting under resource uncertainty. The combination of resource inequality and group voting increases the chances that groups would overharvest resources compared to the 'baseline' treatment. In particular, 63% of groups with relatively fewer resources exhausted resources in the 'inequality and vote' treatment, which is 10 times more than the probability of resource exhaustion in the 'baseline' treatment. As a possible explanation of this finding, subjects in groups with relatively fewer resources might have believed that the affluent partner group would donate resources to their group so as to compensate them for "bad luck". However, the frequency of intergroup sharing has been insufficient here for donations from the affluent groups to offset overharvesting by in-group members. It appears that subjects believed that partner groups would behave more altruistic than individuals, as we do not observe this effect in the 'inequality' treatment.

All in all, there is surprisingly little research on what conditions would be conducive to building relationships between groups, which constitutes an important topic for future research. Resource exchanges between groups can buffer resource variability due to unforeseen events. For instance, livestock transfers have been considered important for improving the resilience of pastoral societies, by allowing tribes to rebuild their herds after natural disasters. Our study provides a starting point for future research, highlighting the role of trust within- and between- groups in promoting resource exchanges.

Acknowledgments

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APPENDIX

A. The results from Mann-Whitney tests

A1. The summary of tests comparing the results between treatments: 2x2 variations in inequality and vote

Table A1.1 Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the resources in the last round in groups, which avoided resource exhaustion, by treatment

	Vote	Inequality	Inequality And Vote
Baseline	0.93	-0.42	0
Vote			0.93
Inequality			1.74*

Table A1.2. Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the number of periods before resource exhaustion, by treatment

	Vote	Inequality	Inequality And Vote
Baseline	0.91	0.71	2.95***
Vote			2.61***
Inequality			2.36**

Table A1.3 Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the mean fraction of harvested resources, by treatment

	Vote	Inequality	Inequality And Vote
Baseline	-0.83	0.34	-1.93*
Vote			-1.64
Inequality			-1.40

Table A1.4 Mann-Whitney U tests based on ranks with pairwise comparisons of medians of mean harvests over time, by treatment

	Vote	Inequality	Inequality And Vote
Baseline	-0.04	1.86**	-2.41**
Vote			-2.50**
Inequality			-1.57

A2. The summary of tests comparing the results between treatments: 2x2 variations in matching and vote

Table A2.1 Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the resources in the last round in groups, which avoided resource exhaustion, by treatment

	Vote	Matching	Matching And Vote
Baseline	0.93	-1.37	-0.67
Vote			-1.64
Matching			0.77

Table A2.2. Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the number of periods before resource exhaustion, by treatment

	Vote	Matching	Matching And Vote
Baseline	0.91	0.91	0.58
Vote			-0.48
Matching			-0.42

Table A2.3. Mann-Whitney U tests based on ranks with pairwise comparisons of medians of the mean fraction of harvested resources, by treatment

	Vote	Matching	Matching And Vote
Baseline	-0.83	-2.96	-1.64
Vote			-1.44
Matching			0.67

Table A2.4 Mann-Whitney U tests based on ranks with pairwise comparisons of medians of mean harvests over time, by treatment

	Vote	Matching	Matching And Vote
Baseline	-0.04	-.287***	-1.73*
Vote			-1.93*
Matching			0.77

A3. The results from F-test comparing the frequency of collapse

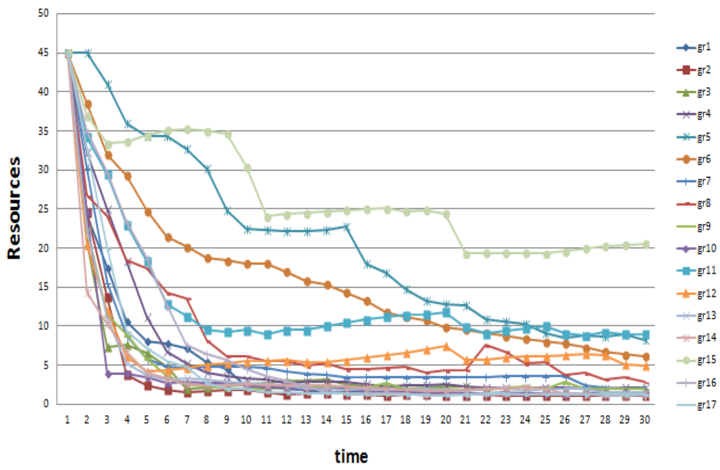
Table. F-statistics indicating whether differences in the frequency of resource exhaustion between pairs of treatments are statistically significant.

F(1,36)	Vote	Inequality	Inequality And Vote
Baseline	1.29	0.84	6.12**
Vote			1.47
Inequality			2.45

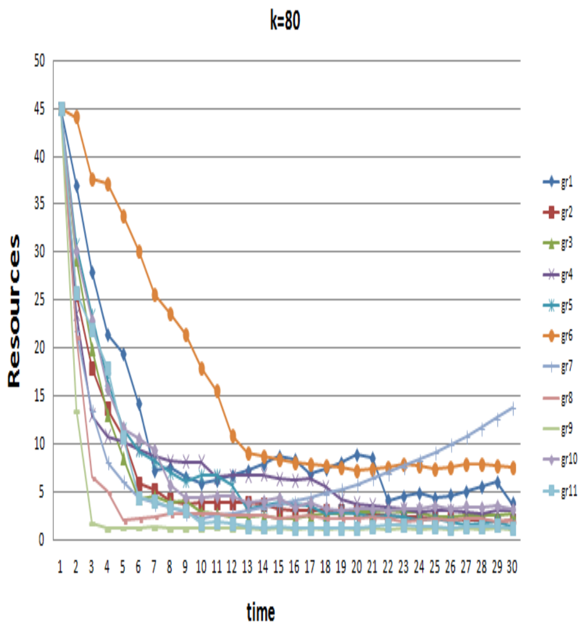
Table. F-statistics indicating whether differences in the frequency of resource exhaustion between pairs of treatments are statistically significant.

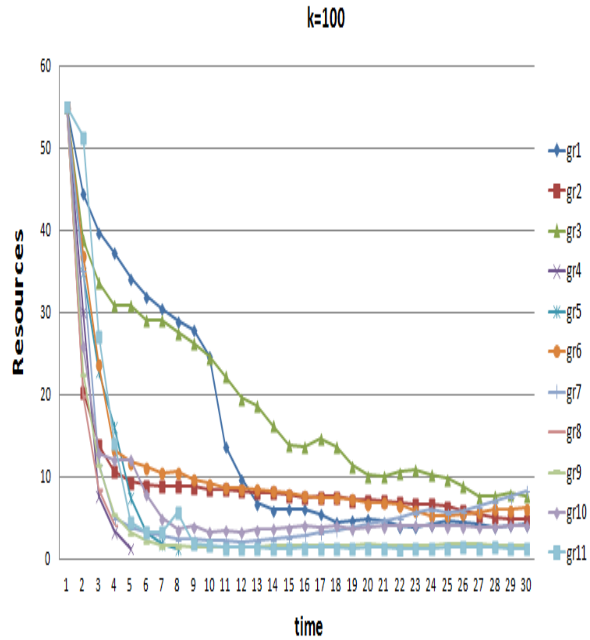
F(1,36)	Vote	Matching	Matching And Vote
Baseline	1.29	1.29	0.52
Vote			0.13
Matching			0.13

A4. Resources over time, per group

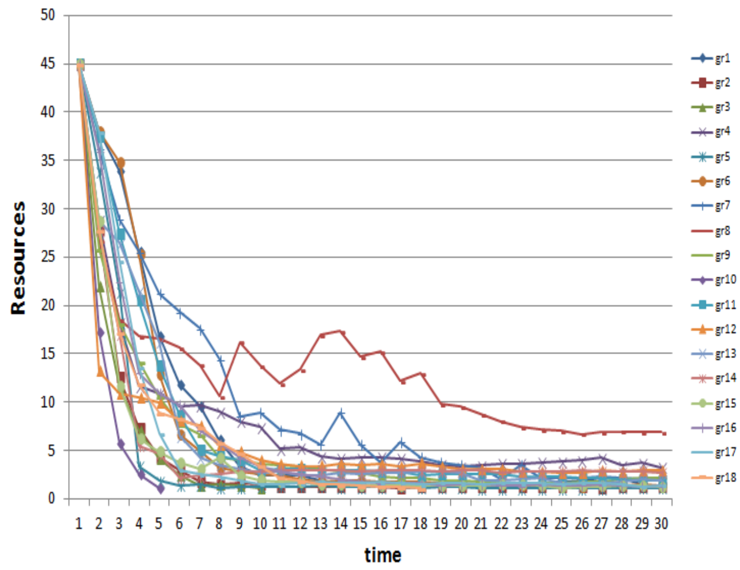


(a) 'Baseline' treatment

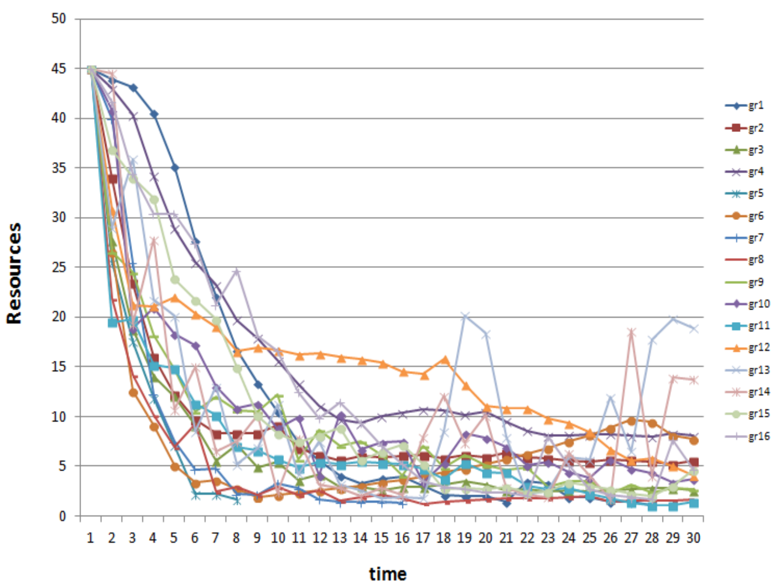




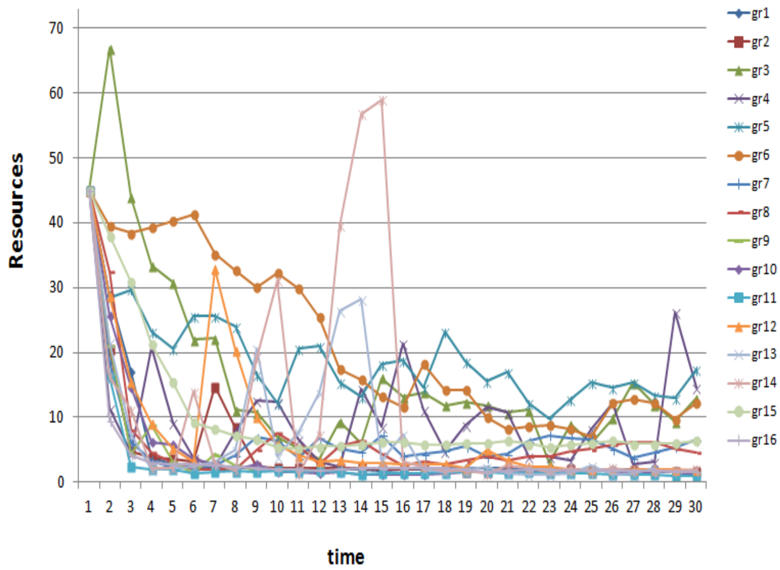
(b) 'Inequality' treatment



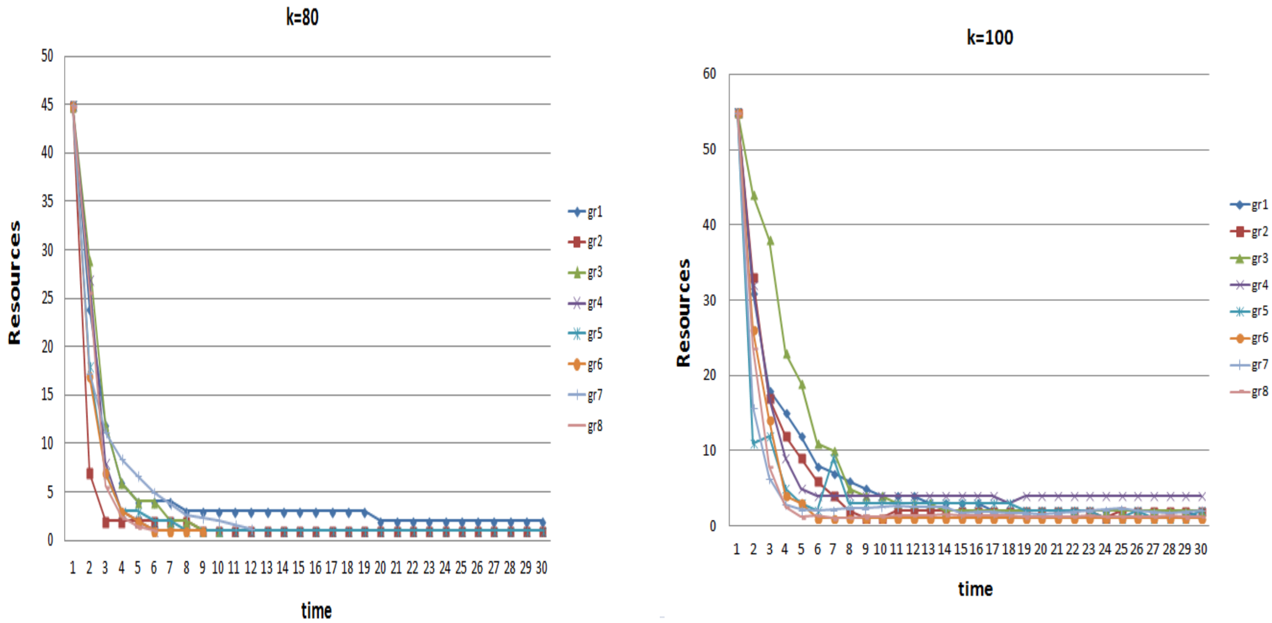
(c) 'Vote' treatment



(d) 'Matching' treatment



(e) 'Matching and vote' treatment



(f) 'Inequality and vote' treatment

Appendix B. Instructions

All

Welcome

You are now taking part in a decision-making experiment. Depending on your decisions and decisions made by others, you may be able to earn a substantial amount of money.

The experiment consists of three parts. In the first part, we will ask you to answer questions which will appear on your screen. Once everybody has answered them, we will distribute a set of instructions. Afterwards, the second part of the experiment will start, during which you can learn dynamics of the game. The third part - of the actual experiment - will follow afterwards with some additional elements. This part will last much longer than the second part. We will distribute instructions for this part prior to its beginning.

All

Part 2

During this part of the experiment, you will have a chance to learn dynamics of the game. In this part of this experiment, you will play with two other "persons", whose decisions will be taken by a computer. In the next part of the experiment, you will play with two participants of this experiment. Each group members will be asked to collect tokens from the common pool of tokens. Your group starts with the common pool of 45 tokens[5].

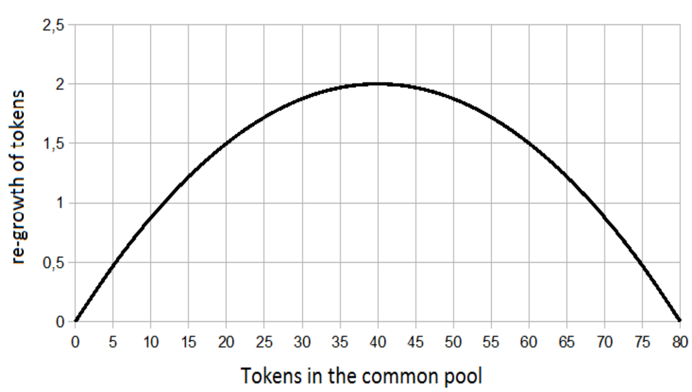
You will not know who is who in your group during or after the experiment. Every member of your group, including you, will decide simultaneously on the number of tokens to collect. The number of tokens collected by each person cannot exceed 1/3~~33%~~ of all tokens available to the group. You will be informed about how many tokens were collected by others in your group. The decisions of group members will be displayed in a random order every period - it will not be possible to determine who collected how many tokens.

The total number of tokens collected by the group will be subtracted from the common pool of tokens. Then, depending on the number of tokens left in the common pool, there will be a re-growth in the number of tokens (RG), according to:

$$RG=0.1*TC*(1-TC/80),$$

where TC is the number of tokens in the pool, and 80 is the maximum carrying capacity of the pool of tokens, i.e. beyond which the number of tokens will not increase further.

The graph below illustrates an increase in the number of tokens (RG) in the common pool, depending on the number of tokens in the common pool (TC):



[5] In the 'inequality' and 'inequality and vote' treatment, half of groups had 55 tokens in the common pool.

For instance, if the number of tokens in the common pool is 40, then the expected re-growth of tokens is 2, and there will be 42 tokens available to your group in the next period.

You will be asked to collect tokens for some periods. However, this part of the experiment may also end if the number of tokens in the common pool of tokens goes below 1 [one]. In this case, everyone is your group loses all their tokens.

Your Earnings:

The aim of this part of the experiment is to give you the opportunity to learn dynamics of the game. You will not earn money.

Timing:

There is another important note. You will have a limited but a sufficient amount of time (some seconds) to decide how many tokens to collect. If you exceed this time, the decision will be taken for you.

Before starting:

In order to check if you understand these instructions, please answer questions which will appear on your screen.

The ‘baseline’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you can decide whether you want your group to share some tokens from your total tokens (tokens which you collected up to this time) with the partner group.

Sharing

After everyone has decided how many tokens to collect, you will be asked to indicate how many tokens you would like to share with the partner group.

Precisely, you will be asked to indicate how many tokens from your total tokens you would like to send to the partner group. If you do not wish to share tokens write 0. The amount of tokens taken from you will be added to the pool of tokens of the partner group. These tokens will be subtracted from your total tokens.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

The ‘inequality’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you can decide whether you want your group to share some tokens from your total tokens (tokens which you collected up to this time) with the partner group. Your group and the partner group will have access to unequal number of tokens in the common pool in the first round: one group will start with 55 tokens, and another with 45.

Sharing

After everyone has decided how many tokens to collect, you will be asked to indicate how many tokens you would like to share with the partner group.

Precisely, you will be asked to indicate how many tokens from your total tokens you would like to send to the partner group. If you do not wish to share tokens write 0. The amount of tokens taken from you will be added to the pool of tokens of the partner group. These tokens will be subtracted from your total tokens.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

The ‘matching’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you can decide whether you want your group to share some tokens from your total tokens (tokens which you collected up to this time) with the partner group. The amount of tokens, which you will decide to send to the partner group, will be doubled. For instance, if you decide to give one token, the amount of tokens in the common pool of the partner group will be augmented by 2 tokens.

Sharing

After everyone has decided how many tokens to collect, you will be asked to indicate how many tokens you would like to share with the partner group.

Precisely, you will be asked to indicate how many tokens from your total tokens you would like to send to the partner group. If you do not wish to share tokens write 0. The amount of tokens taken from you will be added to the pool of tokens of the partner group. These tokens will be subtracted from your total tokens.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

The ‘vote’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you will be asked whether you want that everyone in your group gives some of your harvests to increase the number of tokens in the common pool of the partner group.

Sharing

Everyone in your group will be asked if she/he wants to share some of their harvests with the outgroup. If the majority says yes, you will be asked to indicate how many tokens everyone in your group (including you) should give to the partner group. After everyone answers this question, the computer will draw one answer randomly. The amount of tokens indicated in the selected vote will be subtracted from your tokens (and tokens of other group members) and added to the common pool of tokens of the partner group.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

The ‘matching and vote’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you can decide whether you want your group to share some tokens from your total tokens (tokens which you collected up to this time) with the partner group. The amount of tokens, which you will decide to send to the partner group, will be doubled. For instance, if you decide to give one token, the amount of tokens in the common pool of the partner groups will be augmented by 2 tokens.

Sharing

Everyone in your group will be asked if she/he wants to share some of their harvests with the outgroup. If the majority says yes, you will be asked to indicate how many tokens everyone in your group (including you) should give to the partner group. After everyone answers this question, the computer will draw one answer randomly. The amount of tokens, according to the drawn vote, will be subtracted from your tokens (and tokens of other group members) and twice as much will be added to the common pool of tokens of the partner group. For instance, if your group will decide that everyone should give 1 token to the partner group (thus 3 tokens in total), the amount of tokens in the partner group will increase by 6 tokens.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

The ‘inequality and vote’ treatment

Part 3

During this (last) part of the experiment, you will be asked to collect tokens for many periods - just as you did before. You will be randomly matched with 2 participants, but you will not be informed about their identity.

In this part of the experiment, your group will be matched with another group in the room. We will refer to this group as a “partner group”. During the experiment, you can observe choices made by others in your group and also choices made by others in the partner group. Members of the partner group will collect tokens from their own common pool of tokens.

After collecting decisions take place, you can decide whether you want your group to share some tokens from your total tokens (tokens which you collected up to this time) with the partner group. Your group and the partner group will have access to unequal number of tokens in the common pool in the first round: one group will start with 55 tokens, and another with 45.

Sharing

Everyone in your group will be asked if she/he wants to share some of their harvests with the outgroup. If the majority says yes, you will be asked to indicate how many tokens everyone in your group (including you) should give to the partner group. After everyone answers this question, the computer will draw one answer randomly. The amount of tokens, according to the drawn vote, will be subtracted from your tokens (and tokens of other group members) and twice as much will be added to the common pool of tokens of the partner group. For instance, if your group will decide that everyone should give 1 token to the partner group (thus 3 tokens in total), the amount of tokens in the partner group will increase by 3 tokens.

Members of the partner group will be also asked whether they would like to share some of their tokens with your group.

Your Earnings:

Your earnings will be equal to the number of tokens, which you collected. Each token is worth 1.5 PLN. There is, nevertheless, an exception: if the number of tokens in the common pool goes below 1 [one], everyone in your group will lose all their tokens. In this case, your earnings will be zero in this part of the experiment.

Appendix C. Measurements of other-regarding preferences, IQ and risk aversion

PRE-EXPERIMENT QUESTIONS

DICTATOR GAME

Imagine that you are matched with a person in this room. You have PLN 5.
How many cents would you like to share with this person?

TRUST GAME

Imagine that you are matched with another (different) person. You have PLN 5. How many cents would you like to send him/her? For every cent you send, the person will receive a double value of this amount. He or She will be asked to send you some money back (as he or she wishes), keeping the rest for himself.

RISK-LOVING

You have PLN 5. You have the possibility of investing some cents in a project. The project has 40% of probabilities of being successful. If the project is successful, you will receive the invested amount multiplied by 3. You will also keep cents which you have not invested. If the project fails, you only keep cents, which you have not invested. How many cents would you like to invest in the project?

COGNITIVE SKILLS (IQ)

You have 20 seconds to respond to the following questions. For each correct answer you earn PLN 1.

a) Which number comes next?

3, 5, 8, 13, 21, …

b) Which number is missing?

1	4	3
5	9	4
4	5	…

c) Which number comes next?

4, 54, 654, …

b) Which number is missing?

17	8	5	4

13	7	5	4
10	6	4	...

POST-EXPERIMENT QUESTIONNAIRE

1. Are you: (Male /Female)
2. Nationality
3. Are you a undergraduate student or a master student
4. In you are an undergraduate student, in which year of study are you currently? (1, 2, 3, 4, 5)
5. Which is your major: (Economics / Business, Management / A Social Science / Natural Science, Mathematics, etc, / Art, Language, Humanities / Others)
6. How would you describe the income of your parents from 1 to 7 where 1 = low and 7 = high
7. How much money do you spend every month (apartment, food, clothes...)?
8. How would you describe your political preferences from 1 to 7 where 1 = very right-wing and 7 = very left-wing?
9. Before the experiment, how long did you expect that the experiment would last?