Destructive Behavior in a Fragile Public Good Game

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Abstract

Socially destructive behavior in a public good environment – like damaging public goods – is an underexposed phenomenon in economics. In an experiment we investigate whether such behavior can be influenced by the very nature of an environment. To that purpose we use a Fragile Public Good (FPG) game which puts the opportunity for destructive behavior (taking) on a level playing field with constructive behavior (contributing). We find substantial evidence of destructive decisions, sometimes leading to sour relationships characterized by persistent hurtful behavior. While positive framing induces fewer destructive decisions, shifting the selfish Nash towards minimal taking doubles its share to more than 20%. Female subjects are found to be more inclined to use destructive decisions. Finally, subjects' social value orientation turns out to be partly predictive of (at least initial) destructive choices.

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1 Introduction

Many experimental economic studies have investigated the development of cooperation in a social dilemma or public good environment, and the effect of punishment mechanisms in this context (for a recent survey, see Chaudhuri, 2011). In the real world, however, people can often cooperate with or hurt one another. Interpersonal relationships may even turn sour and induce persistent destructive behavior. Repeated and severe conflict is a very real part of human interaction. Examples are neighborhood conflicts, family feuds, or the destruction of public property by protesters during riots In some studies, a substantial proportion of individuals engaged in the destruction of others' earnings, even when rank egalitarianism and reciprocity motives where not present and when the destruction was costly (Zizzo, 2003; Abbink and Sadrieh, 2009). To study whether destructive behavior can be experimentally observed and modulated in a public good environment we designed a 'fragile public good' (FPG) game. A key feature of our FPG game is that it gives as much room for destructive behavior (taking) as for for constructive behavior (contributing). More formally, it does so by shifting both the (standard) Nash equilibrium and the status quo – i.e., the initial allocation of tokens to the common account – to the middle of the action space, with perfect symmetry in the marginal cost of taking and contributing. Contrary to the relatively few existing public good experiments that allow for an interior Nash equilibrium (see surveys by Laury and Holt, 2008, and Saijo, 2008), we particularly focus on destructive actions in a repeated context where subjects can identify the individual decisions of others.

Because framing can influence behavior in public good games (Brewer and Kramer, 1986; Sonnemans et al., 1998; Willinger and Ziegelmeyer, 1999; for a survey, see Cookson, 2000), we study the sensitivity of our findings in two additional treatments, where we separate the status quo from the Nash outcome. In one case, we move the status quo to a corner so that subjects can only contribute, keeping everything else the same; this is a case of positive framing which - in light of the literature - may induce subjects to contribute more. In the other case, we minimally move the Nash outcome away from the status quo towards taking by introducing a slight payoff asymmetry. Here the Nash choice may be read as aggression by subjects using the status quo as a reference point and induce more destructive behavior.

Our main questions are: (1) does the FPG game generate destructive behavior and even cases where behavior equilibrates towards sour relationships?; (2) how does separating the Nash outcome from the status quo through framing or some minimal payoff asymmetry modulate taking and contributing? After the experimental design we present our results, followed by a summary of our main findings.

2 Experiment

Subjects played the FPG game in fixed dyads over 35 rounds in all three treatments.

2.1 Symmetric Treatment (SYM)

In each round both subjects of a dyad are endowed with a private account holding 7 tokens, earning 10 units each, and a common account holding 14 tokens, earning 10 each for *both* subjects. Subjects can contribute to or take up to 7 tokens from the common account, at increasing marginal costs: moving one token costs 2 units, while the marginal transfer cost of each additional token increases by 2[1]. Earnings are symmetric around the status quo which coincides with the selfish Nash outcome, while any combination of contributions of 4 or 5 is socially optimal.

2.2 Framing Treatment (FRAME)

In FRAME subjects have exactly the same strategy space and equivalent earnings, but now they start each round with 14 tokens in their private accounts and the common account is empty. Thus, to reach an outcome equivalent to an outcome in SYM, subjects would have to contribute 7 more tokens than before[2]. Because now only contributions can be made, this is a case of positive framing.

2.3 Asymmetric Treatment (ASYM)

ASYM differs from SYM in only two respects: tokens in the private account earn subjects 11 units instead of 10, and the first token transferred in either direction has zero costs. As in FRAME, the Nash equilibrium does not coincide with the status quo, but now it is the former that moves by prescribing to take one token out of the common account, while both subjects contributing 5 tokens is the social optimum[3].

Subjects did not see the underlying formulas, but were supplied with graphs illustrating the marginal effects of every decision for themselves and the other, alongside with payoff tables[4].

The public good game was preceded by a test of social value orientation (SVO; see Liebrand and McClintock, 1988, taken from Van Dijk et al., 2002). This test measures the preferences of subjects for

[1]Formally, we use the following payoff function, where c_i can be positive or negative: $V_A(c_A, c_B) = 10(14 + c_A + c_B) + 10(7 - c_A) - (|c_A| + c_A^2)$. See figure 4 in appendix.

[2]Payoff function: $V_A(c_A, c_B) = 10(c_A + c_B) + 10(14 - c_A) - (|c_A - 7| + (c_A - 7)^2)$

[3]Payoff function: $V_A(c_A, c_B) = 10(14 + c_A + c_B) + 11(7 - c_A) + |c_A| - c_A^2$

[4]Instructions are available upon request.

distribution outcomes for themselves and a (generalized) other. We use this measure to see whether it can explain behavior in the game. Sessions were run in November and December 2012 and April 2013 at the CREED-lab in Amsterdam. SYM had 130 participants (50% female, 2% unreported gender, average age 22.2), FRAME 54 (41% female, average age 21.5), and ASYM 80 (43% female, average age 21.5). The experiment had an additional second part, which we do not cover in this paper. The exchange rate of units into euros was 700 to one. Subjects earned on average 1.45 euro in the SVO-test and 10.82 euro in the public good game.

3 Results

Table 1 gives an overview of average contributions, where we adjust for the Nash equilibrium (NE) in each game by subtracting 7 tokens from results in FRAME and adding 1 to results in ASYM.

Table 1: Average contributions

Average Contribution	SYM	FRAME	ASYM
Overall	2.28 (2.01)	2.07 (1.69)	1.83 (3.3)
First round	1.26 (2.55)	-0.02 (2.55)	0.92 (3.06)
Rounds 26-34	2.44 (2.35)	2.49 (3.85)	2.13 (3.85)
Last round (35)	0.68 (2.43)	0.98 (1.81)	0.31 (3.81)
Females	1.94 (2.08)	2.02 (1.85)	0.67 (3.28)
Males	2.61 (1.91)	2.10 (1.59)	2.68 (3.09)

Note: adjusted for the (standard) Nash equilibrium; standard deviation in parentheses, with dyad averages as separate observations.

Across all rounds average contributions are approximately 2 tokens above the Nash-prediction in all treatments. The first round, however, reveals a different pattern as the average contribution in FRAME is significantly lower than in SYM ($p = 0.001$)[5]. Because SYM and ASYM are more similar to a taking game than FRAME (where only contributions are possible), this result contrasts with the general finding that there are typically lower contributions in taking framings, if there is any difference (Andreoni, 1995; Sonnemans et al., 1998; Goerg and Walkowitz, 2010). Khadjavi and Lange (2013) have a treatment with intermediate endowments similar to our SYM and ASYM treatments and find no differences between a

[5]We use the Mann-Whitney U-test with dyad averages as observations unless otherwise mentioned.

contributing frame and this alternative.

Subjects appear to be reluctant to contribute early on in the positive framing treatment, but are able to compensate for this throughout the game, as the difference stays significant at 1% up until the fifth round of the game.

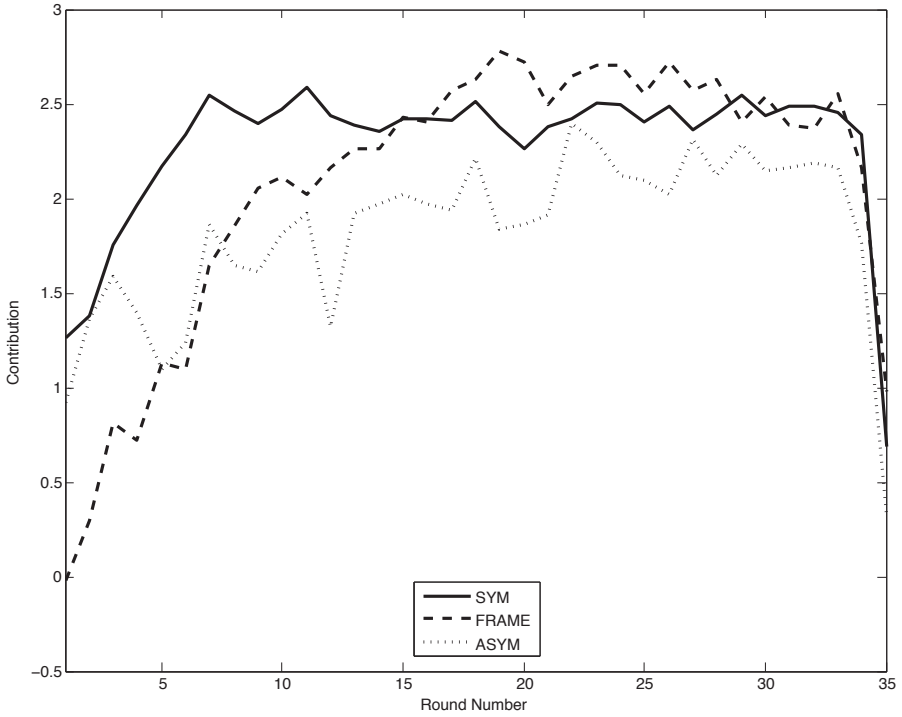

Figure 1: Average contributions, relative to Nash equilibrium

All treatments show an increase in average contributions over time until the (usually observed) sharp decline at the end which is not significantly different across treatments; see figure 1[6]. A simple regression shows significant positive time trends. Although the increase is at odds with the general observation of decreasing cooperation in public good experiments (Ledyard, 1995), it has been observed before in repeated two-player games using a comparable mechanism (Van Dijk et al., 2002). Interestingly, comparing SYM and ASYM, the hypothesis of equal contributions is rejected if they are calculated relative to the status quo ($p = 0.035$), but not relative to the Nash equilibrium outcome, which may suggest that the latter is a more important reference point.

[6]Contributions in the last round are lower than in the ten rounds before ($p < 0.01$ in all treatments)

Table 2: Percentage of destructive decisions

Percentage of destructive decisions	SYM	FRAME	ASYM
Overall	11.25%	6.93 %	21.14%
Last round	13.9%	5.36%	25%
Females	15.33%	10.26%	30.25%
Males	7.33 %	4.64%	14.41%

More relevant to the topic of this paper is the occurrence and development of destructive behavior hurting both partners. Relative to all decisions, destructive decisions count 11% in SYM, 7% in FRAME, and 21% in ASYM; see table 2. The percentages of subjects choosing below the Nash at least once are, respectively, 42%, 46%, and 56%. The higher number of destructive decisions in ASYM, despite similar average contribution levels relative to the Nash outcome (see table 1), suggests distributional differences. Indeed, the variance of subjects' decisions is larger in ASYM than in SYM and FRAME in 31 of the 35 rounds (Levene's test, $p < 0.01$; see also figure 2). Interestingly, this difference only becomes significant from the third round onwards, which indicates that it is at least partly driven by the dynamics in the game. Not only the variance across subjects, but also the variance within each subject's set of 35 decisions is greater in ASYM[7]. Summing the number of destructive contributions of each dyad we find a difference only between SYM and ASYM ($p = 0.094$). Interestingly, the generally higher level of conflict observed in ASYM is also confirmed by the observation that the percentage of destructive decisions in the last round (when there are no strategic considerations present) is higher in ASYM than in the other treatments, and even a bit higher than the overall percentage in this treatment.

[7]Means of within-subject variances: 2.57 in SYM, 2.54 in FRAME, and 4.59 in ASYM. The differences between SYM and ASYM ($p < 0.001$) and FRAME vs ASYM ($p = 0.038$) are significant.

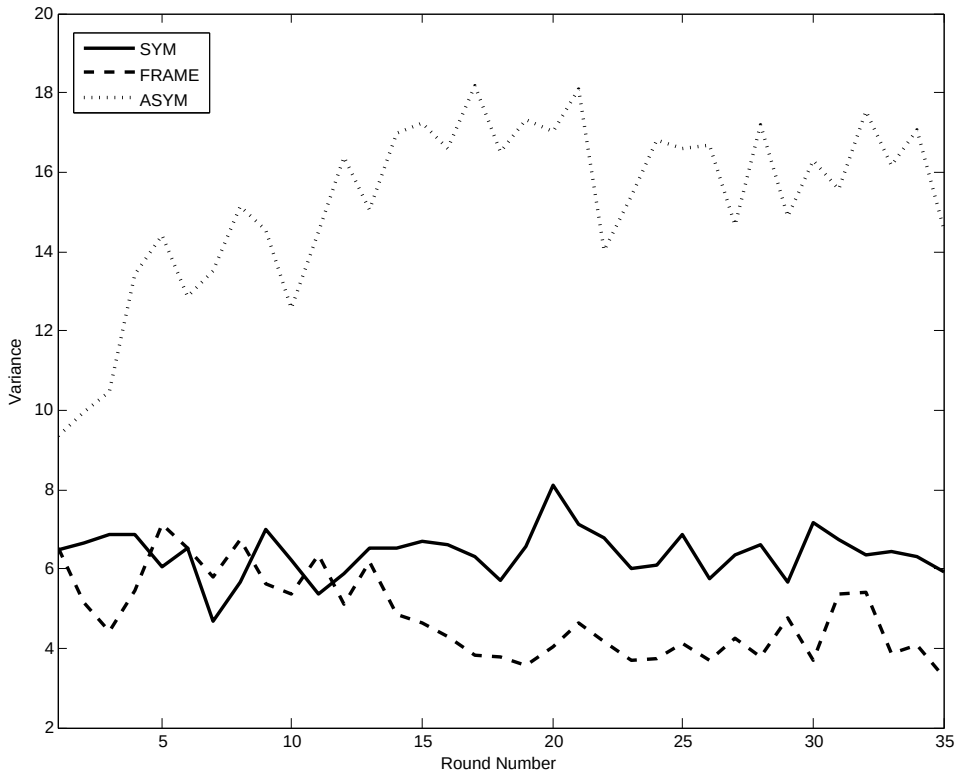

Figure 2: Between-subject variance across treatments/rounds

It appears that sour relationships do indeed develop in our FPG game. We take as criterion that both partners in a dyad make destructive decisions in at least 5 of the last 10 rounds, which happened with 8% of the dyads in SYM and with 18% in ASYM, but with none in FRAME (0%). Figure 3 shows two examples of equilibration towards a sour relationship in SYM.

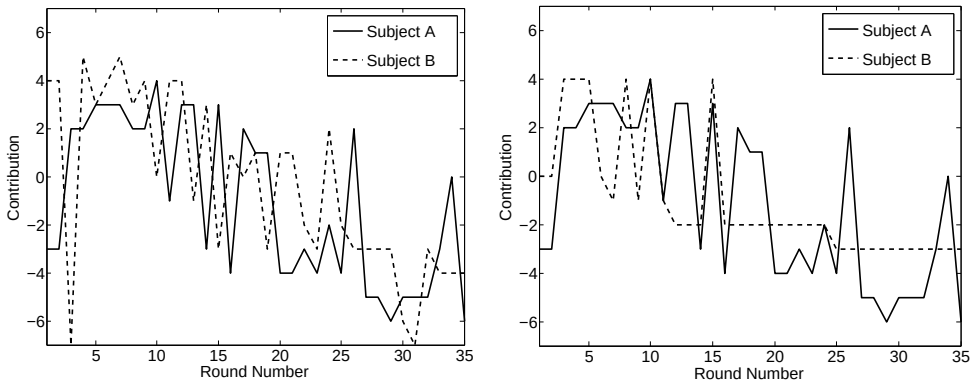

Figure 3: Examples of sour relationships in SYM

Interestingly, we also find evidence of a gender effect. The figures in table 2 suggest that female subjects use the option to destroy more frequently. Separating the dyads into female-female (FF), female-male (FM), and male-male (MM) groups we find that the groups with only female participants

show a significantly higher average number of destructive decisions and a lower average contribution level in SYM and ASYM, but not in FRAME, where subjects can only contribute[8]. This is at odds with Fujimoto and Park (2010), who find higher contributions from women in a taking treatment, but not in a giving treatment. Our result is consistent, though, with findings in the literature on public good games (Croson and Gneezy, 2009; DellaVigna et al., 2013) that females seem to react stronger to modifications in framing and other game features than men.

Table 3: Correlations with SVO (Spearman)

Correlation with SVO	SYM	FRAME	ASYM
Contribution first round	0.30***	0.23*	0.31***
Contribution first 5 rounds	0.11	0.31**	0.36***
Average contribution	0.06	0.29**	0.40***
Number of destructive decisions	0.04	-0.24*	-0.34***

Note: $^{*}: p \leq 0.1$; $^{**}: p \leq 0.05$; $^{***}: p \leq 0.01$

Our final result is that the social value orientation (SVO) of subjects correlates with their (overall) average contributions in the FRAME and ASYM treatments, but only with first round contributions in SYM[9]. It appears that in the alternative versions of the game the subjects' SVO had a stronger influence on the development of their relationship with their partner, and is predictive of the number of destructive decisions, although the correlation coefficients are still relatively low.

4 Conclusion

This study shows that substantial destructive behavior can occur even in a public good environment once the opportunity to do so is present. Our baseline Fragile Public Good game – offering players equal room to take from or contribute to a public good, against fully symmetric marginal costs – showed more than 10% destructive decisions. While, unexpectedly, positive framing had significant negative effects on contributing in the early rounds of the game, players compensated for that later on, such that on average

[8]FF vs. MM in SYM: number of destructive decisions - p = 0.017; average contributions - p = 0.046; FF vs. MM in ASYM: p = 0.041 and p = 0.011. In ASYM the difference in average contribution between FF and FM dyads is also significant (p = 0.025). See figure 5 in appendix.

[9]We exclude subjects whose answers in the different questions making up this measure were below a threshold for answer consistency, a vector length of 700 or less of the maximum 1,000 (Liebrand and McClintock, 1988), and had to exclude four subjects due to technological problems, leaving 123 subjects in SYM, 52 in FRAME, and 70 in ASYM

fewer destructive decisions were observed. Introducing a slight asymmetry by minimally separating the selfish Nash outcome from the initial status quo towards taking one token sharply increased the share of destructive decisions to more than 20% (even in the last round). The FPG game further showed that destructive behavior need not only occur incidentally or intermittently but may also lead to sour relationships, characterized by equilibration towards persistent destructive behavior. Finally, we found evidence of a gender effect, with female subjects being more inclined to make destructive decisions, and that people's social value orientation is predictive of (at least initial) destructive choices in the game.

Appendix

Choice Player 2

Choice Player 1	7	6	5	4	3	2	1	0	1	2	3	4	5	6	7
	← Take														Contribute →
7	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224
6	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238
5	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
4	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
3	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268
2	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274
1	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278
0	140	150	160	170	180	190	200	210	220	230	240	250	260	270	280
1	138	148	158	168	178	188	198	208	218	228	238	248	258	268	278
2	134	144	154	164	174	184	194	204	214	224	234	244	254	264	274
3	128	138	148	158	168	178	188	198	208	218	228	238	248	258	268
4	120	130	140	150	160	170	180	190	200	210	220	230	240	250	260
5	110	120	130	140	150	160	170	180	190	200	210	220	230	240	250
6	98	108	118	128	138	148	158	168	178	188	198	208	218	228	238
7	84	94	104	114	124	134	144	154	164	174	184	194	204	214	224

Take ↑ (rows 5–3) / Contribute ↓ (rows 2–5)

Figure 4: Earnings of player 1, SYM

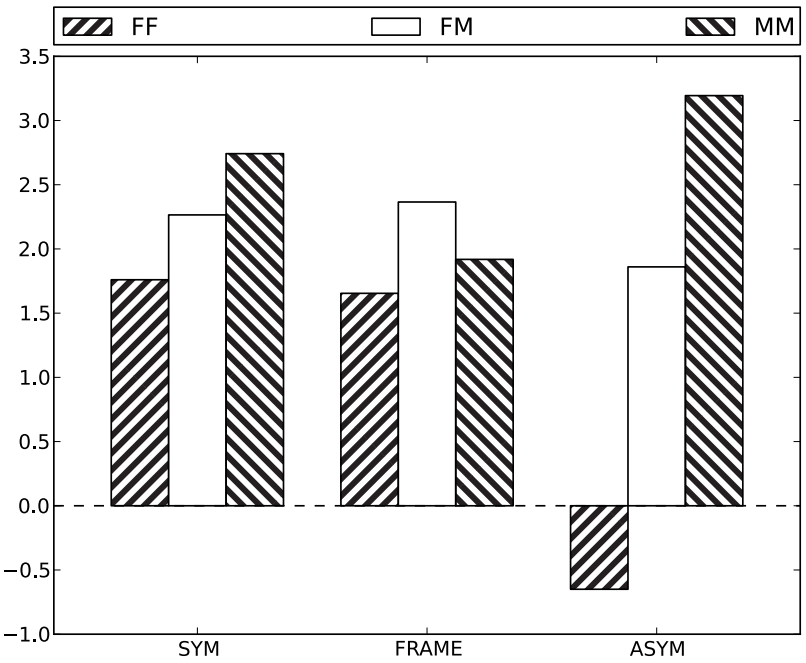

Figure 5: Average contributions separated by gender, adjusted relative to (standard) Nash Equilibrium

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