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Alternating or compensating? An experiment on the repeated sequential best shot game

Lisa Bruttel* Werner Güth†

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Abstract

In the two-person sequential best shot game, first player 1 contributes to a public good and then player 2 is informed about this choice before contributing. The payoff from the public good is the same for both players and depends only on the maximal contribution. Efficient voluntary cooperation in the repeated best shot game therefore requires that only one player should contribute in a given round. To provide better chances for such cooperation, we enrich the sequential best shot base game by a third stage allowing the party with the lower contribution to transfer some of its periodic gain to the other party. Participants easily establish cooperation in the finitely repeated game. When cooperation evolves, it mostly takes the form of "labor division," with one participant constantly contributing and the other constantly compensating. However, in a treatment in which compensation is not possible, (more or less symmetric) alternating occurs frequently and turns out to be almost as efficient as labor division.

Keywords: best shot game, coordination, transfer, experiment

JEL-Classification: C71, C73, C91

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1 Introduction

Probably the most important institutional aspect enabling voluntary cooperation in homo sapiens as well as in other species of the animal kingdom is the so-called "shadow of the future" (Dal Bó, 2005).[1] This shadow of the future means awareness that we interact with the same others repeatedly and that present choices will influence future ones. It has been demonstrated by numerous experimental studies of repeated interaction how this allows for mutually beneficial voluntary cooperation until its endgame decline.

Game theoretically such voluntary cooperation can be justified by (i) an infinite horizon so that there is always a future after finitely many rounds of play, (ii) multiplicity of equilibria in the base game allowing deviations from cooperative play to be punished by switching to some worse equilibrium, or (iii) some (supposed, see Kreps et al., 1982, or experimentally induced, see Anderhub et al., 2002; Brandts and Figueras, 2003) form of incomplete information enabling strategic reputation formation. The problem with (i) is that there usually exists a commonly known upper bound for the number of repetitions that one can run in an experiment. For a finite horizon, (ii) allows for subgame perfect equilibria with voluntary cooperation. Type (iii) equilibria account for initial voluntary cooperation by strategically mimicking the behavior of intrinsically motivated cooperators. Thus, at least probabilistically, they presuppose such motivation, which most studies in the literature want to confirm and explain instead of presupposing it. Subgame perfect equilibria of type (i) and (ii) violate subgame consistency (see Selten and Güth, 1982) requiring that behavior should only depend on the rules of the subgames and not on past moves without any influence on these rules. From the robust experimental evidence of voluntary cooperation, one can conclude that this requirement may be normatively appealing but is definitely not in line with how we reason in repeated interaction. In such situations we usually react to what has happened before, even when this does not affect the rules we are facing now (see Axelrod, 1984).

How we react to the past in order to establish and maintain voluntary cooperation up to an endgame effect has been well studied for repeated interactions in simultaneous and symmetric move base games (for some review, see Camera and Casari, 2009). In our study, we consider

[1] Güth et al. (2007) compare payoff sharing, resembling kinship, with the shadow of the future and show that varying the shadow of the future (the time horizon) is much more influential than varying the degree of payoff sharing.

a sequential and asymmetric game. For such games, it is less obvious than for the usually employed simultaneous and symmetric games how voluntary cooperation will evolve. Although this will typically rely on some "tit for tat," neither the "tit" nor the "tat" may be obvious. In our view, the ambiguity of "tit for tat" is captured nicely by our finitely repeated base game, referred to as Modified Sequential Best Shot, MSBS.

Its two players, 1 and 2, are subjected to the following rules in each of the finitely many rounds: first, player 1 chooses c_1 with $0 \leq c_1 \leq e$, where e is the positive endowment of each player, and informs player 2 about c_1. Then player 2 chooses c_2 with $0 \leq c_2 \leq e$ and informs player 1 about c_2. Finally, if there is a unique player i with $c_i < c_j$ for $i, j = 1, 2$, this player i can transfer any amount t with $0 \leq t \leq e$ to player $j\,(\neq i)$. The payoffs for both, players 1 and 2, consist of three parts, namely the non-spent endowment and the monetary effects of public good provision as well as of compensating. The payoff from the public good is the same for both players and depends only on the maximum of c_1 and c_2, i.e., only the "best shot" counts. We apply a nonlinear rule how the maximal contribution affects the payoff from the public good to allow for interior individually and socially optimal contributions.[2] Player j with $c_j > c_i$ may further receive a positive monetary transfer t from player i whose payoff is reduced by t. Of course, both players, 1 and 2, have to pay their individual contribution cost, c_1 and c_2, respectively.

Voluntary cooperation can be implemented by some positive c_j and $c_i = 0$ in each round. Will participants learn to establish and maintain this form of cooperation? And if so, will cooperation be in the form of *alternating* with 1 and 2 taking turns in being the positive contributor j or free rider i, or via *compensating* in the form of labor division with either player 1 or 2 constantly contributing and the other "freeriding" but compensating? Whereas alternating is more or less symmetric since both players take turns in being the only contributor and the free rider, compensating requires coordination on asymmetric labor division. In the latter case, the only and constant contributor determines the efficiency of voluntary cooperation, what may be possibly influenced by how much equality has been created in the past via the monetary transfers of the constant free rider. Finally, is it the first or the second mover who is constantly contributing or does this vary non-systematically across pairs?

[2] This way, we avoid the disadvantage of "corner solutions" allowing only one-sided deviations and thereby confounding (non-)cooperation with noise.

We find that in roughly half of the observations maximum contributions realize the full efficiency gain, with no substantive differences across treatments. However, the dominant form of voluntary cooperation depends on the details of the game. While the ex post transfer payment, if allowed by the treatment, is frequently used to establish cooperation in the form of "freeriding but compensating," participants are well able to coordinate on alternating contributions if not allowed to use the transfer. Furthermore, we distinguish whether or not the lower of the two contributions (if any) is refunded to its contributor. This makes a difference for cooperation in that with no refund players seem to consider their decisions more seriously, thus enhancing cooperation.

Our study relates to the small literature on turn-taking in asymmetric coordination games (battle-of-the-sexes games). In such games, turn-taking between the two efficient but asymmetric base game equilibria is a way to equalize payoffs in the long run. To establish cooperation during the initial phase of play, the theoretical models of Lau and Mui (2012, 2008) and Bhaskar (2000)[3] suggest that players randomize over both their strategies until the first match occurs. Evans et al. (2013) test these models in an experiment and find evidence for turn-taking behavior, in particular when cheap talk communication among players is allowed. Compared to these games, the sequential structure of our base game avoids the initial phase of unintended miscoordination and allows to detect strategic reasoning in a cleaner way.

The structure of this paper is as follows. In Section 2, we present the experimental design and procedures as well as some behavioral predictions. The experimental results are described in Section 3. Section 4 concludes.

2 Experimental design and procedures

2.1 Design

Participants in the experiment take part in three subsequent supergames with 20 rounds each. In each of the three successive supergames, they meet a new partner (perfect strangers design), but within supergames the matching is fixed. Both players $i = 1, 2$ receive an endowment of

[3]See also the comment by Kuzmics and Rogers (2012).

100 points in each round. Contributions can vary in steps of 10 points from 0 to 100. Player 1 chooses c_1 in stage 1; player 2, knowing c_1, can thus react to c_1 when determining c_2 in stage 2. Finally, in stage 3, the lower contributor can transfer any amount $t \in [0; 100]$ to the maximal contributor. If both contribute the same, there is no transfer. How much the players gain from the maximal contribution is captured by the discrete function $f(\max\{c_1, c_2\})$ which does not vary across treatments and is presented in Table 1. The individually optimal contribution, given that the other player contributes zero, is 20. Efficiency in the sense of maximizing the joint payoff $2 \cdot f(max\{c_1, c_2\}) - max\{c_1, c_2\}$ requires $max\{c_1, c_2\} = 80$, yielding a surplus of 80 that the two partners could share by an appropriate transfer t or by taking turns in contributing.

$max\{c_1, c_2\}$	0	10	20	30	40	50	60	70	80	90	100
$f(max\{c_1, c_2\})$	0	27	40	47	55	61	67	73	80	83	85

Table 1: Payoffs implied by the maximal contribution

Treatments differ in the composition of periodic payoffs (see Table 2). The baseline treatment Base assumes that the lower contribution is refunded. If both players contribute the same, that is $c_i = c_j$ for $i, j = 1, 2$ and $i \neq j$, it is randomly determined who receives the refund. The payoff for $i = 1, 2$ is $u_i = 100 - c_i + f(max\{c_1, c_2\}) + t$ if either $c_i > c_j$ or $c_i = c_j$ and i is not randomly refunded. Otherwise, the payoff is $u_i = 100 + f(max\{c_1, c_2\}) - t$. The AllPay treatment assumes that contributions must be paid regardless whether or not they determine the payoffs from the public good. The payoffs of this treatment are $u_i = 100 - c_i + f(max\{c_1, c_2\}) + \delta_i t$ where $\delta_i = +1$ if $c_i > c_j$ and $\delta_i = -1$ if $c_i < c_j$. If $c_i = c_j$, the transfer $t = 0$ is imposed. The NoTransfer treatment maintains the refund of the lower contribution but does not allow for the transfer payment t. We allow versus exclude "Refund" only for "Transfer" and explore "No transfer" only with "Refund" (see the treatment design in Table 2).

Treatment	Refund of low contribution	Transfer
Base	yes	yes
AllPay	no	yes
NoTransfer	yes	no

Table 2: Treatments

2.2 Predictions

The benchmark solutions in the sense of finitely repeated elimination of dominated strategies or subgame perfect equilibria can be determined by first considering the one-shot games as depending on the treatment. Whereas solutions of AllPay require $min\{c_1, c_2\} = 0$ and $max\{c_1, c_2\} = 20$ and $t = 0$, the set of solutions in Base and NoTransfer is larger by not requiring $min\{c_1, c_2\} = 0$ but only $max\{c_1, c_2\} = 20$ and $t = 0$. Since $t = 0$, neither player wants to be the contributor. However, player 1 can anticipate that player 2 will react to $c_1 = 0$ by $c_2 = 20$. This features player 2 as the only contributor: in Base and NoTransfer all initial contributions $c_1 < 20$ imply $c_2 = 20$ in case of common(ly known) rationality. For the finitely repeated base games these solutions are the stationary solution benchmarks since when applying backward induction future behavior does not depend on what happened in previous rounds. Thus, game theoretically, a maximum contribution of 20 by player 2 and no transfer payments are predicted, irrespective of the treatment.

Neither labor division involving transfer payments t nor alternating are predicted by the benchmark solution. However, behaviorally we expect to reject the hypothesis of solution behavior and predict that participants, as robustly confirmed by previous repeated social dilemma experiments (see the overview by Chaudhuri, 2011), will cooperate rather efficiently. Unlike game theoretically predicted, they will do so by rendering their behavior path dependent. Experimentally, such path dependence in playing the recursive 20-round game is feasible by implementing the appropriate information feedback after playing each round of the respective base game. After each round, both players $i = 1, 2$ learn about c_1 and player 2's reaction c_2 to c_1, the transfer payment t, their periodic earnings u_i as well as their accumulated earnings during the current supergame so far.

2.3 Procedures

The experiment was computerized using z-Tree (Fischbacher 2007). A total of 264 students from various disciplines recruited via ORSEE (Greiner 2004) took part in our experiments, 90 in both Base and AllPay, 84 in NoTransfer. Each participant could register for only one session. Matching was organized in groups of six so that we would have 15 (14) independent observations per treatment. Each matching group contained three player 1 resp. player 2 participants who were then successively paired, guaranteeing a new partner for each supergame. The experiment was run in *Lakelab*, the laboratory for experimental economics at the University of Konstanz. The experiment lasted approximately 2 hours, including the time for reading the instructions and answering a short postexperimental questionnaire. Subjects were paid a show-up fee of 3 euros. On average, participants earned 19 euros (including the show-up fee).

Before starting the experiment, subjects received written instructions on their computer screen.[4] To allow for more familiarity with the three-stage process, participants experienced two trial rounds facing a predetermined decision making program in the other role. After that they had to answer a few control questions before actually interacting with three subsequent partners. At the end of each session, participants were individually called to the exit. They received their payment in cash outside the laboratory with sufficient time between participants to ensure privacy with respect to the amount of money they received.

3 Results

The dynamics of repeatedly playing the three successive supergames with new partners are illustrated in Figure 1 displaying the average $\overline{c}_t = max\{c_{1,t}, c_{2,t}\}$ and the average $\underline{c}_t = min\{c_{1,t}, c_{2,t}\}$ over time. Table 3 additionally summarizes the distribution of $\overline{c}_t$ across treatments and supergames. The share of pairs with an efficient maximum contribution of 80 increases in all three treatments from the first to the third supergame (p-value = 0.02 in Base, < 0.01 in AllPay, 0.11 in NoTransfer).[5] This increase is most pronounced in AllPay, where in the third supergame in 58 percent of all rounds and pairs the maximum contribution is 80 ("increase of % efficient contributions from the first to the third supergame" in AllPay vs. increase in Base: $p = 0.05$, NoTransfer vs. Base: $p = 0.37$).[6] This increase in the share of efficient contributions in AllPay goes hand in hand with a relatively strong decrease of the individually optimal

[4]See the Appendix for a translated version of our instructions.

[5]If nothing else is stated, reported p-values refer to two-sided Wilcoxon signed rank tests, treating matching groups as the unit of observation. For tests of differences between treatments, we similarly use two-sided Wilcoxon rank sum tests.

[6]Similarly, the differences in the increases of $max\{c_{1,t}, c_{2,t}\}$ from the first to the third supergame is statistically significant when comparing AllPay and Base ($p = 0.02$) but not between NoTransfer and Base ($p = 0.76$).

contribution of 20. In all three treatments, the share of pairs with intermediate contributions between 30 and 70 declines over time, from about 25 percent to below 15 percent. In the other ranges of contributions, the shares are relatively stable over time. Whereas contributions below 20 are rationalizable by expectations that the other contributes, contributions above 80 could only be justified by an extreme form of generosity (giving something to the other at higher costs).

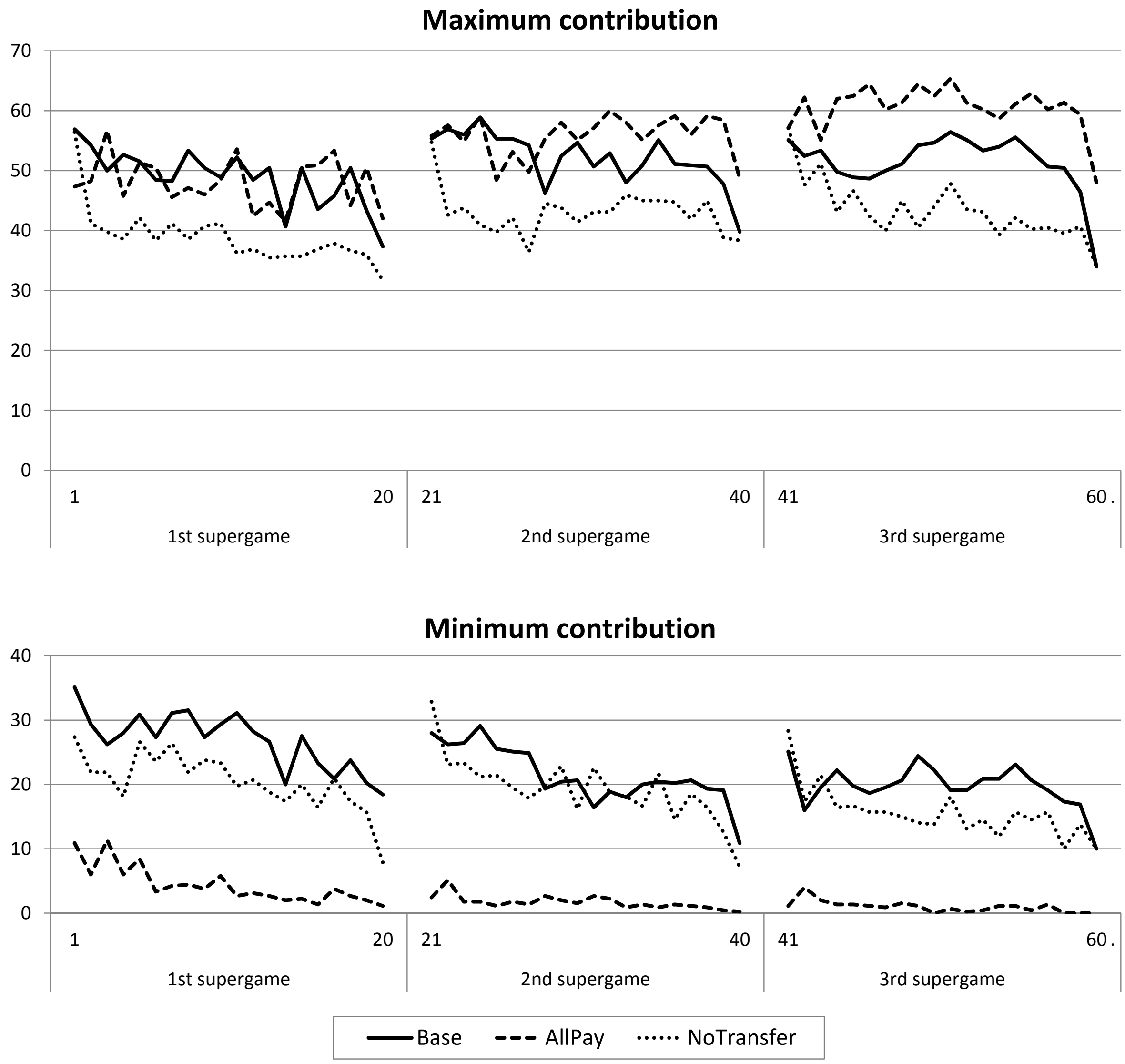

Figure 1: Maximum and minimum contribution in all treatments over time

	SG	Max < 20	Max = 20	20 < Max < 80	Max = 80	Max > 80
Base	1st	0.10	0.30	0.26	0.25	0.09
	2nd	0.10	0.27	0.19	0.38	0.07
	3rd	0.10	0.30	0.11	0.43	0.05
AllPay	1st	0.08	0.33	0.25	0.24	0.10
	2nd	0.08	0.25	0.14	0.45	0.07
	3rd	0.07	0.19	0.12	0.58	0.04
NoTransfer	1st	0.09	0.47	0.23	0.17	0.05
	2nd	0.10	0.40	0.20	0.26	0.04
	3rd	0.09	0.44	0.13	0.29	0.05

Table 3: Maximum contribution across supergames and treatments (SG: supergame, table entries are the shares of contributions in the column range)

The high share of efficient contributions in AllPay also results in a relatively high average maximum contribution of 60.50 points in this treatment in the third supergame.[7] In Base the average maximum contribution is 51.37, in NoTransfer it is 43.44. However, none of the comparisons to the baseline treatment is statistically significant (AllPay vs. Base: $p = 0.10$, NoTransfer vs. Base: $p = 0.36$). With respect to the difference between the maximum and minimum contribution in a pair, we find that $max\{c_1, c_2\} - min\{c_1, c_2\}$ is, with 59.51 points, significantly higher in AllPay than in Base (31.62 points) or NoTransfer (27.87 points) (both p's < 0.01). Average profits per player (including efficiency losses in the AllPay treatment due to both players contributing) are again very similar, with 132.99 in Base, 134.93 in AllPay, and 131.84 in NoTransfer.

Result 1 *In terms of the average maximal contribution, the* AllPay *treatment experiences the strongest increase over time and also reaches the highest level.*

Result 2 *Treatments* NoTransfer *and* Base *are similarly efficient.*

Table 4 organizes subjects' strategies according to the most prominent behavioral patterns. The first pattern captures the cooperative "freeriding but compensating" strategy with one player contributing 80 or more and the other compensating him by about half of this contribution. The second pattern captures a weaker version of category 1 with one player contributing

[7]Consistently, also average transfer payments are also higher in AllPay (26.69 points) than in Base (20.94 points), $p = 0.11$.

on a lower level and the other transferring. The third pattern describes positive contributions of one player that are not rewarded by transfers of the other. Instead, the other player often symbolically contributes some positive but smaller amount that is refunded. The fourth pattern captures the "alternating" strategy with both players taking turns in contributing.[8] The fifth pattern is again efficiency driven, but not always relying on the same player in contributing. Instead, both players contribute the same amount, e.g., 80, and leave it to the randomization who is refunded. Afterwards, there may be a transfer (if allowed by the treatment). The last pattern is the residual category not fitting into any of the first five categories. A pattern of play is assigned to one of the categories if decisions in at least 10 (not necessarily subsequent) rounds out of the total of 20 rounds are in line with its description. Double classifications occur only rarely and are treated as unclassifiable.

Category	Base	AllPay	NoTransfer
1	0.38	0.47	—
2	0.18	0.22	—
3	0.20	0.02	0.24
4	0.04	0.18 (nearly all 80)	0.45 (two thirds 80)
5	0.07 (all 80)	—	0.17 (5/7: 20)
6	0.13	0.11	0.14

Table 4: Strategies: 1 = "Freeriding but compensating": one player contributes ≥ 80, the other transfers ≥ 30 points. 2 = One player contributes varying amounts < 80, the other transfers something. 3 = One player contributes varying amounts < 80, no transfer. 4 = "Alternating". 5 = Both contribute the same and leave it to the randomization who is refunded. 6 = Unclassifiable.

A chi-squared test rejects equality of the distributions for both, the comparison of Base vs. AllPay ($p < 0.02$) and of Base vs. NoTransfer ($p < 0.01$).[9] The transfer, if allowed in a treatment, seems to play an important role for cooperation, as in Base and AllPay the predominantly employed patterns are "freeriding but compensating" and the related category 2 ("freeriding but compensating with maximal contributions below 80"). However, being able to compensate is not necessary for cooperation. Average contributions in NoTransfer are relatively similar to Base due to participants employing a comparatively effective pattern like alternating which is highly frequent in NoTransfer but hardly ever occurs in Base.

[8] We also treat a few observations as fitting to this, where one player contributes 80 in the first half of a supergame while the other player does so in the second half.

[9] Here, we treat each pair as one independent observation.

Result 3 *"Compensating" dominates "alternating" in implementing voluntary cooperation when available (treatment* BASE*).*

When comparing ALLPAY with BASE, both cooperative strategies "freeriding but compensating" and "alternating" are more frequently used without refunding. This may be driven by more serious decision making in ALLPAY. In BASE the average lower contribution $min\{c_{1,t}, c_{2,t}\}$ in a pair in the third supergame is still equal to 19.74, while it is 0.99 in ALLPAY (15.57 in NOTRANSFER). The difference of $min\{c_{1,t}, c_{2,t}\}$ between ALLPAY and BASE is statistically highly significant (p-value < 0.01), while it is clearly insignificant when comparing NOTRANSFER and BASE (p-value $= 0.56$). According to Table 4, in BASE and in NOTRANSFER around one fifth of the pairs use the third strategy. Here, often one of the two players symbolically contributes some amount smaller than her partner in order to pretend that they are also willing to cooperate – without any real payoff consequences. To some extent, this reasoning seems to work in establishing efficient contributions but not as well as when contributions are truly costly. In ALLPAY, such cheap talk is costly since there is no refunding. Thus, the "stricter" rules of the ALLPAY treatment discourage cheap measures and thereby make participants focus on establishing efficient voluntary cooperation.

Result 4 *Inclusion of costless messages in the form of lower contributions that are refunded (*BASE *and* NOTRANSFER*) renders voluntary cooperation less efficient than when all contributions are costly (*ALLPAY *treatment).*

Contrary to the solution play, it is not always the second mover who contributes. Considering only strategies 1 to 3, which employ labor division, we find that in 22 out of 34 cases in BASE, in 17 out of 32 cases in ALLPAY, and in 5 out of 10 cases in NOTRANSFER it is indeed the first mover who contributes more. This suggests that player 1 expects player 2 to react reciprocally, either by compensating or by alternating. Contributing nothing as player 1 could be perceived by player 2 as indicating unwillingness to cooperate, which would make player 2 pessimistic about player 1 transferring an appropriate amount when player 2 contributes. By a high contribution, a cooperatively minded player 1 can avoid that player 2 is uncertain about player 1's intentions.

Result 5 *Contrary to the game theoretical prediction, player 1 participants often contribute more than their partner.*

Let us finally explore how endgame behavior for the sequential best shot game depends on the treatment. When voluntary cooperation breaks down toward the end, i.e., when approaching the 20th round, how does this happen? Due to the rather continuous action space ($0 \leq c_k \leq e$ for $k = 1, 2$), the endgame effect might not set in with a complete collapse of voluntary cooperation. Since any breakdown may occur earlier or later, Figure 2 illustrates the maximal and minimal contributions as well as the transfer in the four last rounds in all treatments, separately for the three supergames.

In Base there is a slight decline in the maximum contribution from round 18 to 19 (significant only in the second supergame, $p = 0.05$) and a slightly stronger one from round 19 to 20 (significant only in the third supergame, $p = 0.06$) in all supergames. The minimum contribution does not significantly change during the endgame in either supergame. However, the transfer payment drops significantly from round 18 to 19 and again from round 19 to 20 in all supergames (all p-values ≤ 0.05). Thus, in treatment Base a breakdown of cooperation by the end of a supergame seems to start at the transfer rather than at the contribution stage. In AllPay both the maximum contribution and the transfer decline mainly in the last round of a supergame, an observation that is statistically significant in all supergames.[10] In AllPay an endgame effect therefore concentrates in the last round and seems to be driven by a decline in contributions, which is naturally followed by a reduction of transfer payments. In the NoTransfer treatment, similar to the Base treatment, there is a slight decline in the maximum contribution from round 18 to 19 in the second supergame (p-value = 0.03) and another one from round 19 to 20 in the third supergame (p-value = 0.08).

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[10] The corresponding p-values for the change from $max\{c_{1,19}, c_{2,19}\}$ to $max\{c_{1,20}, c_{2,20}\}$ are 0.1 (1st supergame) and 0.03 (2nd and 3rd supergame). For the change in the transfer payment, the p-values are 0.02 (1st supergame) and < 0.01 (2nd and 3rd supergame).

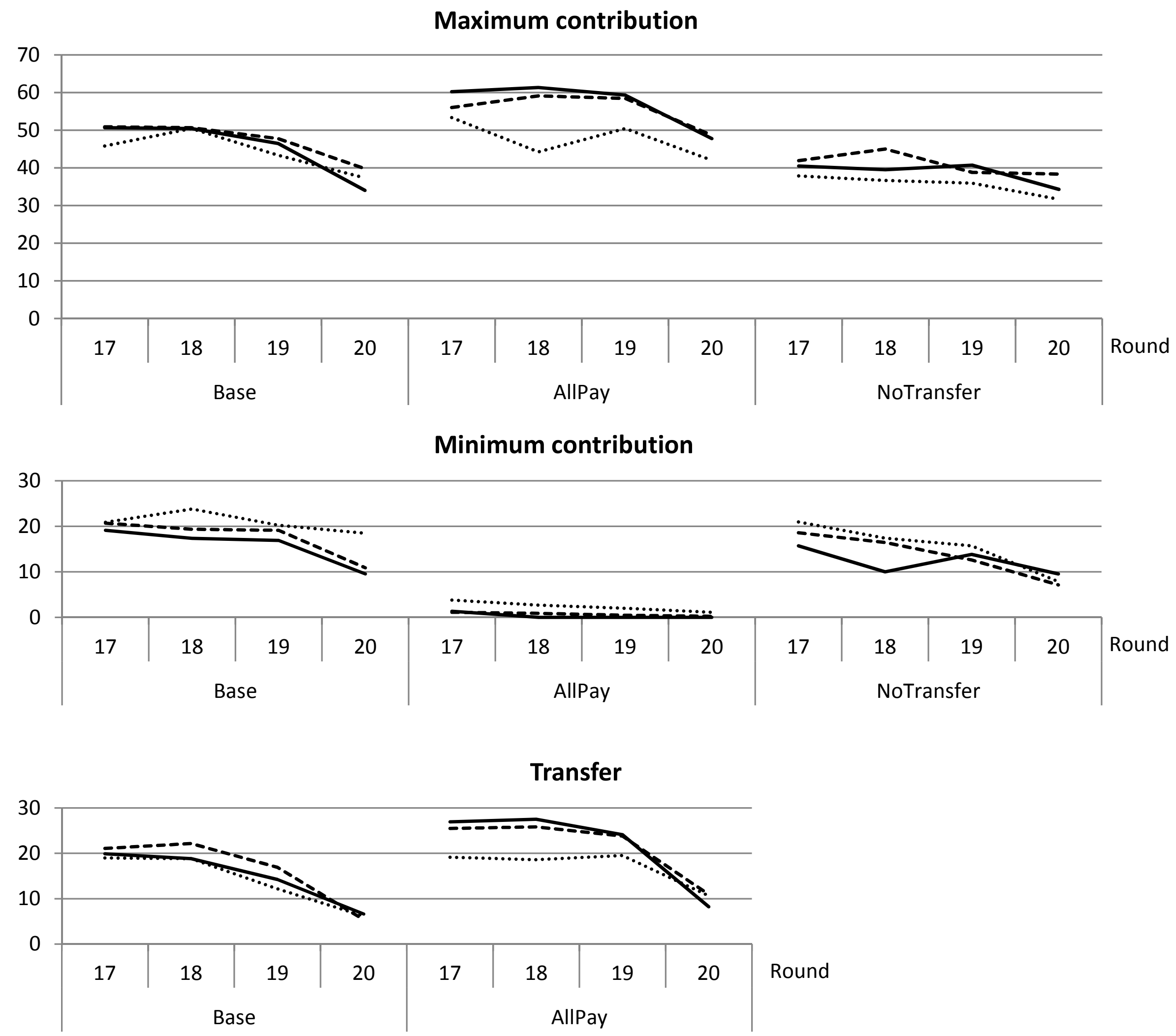

Figure 2: Maximum contribution, minimum contribution, and transfer during the endgame. The dotted line refers to the first supergame of a treatment, the dashed line to the second supergame, and the solid line to the third one.

4 Conclusion

Compared to simultaneously playing a best shot game, sequentially contributing alleviates coordinating voluntary cooperation. To establish constant labor division, the first contributor may simply take on the role of constant contributor until the other fails to compensate. Similarly, to implement alternating, the first mover might begin by contributing. Actually, in more than half of the pairs engaging in constant labor division, player 1 is the constant contributor, and in more than two thirds of the pairs displaying an "alternating" pattern, player 1 is the first contributor. The high efficiency level of all three treatments may thus have been expected.

By our three treatments, we additionally demonstrate that aiming at efficient and fair voluntary cooperation is hardly troubled by any difficulties in implementing it. If compensations are possible, they are used predominantly. If not, players establish alternating. It seems that player 1 bears the main responsibility for the beginning and the level of voluntary cooperation, whereas player 2 determines by compensating rather than alternating that constant labor division should be employed when feasible.

More basically, best shot games differ from the usual social dilemma games (Prisoners' Dilemma, Public Goods, Common Pool resource games) by requiring asymmetric choice behavior when there is voluntary cooperation. In one-shot experiments with such games, this excludes fair and efficient voluntary cooperation, not only game theoretically, as for all social dilemma games, but also behaviorally (see Prasnikar and Roth, 1992) due to the non-convexity of the set of feasible payoff vectors. This non-convexity is partly avoided (in treatments Base and AllPay) by introducing a third stage allowing the lower contributor to compensate the higher one. Played just once, this renders the MSBS scenario a trust game with the innovative feature of two potential trustors who determine endogeneously who becomes the maximal contributor and thus the trustor whom the other might reward by compensating.

In our paper, we did not run a one-shot control experiment of the MSBS scenario, hoping that last round behavior in the supergames would shed at least some light on behavior when voluntary cooperation can no longer rely on the shadow of the future to discourage exploitation attempts. We have commented on this above when discussing endgame behavior. For the repeated sequential best shot game, we could convincingly demonstrate that compensating is mostly used when available but is no "conditio since qua non" for voluntary cooperation. Like lovers managing to come together whenever possible, eager cooperators will find a way to cooperate fairly and efficiently when there is one.

Appendix: Instructions for treatment Base

Welcome and thank you for participating in this experiment. Please read these instructions very carefully. From now on we ask you to remain seated and to stop communicating with other participants. If you have any questions, please raise your hand. We will come to your place and answer your questions in private.

These instructions are the same for all participants.

Your earnings in this experiment will be counted in points. For every 500 points you earn, you will be paid 1 euro in cash directly at the end of the experiment. For showing up you receive an initial endowment of 1,500 points credited to your points account.

You will participate in the following sub-experiment three times. Each sub-experiment consists of 20 rounds. You interact in one sub-experiment repeatedly with the same other participant but in different sub-experiments with different participants. You will not be informed who these other participants are, nor will they learn your identity.

There are two different roles in this experiment. These roles are denoted with 1 and 2. Your role will be assigned randomly at the beginning of the experiment. You then decide only in the role assigned to you. Your role stays the same in all sub-experiments. In the following, the participant who is assigned role 1 or 2, respectively, is called participant 1 or 2, respectively.

In all three sub-experiments, one round consists of three stages. At the beginning of each round, both participants receive 100 points. In the first stage, participant 1 decides how many out of the 100 points he wants to contribute to a joint project (contribution 1). Contributions can only be made in steps of 10. In the second stage, participant 2 is informed about the contribution of participant 1 and decides about his contribution to the project (contribution 2). Here again, contributions can only be made in steps of 10.

The payout from the project is determined depending on the own contribution and that of the other participant. Both participants receive the same payout. The size of the payout depends on the higher of the two contributions, no matter if it was made by participant 1 or 2. The lower of the two contributions does not matter for the payout from the project. The lower contribution is refunded immediately to the participant who made it. If both participants choose the same contribution, a random draw decides who of the two participants (1 or 2) makes his contribution, the other contribution is refunded.

Highest contribution	**0**	**10**	**20**	**30**	**40**	**50**	**60**	**70**	**80**	**90**	**100**
Payout for both participants	0	27	40	47	55	61	67	73	80	83	85

At the end of the second stage, both participants are reminded of their own contribution and informed about the contribution of the other participant. Furthermore, you are informed about the payout from the project for both participants.

In the third stage, the participant who did not pay in anything can make a voluntary transfer payment to the other participant (who made the higher contribution to the project). This payment can amount to between 0 and 100 points.

At the end of each round you learn

- the contribution of participant 1 in the first stage
- the contribution of participant 2 in the second stage
- the amount of the transfer payment in the third stage
- your final profit in the current round
- your current total profit from this sub-experiment (For each sub-experiment the profit is shown separately.)

Your profits from all three sub-experiments are added up at the end of the experiment and paid out to you in cash. The exchange rate is 500 points to 1 euro.

After reading the instructions, you will have the possibility to familiarize yourself with the experiment in two practice rounds. In these practice rounds, you do not interact with another participant but with a computer program. The practice rounds are not relevant for your payoff. Afterwards you will be asked to answer some control questions. Only then will the actual experiment start with the first sub-experiment. After the experiment, we will ask you to answer a short questionnaire.

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