Common Fate, Game Harmony and Contributions to Public Goods: Experimental Evidence*

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Abstract

We experimentally study the effects of common fate on voluntary contributions to linear public goods. In each period, earnings are assigned to subjects according to the outcome of a lottery. We manipulate the level of common fate across treatments by varying the degree of harmony in the lottery structure. We observe higher contributions and stronger reciprocity in the most harmonious manipulation. Surprisingly, we find a positive relation between contributions and having experienced a favourable lottery outcome in the previous period, with the strength of this effect being inversely associated with the degree of harmony.

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Keywords: Public Goods, Common Fate, Laboratory Experiment.

"They have attacked us at Pearl Harbor. We are all in the same boat now!" (Franklin D. Roosevelt, 1941)

1 Common Fate and Contributions to Public Goods.

According to the *common fate* hypothesis, when members of a group are exposed to the same risk, in-group cooperation tends to be stronger.[1] Common fate is expected to induce *group identification*, whereby each individual categorizes others as in-group

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[1] See Bacharach (2006) for a survey of contributions in economics and psychology, and Tan and Zizzo (2008) for a survey of relevant experimental evidence.

or out-group members, and takes on the collective goals of the group as her own. The idea that group-identifying individuals take on group goals has been formalized in the theory of *team reasoning*. In interactions with in-group members, an individual who is motivated by team reasoning does not ask "What should I do?" Instead, she asks "What should *we* do?", and then chooses her component of the profile of actions by group members that best promotes the group's goals. In some versions of the theory, each individual's commitment to team reasoning is conditional on the belief that other group members are similarly committed; this induces reciprocity in pro-social behavior – that is, each individual's behavior is more cooperative, the more cooperative she expects others to be (Sugden, 2003; Bacharach, 2006; Gold and Sugden, 2008). Reciprocity is also predicted by some other theories of non-selfish behavior (Sugden, 1984; Rabin, 1993; Falk and Fischbacher, 2006), but the hypothesis that group identification induces reciprocity is more explicit in the theory of team reasoning.

The public good game is an obvious choice as an experimental design for testing the common fate hypothesis. In the *linear* form of this game, each player $i = 1, .., n$ distributes a fixed endowment I between a *private* and a *group* account. The amount c_i allocated to the latter is interpreted as i's contribution to a public good. Each player's payoff is $(I - c_i) + \frac{\beta}{N}\sum_{j=1}^{N} c_j$, with $1 < \beta < n$. Thus, the Pareto-efficient outcome is for each player to set $c_i = 1$, while the dominant strategy for an individually rational player is to set $c_i = 0$. There is a good deal of evidence that contributions in public good games are increased by manipulations which stimulate group identification (De Cremer and van Vugt, 1998; Cookson, 2000). However, there is very little evidence of the specific effect of common fate on behaviour in public good games.

We know of only one such experiment, that of Brewer and Kramer (henceforth BK; 1986). In this experiment, subjects played a repeated linear public good game. Points accumulated during the experiment were then converted into cash according to an exchange rate determined by the outcome of a lottery. BK manipulated the degree of common fate by using two different lottery structures. In the *common fate* treatment, an "all win or all lose" group lottery was used. In the *independent fate* treatment, there was a separate and independent lottery for each subject. The common fate hypothesis implies that group identification is stronger in the former treatment, since it induces a greater degree of *game harmony* (that is, positive correlation between players' payoffs).[2] BK found slightly higher contributions in the common fate treatment when both were applied to small groups (but not when they were applied to large ones).

However, as evidence of the existence and weakness of the common fate effect, these findings are subject to three qualifications. First, BK's design was based on deception: subjects were told that they were playing against one another and were given feedback about the supposed behaviour of the others, but in reality *"all the feedback ... was predetermined and controlled by the central processing unit"* (BK, p. 545). Second, subjects made all their decisions before having any experience of any lottery. This may have reduced the salience of the distinctive features of the two treatments. Third, BK report only data about total contributions in each treatment. In investigating hypotheses about reciprocity, it is useful to know how the contributions of individual players vary with the previous contributions of their co-players.

[2]The concept of harmony is developed by Bacharach (2006) and Zizzo and Tan (2002).

In this paper, we report a new experiment which is similar to BK's in its basic conception, but not subject to the limitations we have described. We use common fate and independent fate treatments similar to those of BK, but also a new *rival* treatment in which the lottery has a "one wins, others lose" structure, inducing a *negative* correlation between players' payoffs. A natural extension of the common fate hypothesis would imply that, in the rival fate treatment, group identification would be even weaker than in the independent fate treatment.

2 Experimental Design and Behavioral Predictions.

The experiment took place at the EELAB of the University of Milan, Bicocca. We used 216 subjects, mainly students of economics, in nine sessions, three for each treatment. In each session, 24 subjects were randomly and anonymously divided into eight three-player groups, which were fixed for the duration of the experiment. Thus, the experiment generated data from 72 groups, 24 in each treatment.

Each group played a repeated linear public good game, defined by $n = 3$ and $\beta = 3/2$.[3] More specifically, each player's endowment was described to subjects as '100 tokens'. Each token allocated to a player's private account generated two 'points' for that player, while each token allocated to the group account generated one 'point' for each group member. There were 25 periods of the game. After each period, each subject was told the total number of tokens allocated to the group account, and her corresponding *conditional return* (that is, two points for each token in her private account, plus one point for each token in the group account). Her *actual return* for the period was then determined by a lottery in which there was a 1/3 chance of winning the conditional return and a 2/3 chance of winning nothing. The lottery was resolved before the next period began.

In the *common fate* (*CF*) treatment, there was a single lottery with three tickets. One of these tickets was randomly assigned to the group, and then the computer randomly determined the winning ticket. Thus, each subject was credited with her conditional return if and only if other group members were credited with theirs. In the *independent fate* (*IF*) treatment, there was a separate, independent and anonymous lottery for each subject; each such lottery had one winning ticket and two losing tickets. Thus, whether one subject was credited with her conditional return was independent of whether other subjects were credited with theirs. In the *rival fate* (*RF*) treatment, three tickets were randomly distributed between group members in such a way each subject had only one ticket. Thus, each subject was credited with her conditional return if and only the other group members were not *credited* with theirs.

At the end of the experiment, one of the 25 periods was randomly selected and used to determine subjects' final earnings; subjects knew this from the outset. Subjects were paid privately using an exchange rate of 0.10 EUR per point. On average, each subject earned 8.25 EUR plus a show-up fee of 3 EUR. Each session lasted about 50 minutes including instructions. The experiment was computerised using z-tree (Fischbacher, 2007).

[3] An English version of the instructions are reported in appendix.

3 Results.

The experiment was designed as a controlled test for the existence of a common fate effect. Our premise was that, if a common fate effect was at work, the *CF* treatment would show the highest contributions and the strongest reciprocity; the *RF* treatment would be at the opposite extreme, with the lowest contributions and the weakest reciprocity.

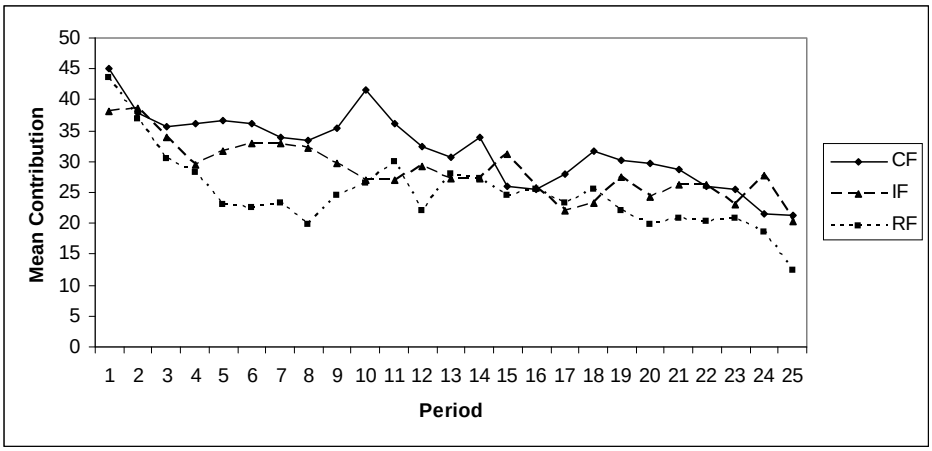

Figure 1: Mean contributions in the three treatments

Figure 1 plots the average contributions in the three treatments over the 25 periods. Averaging across periods, mean contributions (from a budget of 100 tokens) were 32.0 in *CF*, 24.8 in *IF*, and 28.6 in *RF*. The difference between *CF* and *IF* is significant at the 10 per cent level ($p = 0.053$ in a two-sided rank sum test). That contributions are higher in *CF* than in *IF* is consistent with the common fate hypothesis, and with the findings reported by BK. Given this result, and given that the *RF* treatment is the least harmonious of all, it is somewhat surprising that contributions are slightly (but not significantly) higher in *RF* than in *IF*. Further insight can be gained from the panel regression reported in Table 1.

Contributions	(1)	(2)
Others (t-1)	0.075***	0.083***
	(0.009)	(0.016)
Period	-0.443***	-0.522***
	(0.043)	(0.075)
Winner (t-1)	2.394***	0.996
	(0.627)	(1.084)
IF	-6.360**	-9.276**
	(3.301)	(3.963)
RF	-2.703	-2.042
	(3.299)	(4.043)
IF*Winner (t-1)		1.301
		(1.533)
RF*Winner (t-1)		2.972*
		(1.539)
IF*Others (t-1)		0.009
		(0.022)
RF*Others (t-1)		-0.045*
		(0.024)
IF*Period		0.158
		(0.106)
RF*Period		0.071
		(0.106)
Constant	31.697***	32.741***
	(2.527)	(2.871)
Obs.	5184	5184
Wald Chi-sq.	242.81	255.38
Prob. > Chi-sq.	0.000	0.000

Table 1. Two-Way Linear Random Effects Model.

Coefficient estimates (standard errors in parentheses) from a two-way linear random effects model. The dependent variable is individual's contributions over time. *Others (t-1)* is the sum of other group members' contributions in the previous period. *Period* is the time trend. *Winner (t-1)* assumes value 1 in the case of a positive outcome from the lottery in the previous period and 0 otherwise. *IF* and *RF* assumes value 1 if the treatment is *IF* and *RF* respectively and 0 otherwise. *IF*Winner (t-1), RF*Winner (t-1), IF*Others (t-1), RF*Others (t-1), IF*Period* and are *RF*Period* are interaction terms. *,**, and *** denote significance at a level of 10%, 5%, and 1%, respectively.

Specification (1) estimates the separate effects on an individual's contribution in any period 2,...,24 (*Contribtution)*, of the treatment (*IF* and *RF)*, of repetition (*Period)*, of other group members' contributions in the previous period (*Others(t–1))*, and of having been a winner in the lottery of the previous period (*Winner(t–1))*. The negative and significant coefficient for *IF* confirms the existence of a common fate effect with respect to comparisons between the *CF* and *IF* treatments. The negative and highly significant coefficient for *Others(t –1)* shows the general effect of reciprocity. The negative and highly significant coefficient for *Period* replicates an almost universal finding of repeated public good experiments, that contributions decline with repetition.[4] However, we did not anticipate the positive and highly significant effect of *Winner(t–1)*.

Specification (2) adds interaction terms. *Period* and *Others(t–1)* remain highly significant. There are no significant interactions between *Period* and the treatment variables, implying that the tendency for contributions to decline with repetition is constant across treatments. There is no significant interaction between *Others(t –1)* and *IF*; the coefficient for this interaction term is positive but close to zero. However, there is a negative interaction between *Others(t–1)* and *RF*, significant at the 10 per

[4]See Ledyard (1995) for a survey of relevant results.

cent level. The implication is that there is a reciprocity effect in all three treatments, but this effect seems to be stronger in *CF* and *IF* than in *RF*.

Interestingly, the addition of interaction terms makes the coefficient for *Winner(t–1)* insignificant (although still positive); the coefficients for the interaction terms *IF*Winner(t–1)* and *RF*Winner(t–1)* are both positive, and the latter is significant at the 10 per cent level. By combining these findings, we obtain that the coefficient of *Winner(t-1)* is 2.298 in *IF* (*p-value*<0.05) and 3.968 in *RF* (*p-value*<0.01). Moreover, a test for linear combinations does not rejects the hypothesis that coefficients of *Winner(t-1)* in the two treatments are the same (*p-value*=0.278). Thus, the tendency for 'winners' to contribute more than 'losers' is a treatment-specific effect, occurring principally in *RF*.

4 Discussion and Conclusions.

The most surprising finding is the effect of winning in one period on contributions in the next. Had this *winner effect* been constant across treatments, it might have been explained as a response to the different affective experiences of winning and losing. There is a good deal of evidence that, other things being equal, individuals' decisions vary with their affective states[5] and one might conjecture that positive affect tends to induce pro-social behaviour. Alternatively, one might conjecture that individuals think of contributing as a risky strategy, and follow some heuristic which makes them more likely to repeat this strategy if it is successful in terms of actual returns. But, given that the winner effect is particularly strong in *RF*, it seems better explained as a response to differences between the returns earned by different group members. That is, individuals tend to make larger contributions following the experience of *winning when others lose*.

In principle, such behaviour might be motivated by aversion to inequality (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000). However, this explanation does not fit well with results from other experiments which have tested for inequality aversion. Inequality aversion has been found not to account for subjects' behavior in public goods experiments with heterogeneous endowments (Buckley and Croson, 2006); and subjects tend not to show inequality aversion when unequal payoffs are imposed by fair random procedures (Bolton et al., 2005). We conjecture that an additional factor is at work in our experiment. In the *RF* treatment (and, to a lesser extent, also in the *IF* treatment), subjects who are not merely the lucky recipients of a random transfer *from the experimenters*. What they have gained by winning the lottery is partly the product of contributions to the group account from people who have gained nothing. Thus, winners may feel that losers are entitled to some share of their gains. This motivation might be interpreted as a form of *trust responsiveness* (Pelligra, 2005; Bacharach et al, 2007) or *guilt aversion* (Battigalli and Dufwenberg, 2007). Alternatively, it might be seen as team reasoning (in sharing the proceeds of joint action, the winners are playing their parts in achieving the group's goals).

The upshot of this is that BK's apparently clever design may be vulnerable to a previously unrecognised confounding effect. The lottery manipulations which induce different degrees of correlation between subjects' payoffs may not only affect group identification, but also activate motivations to counteract inequalities generated by those

[5]For more on the relationship between affect and decision, see Lyubomirsky and King (2005).

manipulations. This effect may raise contributions in the less harmonious treatments, offsetting the common fate effect.

Our panel regression analysis allows us to isolate the winner effect. After controlling for this effect, we find that contributions are significantly higher in the *CF* treatment than in the *IF* treatment. This confirms BK's specific hypothesis that, in public good games, a common fate manipulation tends to increase contributions. However, we find only partial support for the more general hypothesis that contributions and reciprocity are positively related to game harmony.

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Appendix: Instructions of the Experiment.

[Instructions were originally written in Italian.]

[In all treatments]

Welcome! Thanks for participating in this experiment. By following these instructions carefully you can earn an amount which will be paid in cash at the end of the experiment. During the experiment you are not allowed to talk or communicate in any way with other participants. If you have any question raise your hand and one of the assistants will come to you to answer it. The following rules are the same for all participants.

General Rules

The experiment consists of 25 periods. At the beginning of the experiment you will be randomly and anonymously assigned to a group of three subjects. Of the other two subjects in your group you will know neither the identity nor the earnings. Finally, the composition of your group will remain unchanged during the 25 periods of the experiment.

How to determine your earnings

In each of the 25 periods you have to decide how to allocate an endowment of 100 tokens between a PRIVATE ACCOUNT and a COLLECTIVE ACCOUNT. Each of the two accounts generates a return which is expressed in points. In particular:

- each token allocated by you to the INDIVIDUAL ACCOUNT generates a return for you of 2 points;
- each token allocated by you or by any other of the members of your group to the GROUP ACCOUNT generates a return for you and for every other member of your group of 1 point.

[In CF]

In each period, the returns generated by the two accounts will be assigned according to the outcome of a lottery. At the end of each period, one of three lottery tickets (numbered from 1 to 3) will be assigned to your group randomly and with equal probability. Then, the computer will select the winning ticket among the three tickets, randomly and with equal probability. If your group has the winning ticket, each member of your group will receive in that period the points generated by the two accounts. Otherwise, if your group does not have the winning ticket, none of your group will receive any of the points generated by the two accounts in that period.

At the end of each period, you will be shown three screens. In the first screen, you will see how many tokens you have allocated to the two accounts, the total number of tokens allocated by the members of your group to the GROUP ACCOUNT and the number of points generated by the two accounts before playing the lottery. In the second screen, you will be shown the ticket assigned to your group. Finally, in the last screen you will be shown the outcome of the lottery and the corresponding number of points obtained in the period.

[In RF]

In each period, the returns generated by the two accounts will be assigned according to the outcome of a lottery. At the end of each period, the computer will assign randomly and with equal probability one of three tickets (numbered from 1 to 3) to each subject of your group. Then, the computer will select the winning ticket among the three tickets, randomly and with equal probability. The holder of the winning ticket will receive in that period the points generated by the two accounts. The other subjects in your group will receive none of the points generated by the two accounts in that period.

At the end of each period, you will be shown three screens. In the first screen, you will see how many tokens you have allocated to the two accounts, the total number of tokens allocated by the members of your group to the GROUP ACCOUNT and the number of points generated by the two accounts before playing the lottery. In the second screen, you will be shown the ticket assigned to you. Finally, in the last screen you will be shown the outcome of the lottery and the corresponding number of points obtained in the period.

[In IF]

In each period, the returns generated by the two accounts will be assigned according to the outcome of a lottery. At the end of each period, the computer will assign randomly and with equal probability one of three tickets (numbered from 1 to 3) to you. Then, the computer will select the winning ticket among the three tickets, randomly and with equal probability. If you hold the winning ticket, you will receive in that period the points generated by the two accounts. Otherwise, if you do not hold the winning ticket, you will not receive any of the points generated by the two accounts in that period. Your lottery is indipendent from those of the other subjects in your group. Thus, each subject in your group will participate in a lottery the outcome of which, although determined on the basis of the same rules, is indipendent from those of the lotteries of the other subjects in your group.

At the end of each period, you will be shown three screens. In the first screen, you will see how many tokens you have allocated to the two accounts, the total number

of tokens allocated by the members of your group to the GROUP ACCOUNT and the number of points generated by the two accounts before playing the lottery. In the second screen, you will be shown the ticket assigned to you. Finally, in the last screen you will be shown the outcome of the lottery and the corresponding number of points obtained in the period.

[In all treatments]

At the end of the experiment, the computer will select randomly and with equal probability one of the 25 periods. The points obtained in the selected period will be converted in Euros at the rate 10 points = 1 Euro. The corresponding amount will be paid to you in cash at the end of the experiment.