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Abstract

Extending the power-to-take game, we explore the impact of two forces that may shape retaliation. In our 2x2 design, i) in addition to taking, the proposers can give part of their endowment to the responders, and ii) in addition to destroying their own endowment in retaliation, the responders can destroy the proposer's endowment. Although these added options lead the responders to retaliate more severely, they do not significantly influence the proposers' behavior. It is only when the proposers can give, and the responders can concurrently destroy the endowment of the proposers that the proposers take significantly less from the responders.

JEL-Codes: A120, C720, C910.

Keywords: power-to-take, giving, emotions, retaliation, experiment.

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1 Introduction

A rich literature in economics demonstrates that a large percentage of individuals exhibit other-regarding preferences and are often willing to sacrifice own resources in order to punish others who have treated them unfairly (for an overview, see Drouvelis, 2021). This behavioral regularity has been observed even in one-shot situations where individuals reap no future material benefit from punishing others. For example, decades of research has shown that the overwhelming majority of the proposers in the ultimatum game offer between 40% to 50% of the available surplus, and typically any offers below 20%, which are perceived to be unfair, are rejected (Oosterbeek et al., 2004).

While observing behavior in the standard ultimatum game provides us with useful insights into punishment when individuals can give money to others, it tells us nothing about how people retaliate when take options are present. A useful tool for investigating this issue is the so-called 'power to take' game which was introduced by Bosman and van Winden (2002).

In its standard format, individuals in the power-to-take game are endowed with a fixed amount of money and the proposer decides on a 'take rate' (say t) which is a fraction of the responder's endowment. Following this, the responder is informed of the take rate, and decides how much of their own endowment to destroy (say d). Destruction behavior, thus, provides us with a simple measure of retaliation which continuously varies with the take rate.

Previous research confirms that the take rate is around $t = 0.8$ and the destruction rate is roughly $d = 0.5$ (see Fehr and Schmidt, 2006). This result is robust regardless of whether subjects earn their endowment or the experimenter exogenously allocates the endowment to subjects (Bosman et al., 2005). While negative reciprocation is a commonly observed behavioral pattern in the power-to-take game, existing studies have found that it is also sensitive to various elements within the decision-making environment. For example, Galeotti (2015) finds that a large part (around 70%) of the punishment behavior observed in previous power-to-take studies can be explained by the technology of the punishment adopted. Bosman et al. (2017) show that stake sizes do matter: when the stakes are high, there is less destruction for low and intermediate take rates, and more destruction for high take rates. Introducing waiting times significantly reduces the overall probability of destruction and responders destroy more often when the take rates are higher and the waiting time is longer (see Galeotti, 2013). The importance of gender pairing is explored in Sutter et al. (2009), where more retaliation is observed when the bargaining partners have the same gender, compared to when they have the opposite gender.

In our paper, we broaden the existing literature by considering two surprisingly understudied dimensions of bargaining behavior that might affect retaliation behavior. First, we consider the impact of giving opportunities in the power-to-take game on retaliation. In its standard format, the game allows the proposer to take resources from the responder. However, a significant quantity of research in bargaining (mainly stemming from the ultimatum games; for an overview, see Güth and Kocher, 2014) considers play when proposers can give positive amounts to others and finds significant levels of sharing among players. This leaves open the question of whether and how the presence of giving opportunities affects retaliation behavior. Additionally, our research is motivated by previous evidence from dictator games where retaliation is absent. The existing evidence demonstrates that individuals have context-dependent preferences and, in particular, in the presence of taking opportunities, the level of giving reduces significantly (e.g., List, 2007; Bardsley, 2008; Cappelen et al., 2013; Drouvelis, 2023). However, little is known about the reverse relationship: how does the possibility of giving affect taking behavior when retaliation is possible? Our natural starting point is, thus, to examine the power-to-take game where the existing literature provides us with a reliable baseline from which to understand taking and to build upon it by introducing giving opportunities.

From a selfish economic perspective, the actions of giving and taking have identical payoff consequences, assuming individuals care about maximizing their own welfare. However, from a psychological perspective, giving and taking are perceived to be two distinct sets of actions. For example, actions of giving in public good games (see Andreoni, 1995) have been interpreted as generating warm-glow feelings, which lead to higher cooperation levels in public good games, as compared to cold-prickle effects due to taking behavior. Subsequent work by Cubitt et al. (2011) finds no significant differences in punishment responses between give and take frames in one shot-games, suggesting that negative reciprocity is not sensitive to give and take options. Using a trust game, Bohnet and Meier (2005) show that trustworthiness (as a behavioral indicator of positive reciprocity) crucially depends on whether the trustor can give to or take money from the trustee. Specifically, lower reciprocity is observed in the latter compared to the former case. This paints a mixed picture of whether reciprocal behavior is affected by giving and taking options, calling for the need to investigate this issue more systematically.[1]

To deepen our understanding of how reciprocity is shaped in the presence of giving and taking opportunities, our experiment considers another dimension that has, thus far, been overlooked by existing studies: the type of retaliation. While the standard setting of the power-to-take game explores only costly retaliation (namely, the responders can destroy part of their own endowment), it follows naturally to ask whether and how the presence of costless retaliation (namely, when the responders can destroy part of the proposer's endowment) influences the behavior of the proposers. One may expect that when the retaliation is costless for the responders, they will retaliate much more frequently than when it is costly (see, e.g., de Quervain et al., 2004, in a neuroeconomic study based on a trust game experiment).[2]

[1]It is worth noting that in these studies subjects are given the opportunity to either give or take. The case where both actions can occur simultaneously has received little attention in the literature (e.g., Bardsley, 2008).

[2]Accordingly, the literature has focused on costly punishment and has investigated, among others, the motives behind punishment behavior (Bone and Raihani, 2015; Raihani and Bshary, 2019). An exception is Kuwabara and Yu (2017). These authors compared the costly and costless punishment in a public good game and found that participants

Thus, this would make proposers refrain from taking. Surprisingly, however, we did not find any experimental test of this simple prediction.[3] Thus, we have decided to investigate this in detail.

To address our research question, we design a 2x2 between-subjects experiment. As a baseline treatment, our experiment considers a standard power-to-take game as earlier outlined. Recall that, in this game, the proposers can take part of the responder's endowment and, in turn, the responders can retaliate by destroying their own endowment (costly retaliation). In one treatment arm, we augment the proposer's actions by considering giving options (namely, the proposer can either take part of the responder's endowment or give part of their own endowment to the responder). In another treatment arm, we augment the responder's actions by considering costless retaliation (namely, the responders can destroy part of the proposer's endowment or their own endowment).

Based on the existing literature on the dictator game with an option to take, we hypothesize that the responders retaliate more severely to the

punished low contributors more when it was costly to do so than when it was costless. They interpreted this from the legitimacy of punishing behavior. Namely, the act of punishing is not considered to be legitimate when it is costless to do so.

[3] de Quervain et al. (2004) consider a simplified trust game in which player A had the option to either trust or not trust player B, who in turn had the option to either act in a trustworthy manner or not. However, their analyses focused on player A, who faced non-trustworthy player B in four different conditions regarding the effectiveness and cost of punishment. It also focused on whether the choice of player B was made by player B themselves, or by a random device. Thus, it does not report on the effect of the availability of the costless punishment on the behavior of player B.

proposers' decisions to take their endowment when the proposers have the option to give, than when they do not. Furthermore, based on the existing literature on the dictator game and the ultimatum game, we also hypothesize that when the responders have the option to costlessly retaliate, the proposers take less from the responders, compared to when the responders do not have such an option.

Our main findings show that, consonant with the existing power-to-take studies, proposers take, on average, 62% of the responder's endowment. However, most of the responders do not destroy their own endowment in retaliation. The few who do, on average, destroy 68% of their own endowment. The presence of giving opportunities alone, however, makes little difference to the proposer's behavior, despite the fact that the responders retaliate more severely in such cases by destroying their own endowment, than when they do not have the option to give. This is in contrast with the literature on the dictator games where there is an option to take (List, 2007; Bardsley, 2008; Cappelen et al., 2013; Drouvelis, 2023) and these show the behaviors of dictators being greatly influenced by the availability of a taking option.

Furthermore, to our surprise, the opportunity for responders to costlessly retaliate alone does not have a significant impact on the proposer's behavior. This is despite the fact that the responders retaliate significantly more frequently by destroying the proposer's endowment in such cases, than when there is no option to costlessly retaliate.[4] Only with the presence of both the possibility for responders to costlessly retaliate and for proposers to give does the behavior of the proposers change significantly, causing the overall take rate to reduce to less than 30%.

We believe that our results can be explained as follows: without the option to costlessly retaliate, the cost of punishing proposers who take is high for responders. Anticipating that responders will not retaliate, proposers take from them even when they have the option to give. When responders have the option to costlessly retaliate, however, an act of taking by proposers who have the option of giving invites severe retaliations from responders. This is because such behavior is considered to be highly socially inappropriate (Krupka and Weber, 2013). Anticipating harsh punishments in response to taking, proposers do not take. In the absence of the option to give, the act of not giving is considered to be less socially inappropriate. Anticipating, perhaps wrongly, that taking would not invite harsh punishments, proposers take from the responders.

Our paper is organized as follows. Section 2 outlines the experimental design and procedures. Section 3 presents our results and Section 4 concludes.

[4] There is a tendency for the choices of the proposers to become more extreme, i.e., to take all or to take nothing, when such an option is available. However, the choices of proposers do not differ significantly between the two treatments with and without such an option for responders.

2 Experimental Design

The main framework that we consider in our experiment is a one-shot 'power to take' game (PTG) as introduced by Bosman and van Winden (2002). The basic structure of this framework involves a simple two player game, with each player being randomly assigned one of two roles: either a 'proposer' or a 'responder' (called player 1 and player 2, respectively, in the instructions).

At the beginning of the game, each player earns their own endowment by performing a real effort task. The maximum value of the endowment they can earn is 1,000 Japanese Yen (JPY).[5] Participants are informed that the endowment they will have in the PTG (without receiving information about what this is) is determined based on their performance in the real effort task. We employ a similar task as the one used in Kamei and Markussen (2022). Subjects face randomly formed sequences consisting of ten 0/1 digits and must correctly count the number of 1s. The task is set so that all the participants should be able to obtain the maximum endowment. Specifically, subjects were given 2 minutes to perform the task and were paid 25 Japanese Yen per correct answer. If the number of correct answers for a subject exceeded 40, then this subject received 1,000 JPY.

The real effort task is followed by the PTG. The structure of the game is sequential and consists of two stages. In Stage 1, proposers decide how much

[5]At the time of the experiment, 1 USD corresponded to approximately 114 JPY.

of responder's endowment to take. In Stage 2, responders decide how much of their own endowment to destroy, after being informed of the proposer's decision. Players' earnings are calculated as follows.

- proposer's earnings: $Y_1 + t(1-d)Y_2$
- responder's earnings: $(1-t)(1-d)Y_2$

where Y_i is the endowment of player i (equal to 1,000 JPY) and $t \in [0,1]$ is the fraction of the responder's endowment that the proposer decides to take, and $d \in [0,1]$ is the fraction of their own endowment that the responder decides to destroy.

We extend this basic framework by varying two dimensions across treatments. The first variation is based on whether proposers have the option to give part of their own endowment to the responder in addition to taking part of the responder's endowment. The second is whether responders have the option to destroy part of the proposer's endowment in addition to destroying part of their own endowment in response to the proposer's decision. Our experiment implements a 2x2 between-subjects design, resulting in four treatments summarized in Table 1. Let $g \in [0,1]$ be the fraction of own endowment proposers give to the responder (in treatments PTG+G and PTG+G+CLR), and let $r \in [0,1]$ be the fraction of the proposer's endowment that responders destroy (in treatments PTG+CLR and PTG+G+CLR). Each player's earnings in the four treatments are also summarized in Table 1.

Table 1: Overview of experimental treatments

	Taker can take part of responder's endowment	Taker can take part of responder's endowment or give part of own endowment to the responder
Responder can destroy own endowment	Power to take game (PTG)	Power to take game with an option to give (PTG+G)
	$\pi_1 = Y_1 + t(1-d)Y_2$ $\pi_2 = (1-t)(1-d)Y_2$	$\pi_1 = (1-g)Y_1 + t(1-d)Y_2$ $\pi_2 = gY_1 + (1-t)(1-d)Y_2$
Responder can destroy either own or taker's endowment	PTG with costless retaliation (PTG+CLR)	PTG+G with costless retaliation (PTG+G+CLR)
	$\pi_1 = (1-r)Y_1 + t(1-d)Y_2$ $\pi_2 = (1-t)(1-d)Y_2$	$\pi_1 = (1-r)(1-g)Y_1 + t(1-d)Y_2$ $\pi_2 = (1-r)gY_1 + (1-t)(1-d)Y_2$

π_i: Payment for player i.
$t \in [0,1]$: the fraction of responder's endowment proposer decides to take.
$d \in [0,1]$: the fraction of own endowment responder decides to destroy.
$g \in [0,1]$: giving by proposer (in treatments PTG+G and PTG+G+CLR).
$r \in [0,1]$: the rate of proposer's endowment that responder destroys (in treatments PTG+CLR and PTG+G+CLR).

2.1 Additional tasks

As decisions to take (or to give), as well as to retaliate, can be influenced by the participants' degrees of inequality aversion, as shown in our theoretical analyses reported in Appendix B, we measure the subjects' degrees of inequality aversion before they perform the real effort task.

To do so, we extend the task proposed by He and Wu (2016) to estimate the degree of the advantageous and disadvantageous inequality of the model proposed by Fehr and Schmidt (1999). In this task, two participants are randomly paired, and each makes a series of binary choices between two options, A and B, regarding the amount of money the participant and the randomly paired other participant will receive. The choice problems are presented in two lists (see Appendix A.1); one for measuring the degree of disadvantageous inequality aversion (the first list) and the other for measuring the degree of advantageous inequality aversion (the second list).

Each list contains 31 binary choice questions and all monetary values are in Japanese Yen. The first list starts with a choice between option A (600 for you, 600 for the other) and option B (400 for you, 1,040 for the other), and ends with a choice between option A (0 for you, 600 for the other) and option B (400 for you, 1,040 for the other). The second list starts with a choice between option A (1,407 for you, 360 for the other) and option B (1,267 for you, 200 for the other), and ends with a choice between option A (360 for you, 360 for the other) and option B (1,267 for you, 200 for the other).

Note that in each list, option B is constant, and the amount of money for the participant in option A becomes smaller as one moves down the list. The switching point for a participant from choosing option A to choosing option B in each list allows us to identify their degree of disadvantageous and advantageous inequality aversion. In the experiment, we impose a single switching point in each list. At the end of the experiment, participants are rewarded based on the choice made by one of the participants for each pair in one randomly selected question (out of 62). Participants are not informed of the outcome of this task until they complete the PTG.

Finally, previous evidence from PTG experiments has shown that emotions can explain part of the subjects' behavior in the game (see Bosman and van Winden, 2002; Bosman et al., 2005; Galeotti, 2015). As in Bosman and van Winden (2002) study, we elicit the intensity with which subjects feel each of following emotions using a seven-point Likert scale (1 = 'not at all', 7 = 'very much'): irritation, anger, contempt, envy, jealousy, sadness, joy, shame, fear, and surprise. We measure their emotions three times during our experiment: at the beginning of the experiment before participants have received any instructions, after participants have gone through the instructions for the PTG, and after participants have participated in the PTG. This allows us to investigate the change in their emotions from one phase to another.

3 Results

The experiment was computerized using oTree (Chen et al., 2016) and conducted at the ISER Lab, Osaka University, in December 2021. Participants were recruited from the subject pool managed by ORSEE (Greiner, 2015) which consists of Osaka University students. A total of 162 students (115 males, 45 females, and 1 other) participated in the experiment.[6] The experiment lasted around 65 minutes including instruction and payment time. The average earning based on all the tasks was 2051.9 JPY (SD = 702.5), which includes a fixed fee of 500 JPY.

Appendix C shows that our samples are well-balanced in terms of gender composition, the measured degrees of inequality aversions, and the initial emotions across the four treatments. As noted in Section 2, we set the real effort task so that everyone can obtain the maximum endowment reward amount of 1,000 JPY to then be used in the PTG. Although participants needed to answer a minimum of 40 questions correctly, they did in fact answer a substantially higher number of questions. The results of the real effort task are discussed in Appendix C.4.

[6] We conducted two sessions for each treatment. The number of participants per treatment is as follows. PTG: 42, PTG+G: 42, PTG+CLR: 40, PTG+G+CLR: 38. Although we have recruited the same number of participants for each session, the number of participants varies due to no shows.

Table 2: Average payoffs in the PTG tabulated by treatments (standard deviations are shown in parentheses)

	proposer	responder	Total in pair
PTG	1459.64	442.74	1902.38
	(288.84)	(287.89)	(300.20)
PTG+CLR	948.5	428.5	1377.0
	(221.94)	(407.60)	(468.65)
PTG+G	1403.48	390.33	1793.81
	(320.31)	(324.92)	(385.88)
PTG+G+CLR	969.74	702.36	1672.11
	(438.62)	(449.42)	(439.54)
p-value in KW test	0.0001	0.0727	0.0013

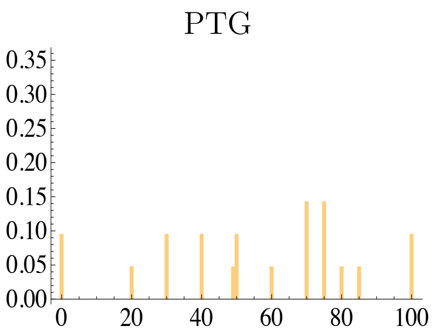
3.1 Behavior in the extended power-to-take games

Table 2 shows the average payoff obtained in the PTG by proposers and responders across the four treatments. We observe that payoffs for proposers are significantly lower in the treatments with costless retaliation (PTG+CLR and PTG+G+CLR), than those without (PTG and PTG+G). We also observe that the increase in the payoffs for responders is marginally more significant in the treatments with both the option to give and costless retaliation (PTG+G+CLR) than in the three other treatments. The total payoff for a pair was lowest in PTG+CLR. Below we analyze the behavior of proposers and responders separately.

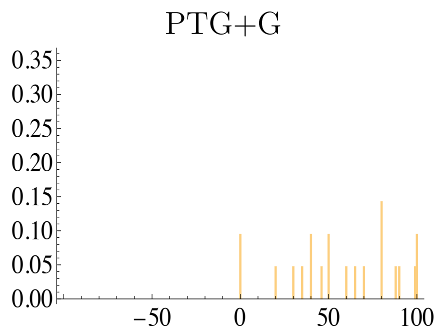
3.1.1 Proposer's behavior

Figure 1 shows the distribution of choices made by the proposer for each of the four treatments. In the treatments with an option to give (PTG+G and

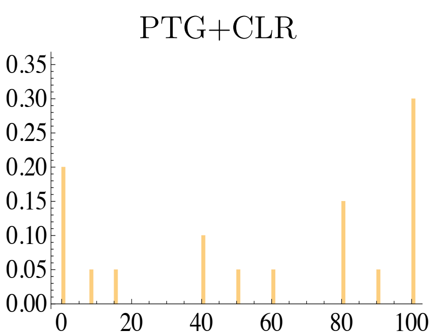
Figure 1: Distribution of choices made by proposer across treatments



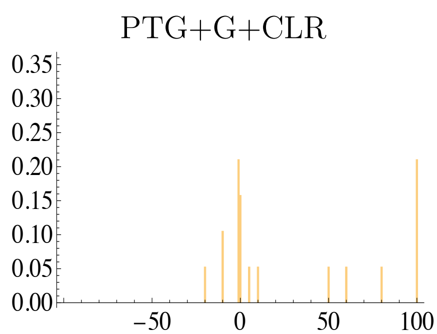
	take	total
N	19	21
mean	61.53	55.67
std.dev	(23.19)	(28.75)



	take	give*	total*
N	19	0	21
mean	64.37	n.a.	58.24
std.dev	(25.48)	n.a.	(30.97)



	take	total
N	16	20
mean	71.44	57.15
std.dev	(31.87)	(40.76)



	take	give*	total*
N	9	7	19
mean	67.22	−6.29	29.53
std.dev	(38.66)	(7.39)	(45.13)

Notes: 'Take' considers only positive take rates; 'Give' considers only negative take rates; 'Total' considers positive, negative and zero take rates.

Table 3: Result of pairwise comparisons of proposer behavior

(a) P-values from pairwise Kolmogorov–Smirnov (KS) test

	PTG+CLR	PTG+G	PTG+G+CLR
PTG	0.143	0.690	0.001
PTG+CLR	-	0.621	0.044
PTG+G	-	-	0.001

(b) P-values from pairwise Mann–Whitney (MW) test

	PTG+CLR	PTG+G	PTG+G+CLR
PTG	0.524	0.698	0.015
PTG+CLR	-	0.756	0.010
PTG+G	-	-	0.012

PTG+G+CLR), the give rates are represented as negative take rates. Below the histogram, we report the average (standard deviations in parentheses) choices, including giving and taking where appropriate (see column 'total'). We also look separately at the average take rates (see column 'take') and average give rates (see column 'give'). An eyeballing inspection of Figure 1 reveals that, when the give option is present but there is no opportunity for the responder to costlessly retaliate (i.e., PTG+G treatment), the proposer decides not to give anything to the responder. Furthermore, the distribution of choices between PTG and PTG+G are not significantly different (p = 0.690, Kolmogorov–Smirnov, KS, test). Panel (a) of Table 3 summarizes the p-values of the pairwise KS tests.

The behavior of the proposer tends to be more extreme when costless retaliation is possible for the responder (PTG+CLR). Compared to PTG, we observe the take rate of 0 and 100 in PTG+CLR more frequently, although the distribution of choices are not significantly different between the two ($p = 0.143$, KS test). This is also the case if we compare two treatments in which the proposer has the option to give (PTG+G and PTG+G+CLR). The frequency of 0 and 100 is significantly higher in PTG+G+CLR than in PTG+G. Furthermore, we observe some proposers giving, instead of taking, in PTG+G+CLR. The two distributions are significantly different ($p = 0.001$, KS test).

In addition, in the presence of costless retaliation, a proposer with the option to give takes less from the responder than those without such an option. Namely, the frequency of taking everything from the responder is lower in PTG+G+CLR than in PTG+CLR. The distributions of the proposer's choices are significantly different between PTG+CLR and PTG+G+CLR ($p = 0.044$, KS test).

The overall average take rates (including the give rates represented as negative take rates) by proposers across the four treatments are 55.67, 58.24, 57.15, and 29.53 for PTG, PTG+G, PTG+CLR, and PTG+G+CLR, respectively. The differences between the choices across the four treatments are marginally significant ($p = 0.073$, Kruskal–Wallis, KW, test).[7] In particular, looking at the proposers' overall behavior, we find that they take, on average,

[7]Any statistical tests reported in this section refer to two-sided tests unless otherwise stated.

significantly less in PTG+G+CLR compared either to the PTG+G treatment ($p = 0.012$, Mann–Whitney, MW, test) or the PTG+CLR ($p = 0.010$, MW test). This indicates that the presence of both the give and retaliation options are important for making the proposer take less (PTG+G+CLR vs PTG: $p = 0.040$, MW test). On the other hand, the introduction of only give options without the possibility of retaliation (PTG vs. PTG+G: p = 0.698, MW test) or the introduction of only costless retaliation without the give option (PTG vs PTG+CLR: $p = 0.524$, MW test) does not significantly change the behavior compared to the baseline PTG treatment. Panel (b) of Table 3 summarizes the p-values of the pairwise MW tests.

Evidence from previous dictator games (e.g., List, 2007; Bardsley, 2008; Drouvelis, 2023) shows that allowing dictators to take money from their matched recipients reduces the amount allocated to the recipients. Unlike dictator games where taking affects sharing, introducing give options in the PTG treatment does not have a significant effect on behavior.[8]

Let us further analyze the behavior of the proposers by looking at the increase in their payoffs due to their own decisions ($tY_2 - gY_1$).[9] Regression (1) in panel (a) of Table 4 shows the result of regressing ($tY_2 - gY_1$) on treatment dummies (I_{+CLR}, I_{+G}, and I_{+G+CLR}, corresponding to PTG+CLR,

[8] If we focus on those proposers with positive take rates, the mean take rates are 61.53, 64.73, 71.44, and 67.22 for PTG, PTG+G, PTG+CLR, and PTG+G+CLR, respectively, and there is no significant difference across the four treatments ($p = 0.479$, KW test).

[9] Note that given that $Y_1 = Y_2$ in our experiment, this is equivalent to the net take rate $t - g$.

Table 4: Decisions by proposer

(a) Dependent variable: Increase in proposer's payoff due to proposer's decision ($tY_2 - gY_1$)

Dependent variable	Increase in proposer's payoff due to proposer's decision $tY_2 - gY_1$	
	(1)	(2)
$I_{+\mathrm{CLR}}$	14.833	28.870
	(114.795)	(120.852)
$I_{+\mathrm{G}}$	25.714	30.867
	(113.386)	(114.642)
$I_{+\mathrm{G+CLR}}$	−261.404**	−281.932**
	(116.332)	(118.753)
α		519.421
		(556.079)
β		−53.818
		(78.355)
const.	556.667***	560.440***
	(80.176)	(82.214)
N	81	80
adj. R^2	0.061	0.054

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively.

(b) P-values for pairwise comparisons based on regression (1) (Wald test)

	PTG+CLR	PTG+G	PTG+G+CLR
PTG	0.898	0.821	0.028
PTG+CLR	-	0.925	0.022
PTG+G	-	-	0.016

PTG+G, and PTG+G+CLR, respectively). The baseline treatment is the PTG. As one can observe from the estimated coefficients, as well as the p-values based on the Wald tests reported in panel (b), the increase in the proposer's payoffs due to their own actions is not significantly different across PTG, PTG+G, and PTG+CLR. However, the amount is significantly lower in PTG+G+CLR compared to the three other treatments, confirming the non-parametric analyses we have conducted above.

In regression (2), we further control for the measured degrees of inequality aversion, α and β, of the proposer. As one can observe, neither α nor β are statistically significant, and the magnitude and significance of the treatment dummies are similar to those reported in regression (1). We can therefore summarize our findings as follows:

Finding 1 *On average, the proposer takes less from the responder only when both give and costless retaliation options are present.*

3.1.2 Responder's behaviour

Let us now turn to the responder's behavior. Figure 2 shows the frequency distribution of choices made by the responder for each of the four treatments. In the treatments with an option to costlessly retaliate (PTG+CLR and PTG+G+CLR), the retaliation rates are represented as negative destruction rates. Recall that the term 'destruction' refers to the destruction of the responder's own income. Whereas 'retaliation' refers to the destruction of the proposer's income. Below the histogram, we report the average

Table 5: Result of pairwise comparisons (MW test)

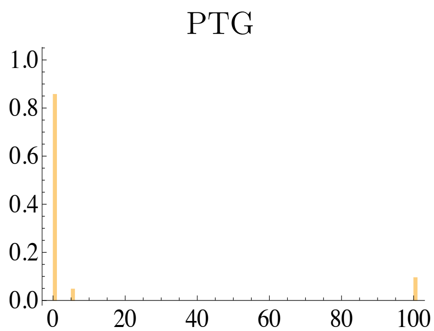
	PTG+CLR	PTG+G	PTG+G+CLR
PTG	<0.001	0.069	0.004
PTG+CLR	-	<0.001	0.025
PTG+G	-	-	<0.001

(standard deviations in parentheses) choices, including the destruction and retaliation rates where appropriate (see column 'total'). We also look separately at the average positive destruction rates (see column 'destroy') and average retaliation rates (see that column 'retaliate' is reported as a negative destruction rate).

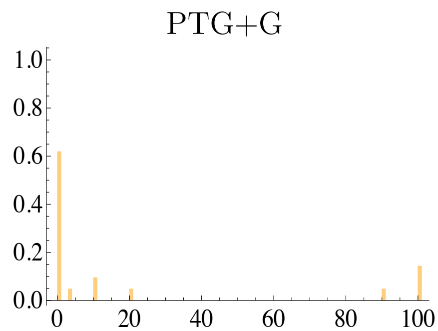
The average choices made by the responder are 9.76, 20.62, -52.3, and -22.05 in PTG, PTG+G, PTG+CLR, and PTG+G+CLR, respectively. The choices are significantly different across treatments ($p < 0.001$, KW test). When we compare the choices between the two treatments without costless retaliation (PTG vs PTG+G), the difference between the choices is marginally significant ($p = 0.069$, MW test). When we compare the two treatments with costless retaliation (PTG+CLR vs PTG+G+CLR), the average total destruction rate (that includes both destruction and retaliation) is significantly lower in the former than in the latter ($p = 0.025$, MW test). This is mainly due to the fact that the proposers take less in PTG+G+CLR than in PTG+CLR. Table 5 summarizes the p-values from the pairwise MW tests.

These analyses, however, do not take into account the proposers' be-

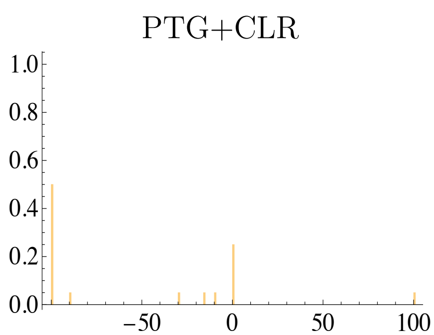
Figure 2: Distribution of choices made by responder across treatments



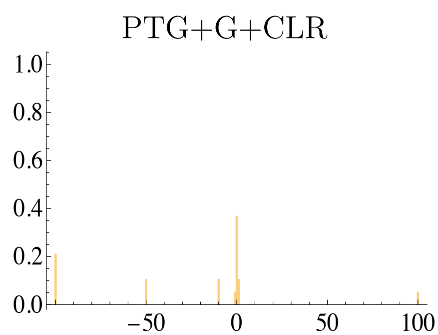
	destroy	total
N	3	21
mean	68.33	9.76
std.dev	(54.85)	(30.02)



	destroy	total
N	8	21
mean	54.13	20.62
std.dev	(46.71)	(38.59)



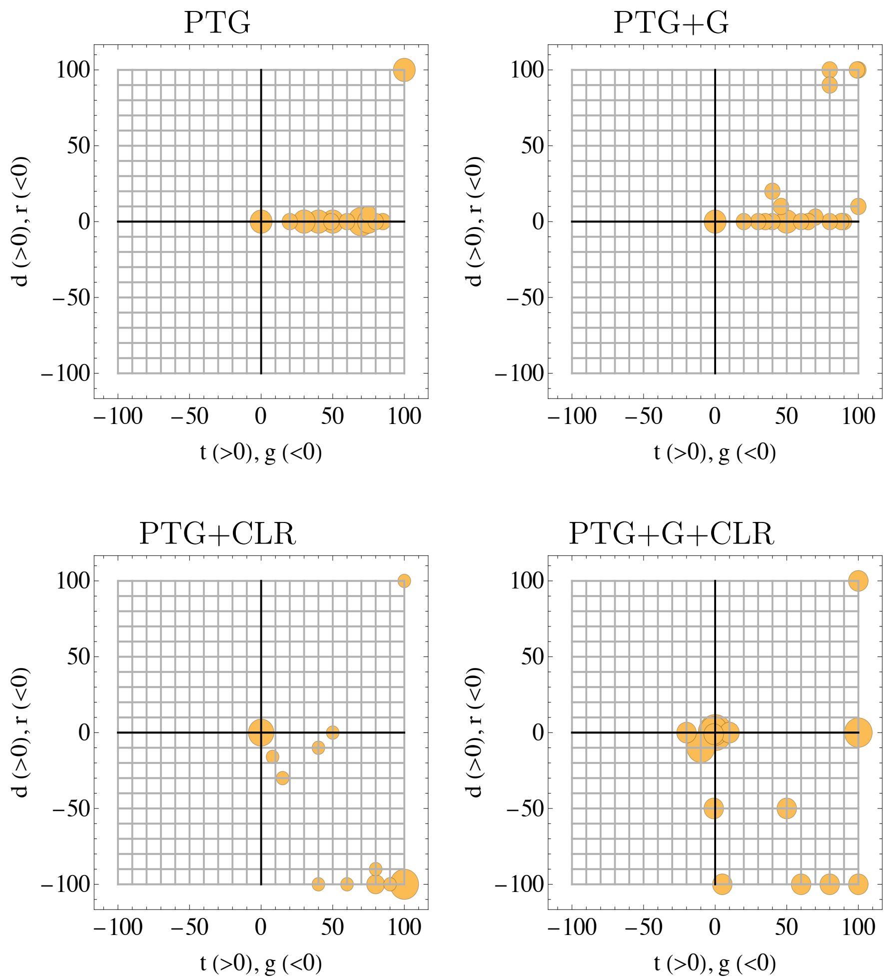
	destroy	retaliate*	total*
N	1	14	20
mean	100.0	−81.86	−52.3
std.dev	n.a.	(34.58)	(58.33)



	destroy	retaliate*	total*
N	3	9	19
mean	34.00	−57.89	−22.05
std.dev	(57.16)	(43.36)	(50.53)

Note: 'Destroy' considers only positive destruction rates; 'Retaliate' considers only negative destruction rates; 'Total' considers positive, negative and zero destruction rates.

Figure 3: Distribution of pair of choices across treatments



Note: Size of the dots is proportional to the number of observations falling on the center of the dot.

haviors against which the responders have responded. We now look at the behaviors of the pairs of players. Figure 3 shows the distribution of choices made by a pair of subjects in the four treatments using a bubble plot. Each dot corresponds to a pair of choices made by the proposer (x-axis) and responder (y-axis) in a pair. As before, the give rate of the proposer and the retaliation rate of the responder are represented by negative numbers.

In PTG+G, we can observe high destruction rates (above 90%) chosen by the responders even when the take rates chosen by proposers are less than 100%. Such severe responses to less than 100% take rates are not observed in PTG.

For the treatments with the option to costlessly retaliate (PTG+CLR and PTG+G+CLR), on the one hand, we observe that the responders respond to the proposers taking 100% of their endowment, either by destroying their own endowment or the proposer's endowment. Note that the payoff consequences are the same either way. In PTG+G+CLR, there are also a small number of responders who have chosen not to react at all (choosing $r = d = 0$) to the 100% take rate chosen by the proposers. For take rates below 100%, on the other hand, many responders respond with a 100% retaliation rate (i.e., fully destroying the proposer's endowment).

To better understand the behavior of the responders, we analyze the decrease in the proposer's, as well as the responder's payoff, due to the responder's decision across the four treatments taking the intermediate payoff consequence of the proposer's decision into account.

Table 6: Decision by responder

(a) Regression results

Dependent variable	Decrease in proposer's payoff due to responder's decision $(1-g)rY_1 + tdY_2$			Decrease in responder's payoff due to responder's decision $grY_1 + (1-t)dY_2$		
	(1)	(2)	(3)	(4)	(5)	(6)
$I_{+\mathrm{CLR}}$	525.976***	515.819***	503.745***	−0.595	−0.661	0.692
	(123.137)	(95.415)	(97.588)	(9.733)	(9.785)	(9.313)
$I_{+\mathrm{G}}$	81.881	64.273	61.85	26.690***	26.576***	25.790***
	(121.626)	(94.266)	(98.011)	(9.614)	(9.667)	(9.353)
$I_{+\mathrm{G+CLR}}$	228.497*	407.494***	414.998***	1.778	2.940	2.008
	(124.786)	(99.802)	(101.060)	(9.864)	(10.235)	(9.644)
$t-g$		6.848***	7.075***		0.044	0.035
		(0.947)	(0.977)		(0.097)	(0.093)
α			−41.001			−33.755
			(322.271)			(30.754)
β			−34.319			−10.211***
			(28.343)			(2.705)
const.	97.024	−284.154***	−300.028***	0.595	−1.878	−1.500
	(86.003)	(84.969)	(86.114)	(6.798)	(8.714)	(8.218)
N	81	81	78	81	81	78
adj. R^2	0.184	0.510	0.508	0.093	0.083	0.234

***, ** ,*: statistically significantly different from zero at 1%, 5%, and 10% significance level.

(b) P-values for pairwise comparison based on regression (2) (Wald test)

	PTG+CLR	PTG+G	PTG+G+CLR
PTG	< 0.001	0.497	< 0.001
PTG+CLR	-	< 0.001	0.288
PTG+G	-	-	0.001

(c) P-values for pairwise comparison based on regression (5) (Wald test)

	PTG+CLR	PTG+G	PTG+G+CLR
PTG	0.946	0.007	0.775
PTG+CLR	-	0.007	0.730
PTG+G	-	-	0.025

Column (1) in panel (a) of Table 6 shows the result of regressing the decrease in the proposer's payoff (from the intermediate one resulting from the proposer's decision) due to the responder's decision[10] $((1-g)rY_1 + tdY_2)$ on three treatment dummies (I_{+CLR}, I_{+G}, and I_{+G+CLR}, corresponding to PRG+CLR, PTG+G, and PTG+G+CLR, respectively). The baseline treatment is PTG. We consider the decrease in payoff from the intermediate payoff following the proposer's decision because, as we have seen above, even with the same rate of retaliation or destruction, its impact in terms of monetary units differs depending on how much the proposer has taken from the responder. Similarly, column (4) in panel (a) of Table 6 shows the result of regressing the decrease in the responder's payoff (from the intermediate one resulting from the proposer's decision) due to responder's decision[11] $(grY_1 + (1-t)dY_2)$ on three treatment dummies.

Column (1) of Table 6 shows that, compared to the PTG, the responder's decision reduces the proposer's payoffs significantly more in PTG+CLR and PTG+G+CLR, and that the magnitude of the reduction is significantly greater in the former than in the latter ($p = 0.021$, Wald test). While this is consistent with the non-parametric analyses above, this effect is due to the proposers taking less in the latter than in the former, as we show below. Furthermore, column (4) of Table 6 shows that the responder's decision re-

[10] $[(1-g)Y_1 + tY_2] - [(1-g)(1-r)Y_1 + t(1-d)Y_2] = (1-g)rY_1 + tdY_2$
[11] $[gY_1 + (1-t)Y_2] - [g(1-r)Y_1 + (1-t)(1-d)Y_2] = grY_1 + (1-t)dY_2$

duces their payoffs significantly more in PTG+G than in PTG. This is also consistent with our non-parametric analyses above, namely, when costless retaliation is not possible, the responders are both more likely to destroy their endowment, and to destroy a greater proportion of it, when the proposer has the option to give than when the proposer does not have such an option.

As already noted, columns (1) and (4) do not control for the behavior of the proposer. Given that the responder's decision is likely to be influenced by the proposer's behavior, in columns (2) and (5) in panel (a) of Table 6, we control for the proposer's behavior $(t - g)$. Furthermore, in columns (3) and (6), we further control for the responder's degree of inequality aversion, α and β. Columns (2) and (5), as well as (3) and (6), show that, overall, while a higher take rate $(t - g)$ by the proposer results in a significantly greater reduction in the proposer's payoff, it does not lead to a significantly greater reduction in the responder's payoff.

Once the behavior of the proposer is controlled for in columns (2) and (3), relative to PTG, there is no longer a significant difference in the reduction in the proposer's payoff due to the responder's decision when choosing between PTG+CLR and PTG+G+CLR (see panel b), which are both higher than PTG and PTG+G. Neither α nor β are significant in column (3), suggesting that the degree of inequality aversion is not significantly correlated with the responder's decision to reduce the proposer's payoff. However, column (6) shows a negative and significant coefficient of β. That is, the responder's degree of advantageous inequality aversion is negatively correlated with the degree to which they reduce their own payoff. This finding, however, is difficult for us to interpret, mainly because the responders tend to be in a disadvantageous position in our experiment.

Panels (b) and (c) of Table 6 report the p-values of pairwise treatment comparisons based on columns (2) and (5) of panel (a), respectively. We observe from panel (b) that there are significant treatment differences in terms of the reduction in the proposer's payoff due to the responder's decision between the treatment with and without costless retaliation (greater in the latter). Similarly, we observe from panel (c), that the reduction in the responder's payoff due to their decision is significantly greater in PTG+G compared to the remaining three treatments. We can summarize our findings as follows:

Finding 2 *Controlling for the proposer's decision, when costless retaliation is possible, the responders destroy the proposer's endowment, regardless of whether the proposers have the option to give or not.*

Finding 3 *When costless retaliation is not possible, responders destroy their own endowment more when proposers have the option to give than when they do not.*

3.2 Emotions

In Appendix C.3, we show that there is no significant difference in the emotions elicited at the beginning of the experiment across the four treatments.

As summarized in Appendix D, there are, however, some significant differences across treatments in the emotions elicited (namely, anger, envy, jealousy, and sad) after receiving instruction and understanding the nature of the game (but before knowing their assigned role and playing the game). If we focus on the changes in the strength of each emotion, in treatment PTG, participants express a significantly stronger feeling of all emotions except joy and shame. Indeed, after receiving the instructions for the game, participants felt significantly less joy in all the treatments. Changes in anger, envy, jealousy, and shame are significantly different across the four treatments.

Table 7 shows the changes in emotion between those elicited before playing the game and after playing the game for the proposer (panel a) and the responder (panel b).[12]

As can be seen from Table 7, we do observe a significant difference in the way that the emotions changed before and after playing the game between proposers and responders in PTG and PTG+G. For example, while the intensity of negative emotions such as irritation, anger, and sadness have declined after playing the game for the proposers, they have increased for the responders in these two treatments. In fact, for the responders, other negative emotions such as contempt and jealousy are also felt significantly more strongly after playing the game than before playing the game. For the proposers, reductions in some of these negative emotions are not observed

[12]Table 18 in Appendix D shows only those emotions elicited after playing the game.

Table 7: Mean (Std. Dev.) of changes in emotions before and after playing the game

(a) proposer

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	−1.286***	−0.762***	−0.286	−0.619**	−0.524**	−0.476*	2.714***	0.905**	−0.857	0.714
	(1.521)	(1.136)	(0.784)	(1.024)	(1.078)	(1.167)	(2.053)	(1.513)	(2.351)	(2.493)
PTG+CLR	0.300	0.500*	0.600*	−0.150*	0.000	0.550*	0.550	0.450**	−0.800**	0.600*
	(1.129)	(1.100)	(1.465)	(0.366)	(0.000)	(1.317)	(1.638)	(0.945)	(1.322)	(1.353)
PTG+G	−0.571**	−0.238	0.238	−0.095	0.048	−0.143	1.762***	0.143	−0.857**	−0.095
	(1.165)	(0.768)	(0.995)	(0.831)	(0.498)	(1.062)	(1.841)	(0.854)	(1.459)	(2.095)
PTG+G+CLR	0.158	0.526	0.737*	0.105	0.053	0.105	1.263**	−0.053	−1.474***	0.684
	(1.302)	(1.867)	(1.790)	(0.567)	(0.780)	(1.370)	(2.077)	(0.405)	(1.679)	(1.765)
p-value (KW test)	0.0004	0.001	0.009	0.011	0.025	0.049	0.005	0.005	0.429	0.724

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively, using the two tailed t-test.

(b) responder

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	1.000**	1.190***	1.286***	0.619*	1.095***	1.333***	0.143	−0.095	−1.190***	0.476
	(1.871)	(1.806)	(2.053)	(1.322)	(1.729)	(1.983)	(1.621)	(0.831)	(1.721)	(1.692)
PTG+CLR	1.750***	1.650**	1.600***	0.100	1.100**	1.850***	−0.050	−0.150	−0.750**	0.800
	(2.531)	(2.681)	(2.210)	(0.553)	(1.804)	(2.581)	(1.791)	(0.933)	(1.333)	(2.397)
PTG+G	1.476***	1.714***	0.667*	1.190**	1.048**	1.524**	−0.095	−0.048	−0.667*	0.143
	(1.914)	(2.148)	(1.653)	(2.462)	(1.830)	(2.695)	(0.995)	(0.218)	(1.494)	(2.197)
PTG+G+CLR	−0.316	0.368	0.895*	0.474	0.842**	0.579	1.211**	0.632	−0.263	1.211**
	(2.405)	(2.087)	(2.208)	(1.264)	(1.537)	(1.981)	(2.070)	(1.892)	(1.695)	(2.485)
p-value (KW test)	0.004	0.150	0.474	0.441	0.901	0.373	0.066	0.700	0.648	0.396

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively, using the two tailed t-test.

(c) P-values for comparing proposer and responder (Mann–Whitney, two-tailed)

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	0.0001	0.0002	0.0005	0.0007	0.0003	0.0019	0.0001	0.0064	0.4966	0.7284
PTG+CLR	0.1660	0.2153	0.2073	0.1007	0.0042	0.1047	0.1245	0.0473	0.8696	0.4129
PTG+G	0.0001	0.0004	0.1888	0.1003	0.0121	0.0223	0.0003	0.6708	0.6916	0.9561
PTG+G+CLR	0.1214	0.6243	0.8901	0.3696	0.0188	0.5544	0.9517	0.4482	0.0861	0.6452

in the remaining two treatments, PTG+CLR and PTG+G+CLR. In fact, in these two treatments where the responders engage in costless retaliation, we observe a significant increase in the intensity of contempt felt by the proposers.

For each role (proposer and responder), several of the emotions demonstrate similar changes within treatments, at least in terms of the sign. For this reason, we carry out the principal component analysis (separately for the proposer and the responder) to summarize these changes in various emotions and identify two main components. For both roles, while Component 1 mainly consists of changes in irritation, anger, contempt, envy, jealousy, sadness, and joy (but negatively), Component 2 mainly consists of changes in shame, fear, and surprise. See Appendix E for details.

Table 8 reports the mean (standard deviation) of the two components for each role and treatment. We observe that, for the proposer, the sign of Component 1 differs depending on whether the responder has the option of costless retaliation. On the one hand, in the treatment without such an option (PTG and PTG+G), the first component is negative and significant for PTG, while, on the other hand, in the treatment with such an option (PTG+CLR and PTG+G+CLR), they are positive and significant for PTG+CLR. For Component 2 of the proposer, while it is positive and significant in PTG, they are negative in the other three treatments and significantly so for PTG+G+CLR. Two components for the proposer are both significantly different across the four treatments ($p < 0.001$ for Component 1 and $p = 0.015$ for Component 2, respectively, based on the KW test). For the responder, on one hand, the sign of Component 1 is negative and significant only for PTG+G+CLR, and they are positive for the three other treatments, though not statistically significant.

Note that because we have elicited emotions before and after playing the game, the changes in emotions summarized in these two components are the results of the behavior of both the proposer and the responder during the game. However, given the sequential nature of the game, we may be able to consider the following dynamics between behavioral and emotional changes. On one hand, the changes in the emotions of the responders are mainly driven by the decisions of the proposers, and such changes in emotions drive the decisions of responders at least partly. On the other hand, the changes in the emotions of the proposers are mainly driven by the decisions of the responders. Indeed, Bosman and van Winden (2002) organize their data in a similar manner. Below, we follow these dynamics and analyze the data accordingly.

3.2.1 Changes in emotions and behaviors

Table 9 reports the results of regressing the two emotional components of the responder on treatment dummies and the proposer's decision ($t - g$). In regressions (2) and (4), we control for the degrees of inequality aversion (α and β) of the responder. In regression (1), we observe a positive and significant effect of the proposer's decision on Component 1 of the respon-

Table 8: Mean (Std. Dev.) of two components

	proposer		responder	
	Component 1	Component 2	Component 1	Component 2
PTG	−1.325**	0.605*	0.081	−0.268
	(1.918)	(1.947)	(1.845)	(0.896)
PTG+CLR	0.806***	−0.096	0.440	0.066
	(1.334)	(0.910)	(2.156)	(0.991)
PTG+G	−0.084	−0.050	0.312	−0.259
	(1.549)	(1.091)	(1.740)	(1.132)
PTG+G+CLR	0.708	−0.512**	−0.898**	0.513
	(2.202)	(0.832)	(1.778)	(1.867)
p-value (KW test)	< 0.001	0.015	0.065	0.487

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively, using the Wilcoxon test.

der. Recall that Component 1 consists mainly of negative emotions, some of which are directed toward another person (such as contempt, jealousy, and envy). Furthermore, there are no statistically significant differences across treatments.[13] The result is unchanged, even when we control for the degrees of inequality aversion (regression (2)). As regressions (3) and (4) show, however, Component 2 is not significantly related to the decision of the proposer. This suggests that Component 2 of the responder captures the changes in emotion that are not directly related to the proposer's action toward the responder.

We now analyze the emotions influencing the responder's decision. Table 10 shows the result of regressing the change in the proposer's payoff

[13]None of the treatment dummies are significant. Additionally, none of the pairwise comparisons among PGT+CLR, PTG+G, and PTG+G+CLR are significant (Wald test).

Table 9: Changes in emotions of responder in response to proposer's decision

	Component 1		Component 2	
	(1)	(2)	(3)	(4)
$I_{+\mathrm{CLR}}$	0.154	0.197	0.010	−0.137
	(0.475)	(0.497)	(0.393)	(0.397)
$I_{+\mathrm{G}}$	0.315	0.373	0.334	0.283
	(0.481)	(0.495)	(0.398)	(0.396)
$I_{+\mathrm{G+CLR}}$	−0.194	−0.166	0.758*	0.784*
	(0.503)	(0.513)	(0.416)	(0.410)
$t-g$	0.030***	0.030***	−0.0009	−0.0001
	(0.005)	(0.005)	(0.0039)	(0.0040)
α		−0.057		−0.417
		(1.636)		(1.306)
β		−0.233		−0.252**
		(0.144)		(0.115)
const.	−1.591***	−1.634***	−0.220	−0.283
	(0.428)	(0.437)	(0.354)	(0.349)
N	81	78	81	78
adj. R^2	0.358	0.367	0.012	0.054

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively.

(regression 1) and the responder's payoff (regression 2) as a result of the responder's decision on the treatment dummies and two emotional components.

The estimated coefficient of Component 1 is positive and significant in regression (1), suggesting that a more intense emotional response by the responder is associated with a more severe punishment. The estimated coefficients of the treatment dummies are similar to those found in regression (1) in Panel (a) of Table 6. The estimated coefficient of Component 1, however, is not significant in regression (2), suggesting that it is not related to the decision of the responder to decrease the payoff. The estimated coefficient of

Table 10: responder's decision

Dependent variable	Decrease in proposer's payoff due to responder's decision $(1-g)rY_1 + tdY_2$	Decrease in responder's payoff due to responder's decision $grY_1 + (1-t)dY_2$
	(1)	(2)
$I_{+\text{CLR}}$	483.714***	−0.932
	(114.004)	(9.895)
$I_{+\text{G}}$	62.490	26.386***
	(111.975)	(9.719)
$I_{+\text{G+CLR}}$	279.694**	3.409
	(119.781)	(10.397)
Component 1	82.520***	1.330
	(21.938)	(1.904)
Component 2	37.883	−0.421
	(32.723)	(2.840)
const.	100.477	0.375
	(79.611)	(6.910)
N	81	81
adj. R^2	0.310	0.075

***, ** ,*: statistically significantly different from zero at 1%, 5%, and 10% significance level.

Component 2 is not statistically significant in either regression (1) or (2).

In Appendix F, we report the change in the proposer's emotion while controlling for the behavior of the responders. We find that their emotional reactions are influenced by the severity of the retaliation by the responders, and that they are significantly stronger in PTG+G, PTG+CLR, and PTG+G+CLR than in the PTG. There are, however, no significant differences across these three treatments.

4 Conclusions

The main goal of our paper is to test experimentally the impact of two behavioral forces that may affect retaliation behavior. We used the power-to-take game which allows us to obtain a simple measure of retaliation that continuously varies with the take rate. We report on an experiment which broadens the existing literature by exploring how the addition of giving and costless retaliation opportunities affects behavior in the power-to-take game.

Our experimental results indicate that the presence of giving opportunities alone makes little difference to the proposers' behavior. This is in contrast to previous results from dictator games showing that taking options reduce generosity substantially, and highlights that the impact of giving and taking is moderated by the presence of retaliation options. We also find that costless retaliation alone does not change proposers' behavior significantly. This is true, despite the responders retaliating much more frequently by destroying the proposers' endowments when such an option is given to them. It is the combination of offering the responders the opportunity to costlessly retaliate and allowing the proposers to give that causes the taking behavior to reduce to less than 30%. Additionally, we report that when the responders do not have the option to costlessly retaliate, they destroy their own endowment more frequently, and destroy a greater proportion of it, when proposers have the option to give than when they do not.

Taken together, our results suggest an act of taking by the proposers who have the option to give is expected to trigger a harsh retaliation from the responders (when they have the option to costlessly retaliate), as taking may be considered to be socially inappropriate (e.g., Krupka and Weber, 2013). Such anticipation of severe retaliation discourages proposers from taking. By contrast, when the giving option is removed, the act of taking is perceived to be less socially inappropriate and, as a result, proposers do then take from the responders.

Our study opens novel paths for future research. It seems natural to extend our setting by studying how the presence/absence of giving opportunities may affect what can be construed as being a socially (in)appropriate behavior. Our study provides suggestive motivation for a more systematic investigation of social norms when giving co-exists with taking. The role of beliefs about the other player's behavior may also be a promising research avenue. Previous research from public good games (e.g., Fischbacher and Gächter, 2010) has shown that beliefs and actions are positively and highly correlated. Our results thus call for the need to explore the role of beliefs in our setting more systematically. We also study behavior in a one-shot experiment where subjects can reap no material future benefit from retaliation. The extent to which our results are robust to the repetition of the game where strategic considerations are present would be an interesting line of future investigation.

As a final note, we discuss SANS conditions (selection, attrition, naturalness and scaling) proposed by List (2020) to address concerns about the generalizability of our study. In terms of selection, a student sample was used in our laboratory experiment, and assignment to treatments was random. There was no attrition as all participants completed the full experiment. The task that subjects undertook was a simple (modified version of the) power-to-take game. Therefore, our experimental setting is less natural when compared to the decisions taken by subjects outside of a laboratory setting. In terms of scaling, the baseline power-to-take game has already been employed by existing experimental studies (see Section 1) which show that, not only are proposers willing to take part of the responder's endowment, but also that responders are willing to sacrifice part of their payoff to punish unkind behavior. Our experiments and results broaden the existing knowledge base by uncovering the power of two additional mechanisms that shape the behavioral content of negative reciprocity: giving and costless retaliation.

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A English translation of the instruction

Instruction

Thank you for your participation in our experiment today.
Please read the following instructions carefully.

Note

- Please follow the instructions given by the experimenter.
- Please do not perform any operations other than those specified.
- Please do not talk or exchange notes with other participants during the experiment.
- Please do not try to peek at the screens of other participants.
- Please turn off your cell phone and put it in your bag.
- If you have any questions, please raise your hand quietly.

Flow of the experiment

- Today's experiment will proceed as follows. It will take approximately 120 minutes.
  1. questionnaire
  2. Experiment 1 introduction/quiz/task
  3. Experiment 2 introduction/practice part/task
  4. Experiment 3 introduction/quiz
  5. questionnaire
  6. Experiment 3 task
  7. questionnaire
  8. Pay reward

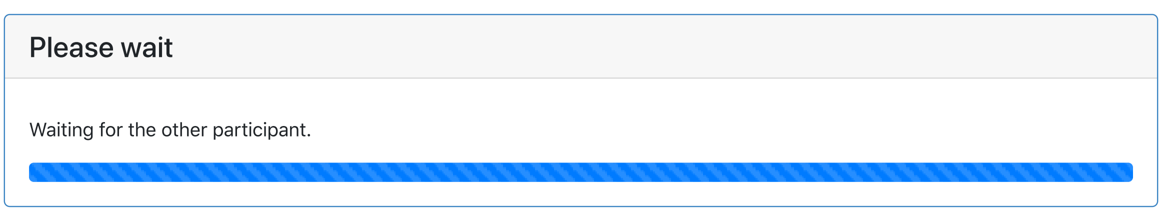
- Each experiment will be explained just before it starts. Please make sure you understand the instruction well.
- There are two types of experiment: an individual task and those that you and another participant will be paired. The pair will be changed at random each time.
- Now, after explaining the rewards and how to operate the computer, we will proceed to Experiment 1.

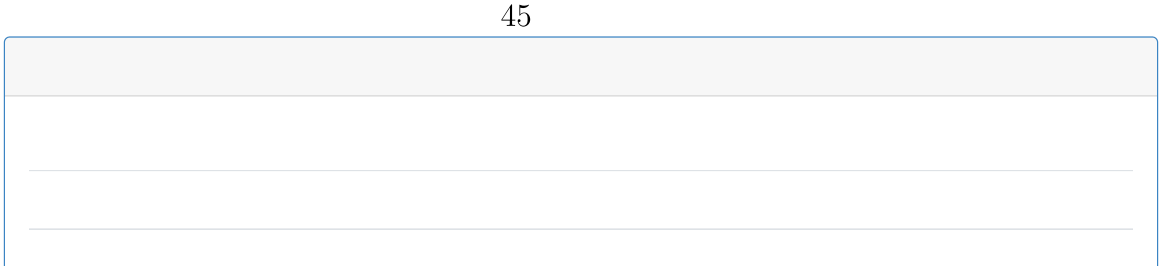
Reward

- You will receive 500 JPY as the participation fee.
- In addition to the participation fee, you will receive the total amount you earn in the three experiments.
- The reward will be rounded up to the unit of 10 JPY.

Operation of the computer

- Only the mouse and the keyboard are used in the experiment.
- Click the [Next] button to proceed to the decision screen.
- On each decision screen, click the "Submit" button to submit your decision.
- You will not be able to return to the previous screen.
- Your partner is making the decision when your screen becomes as shown below. Please wait a while. After your partner has made their decision, the screen will change.





A.1 Experiment 1

You will be randomly paired with another participant in this room. Your reward will depend on the decisions made by you and your paired participant.

A.1.1 Decision-making task

The two tables will appear on the screen, which you can also find on the next page. Each table consists of 31 decision problems, and you will make each decision.

In each problem, there are two options: Option A and Option B. You must choose between the two.

The two options represent the allocation of the reward between you and your paired participant. For example, if you choose Option A in the first line of the left table, your payoff is 600 JPY, and that of your paired participant is 600 JPY. If you choose Option B, on the other hand, your payoff is 400 JPY, and that of your paired participant is 1,040 JPY.

Option B in a table is the same for all problems. In Option A, the lower the problem appears in the table, the smaller the allocation to yourself.

In each table, it is typical to choose option A for the first several problems and then change the choice from option A to option B for any of the subsequent problems. To simplify the operations, when you select option B for a problem, option A is automatically selected for those above it, and option B is automatically selected for those below it.

A.1.2 Payoff determination

In total, you must make decisions for 62 problems (31 in each table). At the very end of the experiment, one of the 62 problems will be randomly selected to determine payoff, and the computer program will randomly choose your decision or your paired participant's decision. You will be informed of the result of this experiment at the very end of today's experiment after all the tasks are completed.

The case your decision is chosen

For example, suppose that you have chosen option A as shown in the figure below.

If this problem is chosen, and if your decision is chosen, your payoff is 200 JPY and the payoff of your paired participant is 600 JPY.

The case your paired participant's decision is chosen

Option A				Option B	
Yours	Other's			Yours	Other's
200	600	◉	○	400	1040

For example, suppose that your paired participant had chosen option B as shown in the figure below.

Option A				Option B	
Yours	Other's			Yours	Other's
200	600	○	◉	400	1040

If this problem is chosen, and if the decision of your paired participant is chosen, your payoff is 1,040 JPY and the payoff of your paired participant is 400 JPY.

1st

Option A				Option B	
Yours	Other's			Yours	Other's
600	600	○	○	400	1040
580	600	○	○	400	1040
560	600	○	○	400	1040
540	600	○	○	400	1040
520	600	○	○	400	1040
500	600	○	○	400	1040
480	600	○	○	400	1040
460	600	○	○	400	1040
440	600	○	○	400	1040
420	600	○	○	400	1040
400	600	○	○	400	1040
380	600	○	○	400	1040
360	600	○	○	400	1040
340	600	○	○	400	1040
320	600	○	○	400	1040
300	600	○	○	400	1040
280	600	○	○	400	1040
260	600	○	○	400	1040
240	600	○	○	400	1040
220	600	○	○	400	1040
200	600	○	○	400	1040
180	600	○	○	400	1040
160	600	○	○	400	1040
140	600	○	○	400	1040
120	600	○	○	400	1040
100	600	○	○	400	1040
80	600	○	○	400	1040
60	600	○	○	400	1040
40	600	○	○	400	1040
20	600	○	○	400	1040
0	600	○	○	400	1040

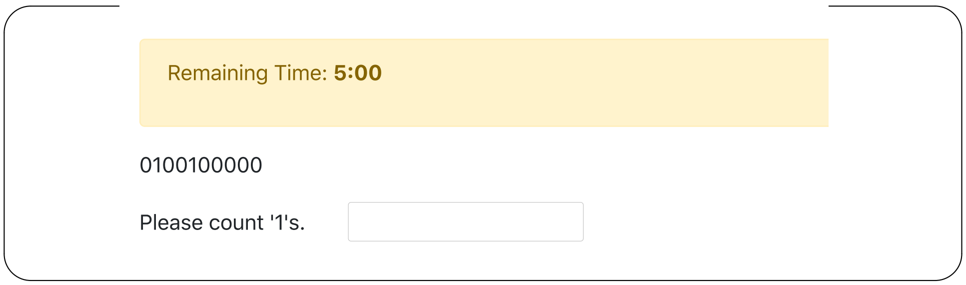
2nd

Option A				Option B	
Yours	Other's			Yours	Other's
1407	360	○	○	1267	200
1387	360	○	○	1267	200
1367	360	○	○	1267	200
1347	360	○	○	1267	200
1327	360	○	○	1267	200
1307	360	○	○	1267	200
1287	360	○	○	1267	200
1267	360	○	○	1267	200
1247	360	○	○	1267	200
1227	360	○	○	1267	200
1207	360	○	○	1267	200
1187	360	○	○	1267	200
1167	360	○	○	1267	200
1147	360	○	○	1267	200
1127	360	○	○	1267	200
1107	360	○	○	1267	200
1087	360	○	○	1267	200
1067	360	○	○	1267	200
1047	360	○	○	1267	200
1027	360	○	○	1267	200
1007	360	○	○	1267	200
987	360	○	○	1267	200
967	360	○	○	1267	200
947	360	○	○	1267	200
911	360	○	○	1267	200
868	360	○	○	1267	200
814	360	○	○	1267	200
747	360	○	○	1267	200
659	360	○	○	1267	200
538	360	○	○	1267	200
360	360	○	○	1267	200

A.2 Experiment 2

A.2.1 Task

- The scre 0 or 1 as shown b



- Please count one(1) and enter your answer (in integer) in the box.
- In the example above, the correct answer is [2].
- The time limit is 5 min. Answer as many questions as possible in 5 minutes.

A.2.2 How to operate

- Enter the numbers using the keyboard, then press [Enter] at the bottom right to submit your answer.
- There is a two-minute practice part. After the practice, you will proceed to the five-minute real part.
- After you have finished the practice part, you will see the [Start Live] button. Start the task when you are ready. If you have any questions, please raise your hand quietly and call the experimenter before starting the task.

Reward

- The reward for Experiment 2 depends on how many questions you correctly answer in the real part. The number of correct answers in the practice part does not count.

- You will earn 25 JPY per correct answer up to a predetermined threshold. If the number of correct answers exceeds the predetermined threshold (i.e., 40), the reward will be 1,000 JPY.
- In Experiment 3, which will be conducted later, you will work on a decision-making task using the rewards you earned in Experiment 2.

A.3 Experiment 3 (Treatment 4)

In Experiment 3, you will be randomly paired with someone else who is participating in this experiment. You and your paired participant will be assigned the role of *Player 1* or *Player 2* and will make a decision once. You will be informed which role you are assigned when the experiment starts.

In Experiment 3, you will use the amount of money you have obtained in Experiment 2 as your endowment.

A.3.1 Decision-making task

First, Player 1 makes a decision, then Player 2 sees Player 1's decision and makes a decision.

Player 1 can take a part or all of the endowment of Player 2 that Player 2 earned in Experiment 2, or give Player 2 some of the endowment of Player 1 that Player 1 earned in Experiment 2. If you are assigned to Player 1, you must answer, as a percentage of the corresponding endowment, how much you take or give.

Player 2 sees Player 1's decision and then can either destroy some of his/her own endowment that Player 2 earned in Experiment 2, or some of Player 1's endowment that Player 1 earned in Experiment 2. If you are assigned to Player 2, you must choose whether to destroy the endowment of Player 1 or Player 2, and the amount, in percentage of the corresponding endowment, you decide to destroy.

A.3.2 Payoff determination

The final rewards in Experiments 2 and 3 are determined according to the decisions of Player 1 and Player 2 as follows. Depending on the combination of decisions made by Player 1 and Player 2, the payoff determination can be explained in four different cases.

Case1: Player 1 takes Player 2's endowment and Player 2 destroys Player 1's endowment

The reward of Player 1 is the total of the amount Player 1 earned in Experiment 2 that Player 2 did not destroy, and the amount Player 1 took from Player 2. Player 2's reward is the amount Player 2 earned in Experiment 2, minus the amount Player 1 took from Player 2.

The reward is calculated as follows.

$$\boxed{\text{Player 1's reward}} = \boxed{\begin{array}{c}\text{Player 1's earning}\\ \text{in Experiment 2}\end{array}} \times \left(100\% - \boxed{\begin{array}{c}\text{Fraction destroyed}\\ \text{by Player 2}\end{array}}\right) + \boxed{\begin{array}{c}\text{Player 2's earning}\\ \text{in Experiment 2}\end{array}} \times \boxed{\begin{array}{c}\text{Fraction taken}\\ \text{by Player 1}\end{array}}$$

$$\boxed{\text{Player 2's reward}} = \boxed{\begin{array}{c}\text{Player 2's earning}\\ \text{in Experiment 2}\end{array}} - \boxed{\begin{array}{c}\text{Player 2's earning}\\ \text{in Experiment 2}\end{array}} \times \boxed{\begin{array}{c}\text{Fraction taken}\\ \text{by Player 1}\end{array}}$$

Calculation example

Let's assume that the earnings in Experiment 2 are as follows.

- Player 1's earning in Experiment 2: 1,000 JPY
- Player 2's earning in Experiment 2: 1,000 JPY

$\boxed{1}$

First, Player 1 makes a decision about the fraction of Player 2's earning in Experiment 2 to take. Let's assume that Player 1 decides to take 60% of Player 2's earning in Experiment 2.

$$\boxed{\begin{array}{c}\text{Fraction taken}\\ \text{by Player 1}\end{array}} = 60\%$$

$\boxed{2}$

Second, Player 2 sees Player 1's decision and makes a decision about the fraction of Player 1's earning in Experiment 2 to destroy. Let's assume that Player 2 decides to destroy 50% of Player 1's earning in Experiment 2.

$$\boxed{\begin{array}{c}\text{Fraction destroyed}\\ \text{by Player 2}\end{array}} = 50\%$$

$\boxed{3}$

The final rewards for Experiments 2 and 3 are as follows.

$$\begin{aligned}
\text{Player 1's reward} &= \text{1,100 JPY} \\
&= 1000 \times (100\% - 50\%) \qquad + 1000 \times 60\% \\
\text{Player 2's reward} &= \text{400 JPY} \\
&= 1000 \qquad\qquad\qquad\qquad - 1000 \times 60\%
\end{aligned}$$

Case 2: Player 1 takes Player 2's endowment and Player 2 destroys Player 2's endowment

Player 1 can only take from the residuals not destroyed by Player 2. Player 1's reward is the total of the amount Player 1 earned in Experiment 2, and the amount Player 1 took from Player 2. Player 2's reward is the amount Player 2 earned in Experiment 2 that Player 2 did not destroy, minus the amount Player 1 took from Player 2.

The following is how reward is calculated.

$$\begin{aligned}
\boxed{\text{Player 1's reward}} = &\ \boxed{\begin{matrix}\text{Player 1's earning}\\ \text{in Experiment 2}\end{matrix}} \\
&+ \boxed{\begin{matrix}\text{Player 2's earning}\\ \text{in Experiment 2}\end{matrix}} \times \left(100\% - \boxed{\begin{matrix}\text{Fraction destroyed}\\ \text{by Player 2}\end{matrix}}\right) \times \boxed{\begin{matrix}\text{Fraction taken}\\ \text{by Player 1}\end{matrix}} \\
\boxed{\text{Player 2's reward}} = &\ \boxed{\begin{matrix}\text{Player 2's earning}\\ \text{in Experiment 2}\end{matrix}} \times \left(100\% - \boxed{\begin{matrix}\text{Fraction destroyed}\\ \text{by Player 2}\end{matrix}}\right) \\
&- \boxed{\begin{matrix}\text{Player 2's earning}\\ \text{in Experiment 2}\end{matrix}} \times \left(100\% - \boxed{\begin{matrix}\text{Fraction destroyed}\\ \text{by Player 2}\end{matrix}}\right) \times \boxed{\begin{matrix}\text{Fraction taken}\\ \text{by Player 1}\end{matrix}}
\end{aligned}$$

Calculation example

Let's assume that the earnings in Experiment 2 are as follows.

- Player 1's earning in Experiment 2: 1,000 JPY
- Player 2's earning in Experiment 2: 1,000 JPY

$\boxed{1}$

First, Player 1 makes a decision about the fraction of Player 2's earning in Experiment 2 to take. Let's assume that Player 1 decides to take 60% of Player 2's earning in Experiment 2.

$$\boxed{\begin{matrix}\text{Fraction taken}\\ \text{by Player 1}\end{matrix}} = 60\%$$

$\boxed{2}$

Second, Player 2 sees Player 1's decision, and makes a decision about the fraction of own earning in Experiment 2 to destroy Let's assume that Player 2 decides to destroy 50% of own earning in Experiment 2.

$$\boxed{\text{Fraction destroyed by Player 2}} = 50\%$$

$\boxed{3}$

The final rewards for Experiments 2 and 3 are as follows.

$$\begin{aligned}
\text{Player 1's reward} &= 1{,}300 \text{ JPY} \\
&= 1000 \qquad\qquad\qquad\quad + 1000 \times (100\% - 50\%) \times 60\% \\
\text{Player 2's reward} &= 200 \text{ JPY} \\
&= 1000 \times (100\% - 50\%) \quad - 1000 \times (100\% - 50\%) \times 60\%
\end{aligned}$$

Case 3: Player 1 gives Player 1's endowment and Player 2 destroys Player 1's endowment

Player 1 can only give from the residuals not destroyed by Player 2. Player 1's reward is the amount Player 1 earned in Experiment 2 that Player 2 did not destroy, minus the amount Player 1 give to Player 2. Player 2's reward is the total of the amount Player 2 earned in Experiment 2, and the amount Player 1 give to Player 2.

The following is how reward is calculated.

$$\begin{aligned}
\boxed{\text{Player 1's reward}} &= \boxed{\text{Player 1's earning in Experiment 2}} \times \left(100\% - \boxed{\text{Fraction destroyed by Player 2}}\right) \\
&- \boxed{\text{Player 1's earning in Experiment 2}} \times \left(100\% - \boxed{\text{Fraction destroyed by Player 2}}\right) \times \boxed{\text{Fraction given by Player 1}} \\
\boxed{\text{Player 2's reward}} &= \boxed{\text{Player 2's earning in Experiment 2}} \\
&+ \boxed{\text{Player 1's earning in Experiment 2}} \times \left(100\% - \boxed{\text{Fraction destroyed by Player 2}}\right) \times \boxed{\text{Fraction given by Player 1}}
\end{aligned}$$

Calculation example

Let's assume that the earnings in Experiment 2 are as follows.

- Player 1's earning in Experiment 2: 1,000 JPY
- Player 2's earning in Experiment 2: 1,000 JPY

$\boxed{1}$

First, Player 1 makes a decision about the fraction of Player 1's earning in Experiment 2 to give. Let's assume that Player 1 decides to give 60% of own earning in Experiment 2.

$$\boxed{\begin{array}{c}\text{Fraction given}\\ \text{by Player 1}\end{array}} = 60\%$$

$\boxed{2}$

Second, Player 2 sees Player 1's decision, and makes a decision about the fraction of Player 1's earning in Experiment 2 to destroy. Let's assume that Player 2 decides to destroy 50% of Player 1's earning in Experiment 2.

$$\boxed{\begin{array}{c}\text{Fraction destroyed}\\ \text{by Player 2}\end{array}} = 50\%$$

$\boxed{3}$

The final rewards for Experiments 2 and 3 are as follows.

$$\begin{aligned}\text{Player 1's reward} &= 200 \text{ JPY}\\ &= 1000 \times (100\% - 50\%) \quad - 1000 \times (100\% - 50\%) \times 60\%\\ \text{Player 2's reward} &= 1{,}300 \text{ JPY}\\ &= 1000 \quad + 1000 \times (100\% - 50\%) \times 60\%\end{aligned}$$

Case 4: Player 1 gives Player 2's endowment and Player 2 destroys Player 2's endowment

Player 1's reward is the amount Player 1 earned in Experiment 2, minus the amount Player 1 give to Player 2. Player 2's reward is the total of the amount Player 2 earned in Experiment 2 that Player 2 did not destroy, and the amount Player 1 give to Player 2.

The following is how reward is calculated.

$$\begin{aligned}\boxed{\text{Player 1's reward}} &= \boxed{\begin{array}{c}\text{Player 1's earning}\\ \text{in Experiment 2}\end{array}}\\ &- \boxed{\begin{array}{c}\text{Player 1's earning}\\ \text{in Experiment 2}\end{array}} \times \boxed{\begin{array}{c}\text{Fraction given}\\ \text{by Player 1}\end{array}}\\ \boxed{\text{Player 2's reward}} &= \boxed{\begin{array}{c}\text{Player 2's earning}\\ \text{in Experiment 2}\end{array}} \times \left(100\% - \boxed{\begin{array}{c}\text{Fraction destroyed}\\ \text{by Player 2}\end{array}}\right)\\ &+ \boxed{\begin{array}{c}\text{Player 1's earning}\\ \text{in Experiment 2}\end{array}} \times \boxed{\begin{array}{c}\text{Fraction given}\\ \text{by Player 1}\end{array}}\end{aligned}$$

Calculation example

Let's assume that the earnings in Experiment 2 are as follows.

- Player 1's earning in Experiment 2: 1,000 JPY
- Player 2's earning in Experiment 2: 1,000 JPY

$\boxed{1}$

First, Player 1 makes a decision about the fraction of Player 1's earning in Experiment 2 to give. Let's assume that Player 1 decides to give 60% of own earning in Experiment 2.

$$\boxed{\substack{\text{Fraction given}\\\text{by Player 1}}} = 60\%$$

$\boxed{2}$

Second, Player 2 sees Player 1's decision, and makes a decision about the fraction of own earning in Experiment 2 to destroy. Let's assume that Player 2 decides to destroy 50% of own earning in Experiment 2.

$$\boxed{\substack{\text{Fraction destroyed}\\\text{by Player 2}}} = 50\%$$

$\boxed{3}$

The final rewards for Experiments 2 and 3 are as follows.

$$\begin{aligned}\text{Player 1's reward} &= 400 \text{ JPY}\\ &= 1000 \qquad\qquad\qquad\qquad - 1000 \times 60\%\\ \text{Player 2's reward} &= 1{,}100 \text{ JPY}\\ &= 1000 \times (100\% - 50\%) \quad + 1000 \times 60\%\end{aligned}$$

B Theoretical Analysis

Here we derive theoretical predictions assuming that decision makers have inequality averse preference represented by Fehr and Schmidt inequality aversion utility function (Fehr and Schmidt, 1999).

$$U_i(x_i, x_j) = x_i - \alpha_i \max(x_j - x_i, 0) - \beta_i \max(x_i - x_j, 0).$$

With $\alpha_i > \beta_i$, and $\alpha_i \geq 0$, $1 > \beta_i \geq 0$. We derive the subgame perfect Nash equilibrium (SPNE) for each treatment. The proposer is the taker, and the responder is the responder.

Assume that two players have the same endowment, $Y_1 = Y_2$. Let $t \in [0, 1]$ and $g \in [0, 1]$ be the take and give rates, respectively, by the proposer, and $d \in [0, 1]$ and $r \in [0, 1]$ be the rate of destruction of the own endowment and the proposer's endowment, respectively, by the responder. Note that when t and g cannot be both strictly positive. Similarly, d and r cannot be both strictly positive.

PTG: $t \in [0, 1]$**,** $g = 0$**,** $d \in [0, 1]$**,** $r = 0$**.** The responder after seeing t maximizes her utility $U_2(t, d)$ by choosing d. Noting that with $t \geq 0$, responder's payoff would not be higher than that of proposer, we have

$$\begin{aligned} U_2(t,d) &= (1-t)(1-d)Y_2 - \alpha_2\big[Y_1 + t(1-d)Y_2 - (1-t)(1-d)Y_2\big] \\ &= (1-t)(1-d)Y_2 - \alpha_2\big[Y_1 + (1-d)Y_2(2t-1)\big] \\ &= (1-d)Y_2\big[(1+\alpha_2) - t(1+2\alpha_2)\big] - \alpha_2 Y_1. \end{aligned}$$

Thus, if $t < (1+\alpha_2)/(1+2\alpha_2)$, then $d^* = 0$, otherwise, $d^* = 1$.

Taking the optimal response by responder which depends on proposer's expectation about responder's degree of disadvantageous inequality aversion, $E(\alpha_2)$, proposer decides t to maximize

$$\begin{aligned} & U_1\big(t, E(d^*(t))\big) \\ &= Y_1 + t\big(1 - E(d^*(t))\big)Y_2 - \beta_1\Big[Y_1 + t\big(1 - E(d^*(t))\big)Y_2 - (1-t)\big(1 - E(d^*(t))\big)Y_2\Big] \\ &= Y_1(1-\beta_1) + \big(1 - E(d^*(t))\big)Y_2\big[(1-2\beta_1)t + \beta_1\big]. \end{aligned}$$

Therefore, on the one hand, when $0 \leq \beta_1 < 0.5$, the proposer chooses the maximum t, such that $E(d_2^*(t)) = 0$. That is, $t^* = \big(1+E(\alpha_2)\big)/\big(1+2E(\alpha_2)\big)$. Thus, $t^* \to 1$ as $E(\alpha_2) \to 0$ and $t^* \to 1/2$ as $E(\alpha_2) \to \infty$. On the other hand, if $0.5 < \beta_1 < 1$, $t^* = 0$. Furthermore, when $\beta_1 = 0.5$, $t^* \in \Big[0, \frac{1+E(\alpha_2)}{1+2E(\alpha_2)}\Big)$

PTG+G: $t \in [0, 1]$**,** $g \in [0, 1]$**,** $d \in [0, 1]$**,** $r = 0$**.** Note that when $g > 0$, $t = 0$, and when $t > 0$, $g = 0$. The payoff for players 1 and 2, (π_1, π_2), are

$$\begin{aligned}
&\big(Y_1 + t(1-d)Y_2,\ (1-t)(1-d)Y_2\big) && \text{when } t > 0 \text{ and } g = 0; \\
&\big((1-g)Y_1,\ gY_1 + (1-d)Y_2\big) && \text{when } t = 0 \text{ and } g > 0.
\end{aligned}$$

Note that when $t \geq 0$ and $g = 0$, the problem is the same as in PTG.

When, when $g \geq 0$ and $t = 0$, the utility for responder is

$$\begin{aligned}
U_2(t = 0, g, d) &= gY_1 + (1-d)Y_2 - \beta_2(1-d)Y_2 \\
&= gY_1 + (1-d)Y_2(1-\beta_2).
\end{aligned}$$

Thus, for $\beta_2 < 1$ as we assumed, $d^* = 0$. Anticipating this response, utility of proposer (conditional on $t = 0$) is

$$U_1(t = 0, g, d) = (1-g)Y_1 - \alpha_1\big(Y_1(2g-1) + Y_2\big)$$

which is maximized with $g = 0$, and is smaller than what she can obtain by choosing $t^* \geq 0$. Thus, the equilibrium choices will be the same as in PTG.

PTG+CLR: $t \in [0, 1]$**,** $g = 0$**,** $d \in [0, 1]$**,** $r \in [0, 1]$**.** As noted above, when $r > 0$, $d = 0$, and when $d > 0$, $r = 0$. The payoffs for Players 1 and 2,

(π_1, π_2), are either

$$\big((1-r)Y_1 + tY_2,\ (1-t)Y_2\big) \qquad \text{when } r \geq 0 \text{ and } d = 0;$$
$$\big(Y_1 + t(1-d)Y_2,\ (1-t)(1-d)Y_2\big) \qquad \text{when } r = 0 \text{ and } d \geq 0.$$

The utility for responder is

$$\begin{aligned} U_2(t, r=0, d) = {} & (1-t)(1-d)Y_2 \\ & - \alpha_2\big[Y_1 + t(1-d)Y_2 - (1-t)(1-d)Y_2\big] \end{aligned}$$

or

$$\begin{aligned} U_2(t, r, d=0) = {} & (1-t)Y_2 \\ & - \alpha_2 \max\big\{(1-r)Y_1 + tY_2 - (1-t)Y_2, 0\big\} \\ & - \beta_2 \max\big\{(1-t)Y_2 - \big((1-r)Y_1 + tY_2\big), 0\big\}. \end{aligned}$$

Note that $U_2(t, r, d=0)$ is maximized when $(1-r)Y_1 + tY_2 - (1-t)Y_2 = 0$. Since $Y_1 = Y_2$ in our setting, this means $r = 2t$ if $t \leq 0.5$. In case $t > 0.5$, $U_2(t, r, d=0)$ is maximized with $r = 1$. Note further that, when $r = 2t$ and $t \leq 0.5$, because $\alpha_2\big[Y_1 + t(1-d)Y_2 - (1-t)(1-d)Y_2\big] \geq 0$, $U_2(t, r=2t, d=0) = (1-t)Y_2 \geq U_2(t, r=0, d)$ for any $d \geq 0$. We can also derive $U_2(t, r=1, d=0) \geq U_2(t, r=0, d)$ when $r = 1$ and $t > 0.5$. Thus, $r^* = \min(2t, 1)$.

Proposer who anticipates this response by responder maximizes

$$
\begin{aligned}
U_1\big(t, r^*(t), d^* = 0\big) = (1 - r^*(t))Y_1 + tY_2 \\
&- \alpha_1 \max\Big\{(1-t)Y_2 - \big((1-r^*(t))Y_1 + tY_2\big), 0\Big\} \\
&- \beta_1 \max\Big\{(1-r^*(t))Y_1 + tY_2 - (1-t)Y_2, 0\Big\}.
\end{aligned}
$$

Note that when $r^*(t) = 2t$, with $Y_1 = Y_2 = Y$, we have $U_1\big(t, r^*(t) = 2t, d^* = 0\big) = (1-t)Y$. Thus, $t^* = 0$.

If $t > 0.5$, because $r^* = 1$, we have

$$
U_1(t, r^* = 1, d^* = 0) = tY_2 - \beta_1(2t-1)Y_2 = ((1-2\beta_1)t + \beta_1)Y_2.
$$

If $1 - 2\beta_1 > 0$, this is maximized with $t = 1$. But even in this case, with $Y_1 = Y_2 = Y$, we have $U_1(t = 1, r^* = 1, d^* = 0) = Y(1 - \beta_1) \leq U_1(t = 0, r^* = 0, d^* = 0) = Y$ for any $0 \leq \beta_1 < 1/2$. Therefore, we have $t^* = 0$ and $r^* = \min\{2t, 1\}$.

PTG+G+CLR: $t \in [0, 1]$, $g \in [0, 1]$, $d \in [0, 1]$, $r \in [0, 1]$. As before, we can show that when $t = 0$, $g \geq 0$, the responder has no incentive to destroy her own or the proposer's endowment, so $r = 0$, $d = 0$. Anticipating this, the proposer sets the minimum g, that is, $g = 0$. If $t \geq 0$, $g = 0$. Then, we have seen for PTG+CLR, $r = \min\{2t, 1\}$, $d = 0$, and the proposer chooses $t = 0$. Thus, $t^* = g^* = 0$ for the proposer and $r^* = \min\{2t, 1\}$ and $d^* = 0$ for the responder.

Table 11: Equilibrium strategies in four treatments

	proposer	responder
PTG and PTG+G	$t^* \begin{cases} = \dfrac{1+E(\alpha_2)}{1+2E(\alpha_2)} & \text{if } \beta_1 \in [0, 0.5) \\ \in \left[0, \dfrac{1+E(\alpha_2)}{1+2E(\alpha_2)}\right] & \text{if } \beta_1 = 0.5 \\ = 0 & \text{if } \beta_1 \in [0.5, 1) \end{cases}$ ($g^* = 0$ in PTG+G)	$d^* = \begin{cases} 0 & \text{if } t < \dfrac{1+\alpha_2}{1+2\alpha_2} \\ 1 & \text{otherwise} \end{cases}$
PTG+CLR and PTG+G+CLR	$t^* = 0$ ($g^* = 0$ in PTG+G+CLR)	$r^* = \min\{2t, 1\}$ ($d^* = 0$)

Table 11 summarizes the theoretical predictions.

Table 12: Gender composition in four treatments

	Total		proposer		responder	
	Male	Female	Male	Female	Male	Female
PTG	32	10	17	4	15	6
PTG+CLR	27	12	14	5	13	7
PTG+G	30	12	14	7	16	5
PTG+G+CLR	27	11	14	5	13	6
p-value in χ^2 test	0.910		0.775		0.882	

Note: One participant who was assigned proposer in Treatment PTG+CLR refused to specify their gender binary, so they are not included in this table.

C Balance check

In this Appendix, we show that our samples are balanced across four treatments in terms of gender composition, measured degrees of inequality aversion (α and β), and initial emotion. We also show the result of the real effort task.

C.1 Gender composition

Table 12 shows the gender composition in four treatments. The gender composition is not significantly different across four treatments (Pearson's $\chi^2(3) = 0.5383$ ($p = 0.910$)).

C.2 Inequity aversion

Table 13 shows the average (standard deviation) of the measured α and β in each treatment. There is no statistically significant difference in the measured

Table 13: Mean (std. dev) of measured α and β in each treatment

	PTG	PTG+G	PTG+CLR	PTG+G+CLR	p-value
α	0.023	-0.004	-0.020	0.011	0.712
	(0.083)	(0.108)	(0.106)	(0.090)	
N	42	42	40	38	
β	0.016	-0.090	0.012	0.014	0.518
	(1.131)	(1.240)	(0.549)	(0.740)	
N	42	40	38	38	

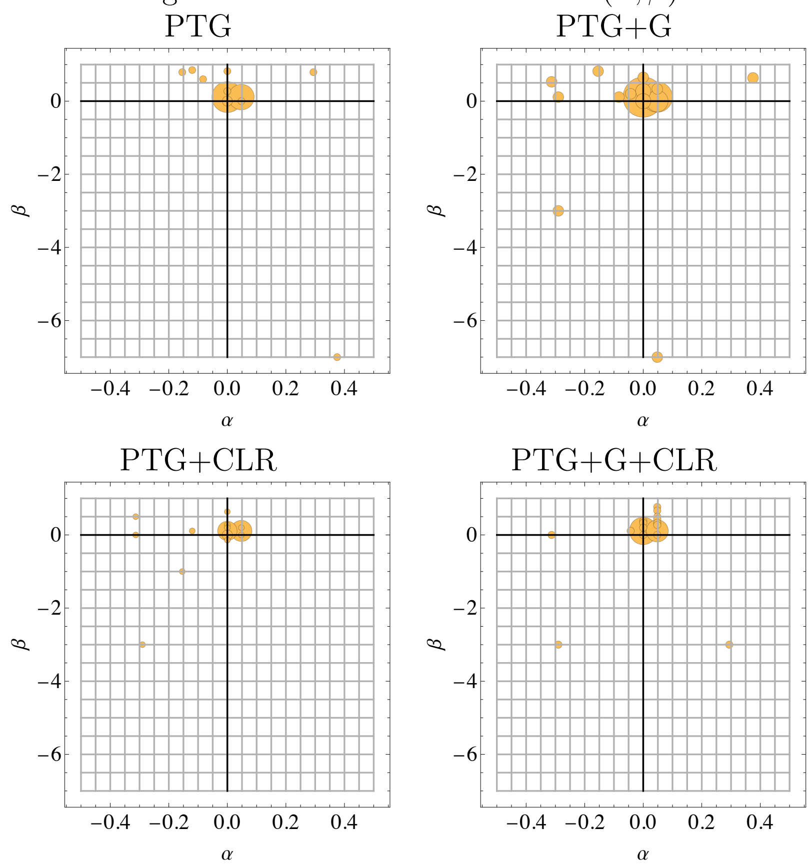
Note: P-values are based on Kruskal–Wallis test (corrected for ties).

degree of inequality aversion across four treatments. Note that there are 4 participants (2 each in PTG+G and PTG+CLR) whose β could not be computed as they have chosen the boundary of the list as their switching point.

Note that we have assumed $\alpha > \beta$, $\alpha \geq 0$, $1 > \beta \geq 0$ in deriving our hypotheses above; we do not impose these restrictions in estimating the values of α and β.

Figure 4 shows the distribution of $\{\alpha, \beta\}$ in the form of a bubble chart. The size of a dot corresponds to the number of observations at the center of the dot. As one can observe for most of the participants, $\{\alpha, \beta\}$ are either $\{0, 0.111\}$ (19, 14, 11, 14 in PTG, PTG+G, PTG+CLR, and PTG+G+CLR, respectively) or $\{0.048, 0.111\}$ (13, 8, 13, 9 in PTG, PTG+G, PTG+CLR, and PTG+G+CLR, respectively).

Figure 4: Distributions of elicited (α, β)



C.3 Initial emotion

Table 14 shows the mean (the standard deviation) of emotion measured at the beginning of the experiment. There is no significant difference in any of the measured emotions across the four treatments.[14]

[14]As we report in Appendix D emotion elicited after the instruction of the power-to-take games (but before the participants knew their assigned role) and their changes from those elicited at the beginning of the experiment. There are some emotions that changed significantly between the two points of elicitation during the experiment and are also

Table 14: Mean (Std. Dev.) of initial emotions

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	1.976	1.476	1.333	1.714	1.548	1.643	2.595	1.595	1.929	1.333
	(1.456)	(0.890)	(0.612)	(1.333)	(1.087)	(0.983)	(1.449)	(1.106)	(1.332)	(0.687)
PTG+CLR	1.857	1.429	1.333	1.738	1.429	1.548	2.143	1.262	1.548	1.381
	(1.317)	(0.831)	(0.786)	(1.191)	(0.914)	(0.993)	(1.555)	(0.627)	(1.131)	(0.882)
PTG+G	1.925	1.500	1.400	2.000	1.650	1.600	2.800	1.625	1.750	1.475
	(1.309)	(1.109)	(1.008)	(1.468)	(1.350)	(0.900)	(1.728)	(1.005)	(1.296)	(0.847)
PTG+G+CLR	2.026	1.342	1.316	1.500	1.500	1.553	2.421	1.447	1.711	1.395
	(1.551)	(0.966)	(0.962)	(1.007)	(1.084)	(1.224)	(1.687)	(0.860)	(1.206)	(1.152)
p-value (KW test)	0.969	0.608	0.516	0.450	0.935	0.766	0.176	0.281	0.531	0.597

Table 15: Outcomes of the real effort task

	proposer	responder
PTG	105.0	100.62
	(16.42)	(14.17)
PGT+CLR	104.6	110.0
	(19.67)	(19.65)
PGT+G	106.95	104.57
	(14.69)	(12.49)
PGT+G+CLR	116.68	112.63
	(20.78)	(23.37)

C.4 Effort task

As noted in Section 2, we set the reward for the real effort task so that everyone can obtain the maximum amount of 1000 JPY endowment to be used in the PTG. Table 15 summarizes the outcomes of the real effort task in terms of the number of correct answers.

As one can observe, although participants were required to answer 40 questions correctly to obtain the full endowment, on average, participants have answered more than 100 questions correctly. The result of two-way ANOVA suggests while there was a significant difference between treatments ($p = 0.0266$), there was no significant across role differences ($p = 0.6250$). Recall that the real effort task was implemented before the role for the PTG

significantly different across the four treatments. This suggests that the difference in the options available to participants in the power-to-take games across treatments influenced participants' emotions differently, although we are unable to identify the precise channels in which emotions are affected by the differences in the instruction.

was assigned.

Table 16 investigates players' decision, controlling for the number of correct answers in the effort task. As one can see, the estimated coefficients of effort are not significantly different from zero, and the estimated coefficients of the treatment dummies are similar to those reported in Tables 4 and 6.

Table 16: effect of real effort task outcome

	proposer's decision		responder's decision			
	Increase in proposer's payoff due to proposer's decision $tY_2 - gY_1$		Decrease in proposer's payoff due to responder's decision $(1-g)rY_1 + tdY_2$		Decrease in responder's payoff due to responder's decision $grY_1 + (1-t)dY_2$	
	(1)	(2)	(3)	(4)	(5)	(6)
effort	−1.414	−0.044	−0.625	−2.924	0.038	0.085
	(2.329)	(2.372)	(2.719)	(1.942)	(0.204)	(0.202)
$I_{+\text{CLR}}$		15.246		543.256***		−1.461
		(117.670)		(96.369)		(10.019)
$I_{+\text{G}}$		25.888		75.839		26.239***
		(114.514)		(93.805)		(9.752)
$I_{+\text{G}+\text{CLR}}$		−260.876**		442.543***		1.918
		(120.511)		(101.682)		(10.571)
$t-g$				6.845***		0.045
				(0.939)		(0.098)
const.	658.634**	561.089**	368.489	10.248	3.730	−10.460
	(255.445)	(251.942)	(294.378)	(212.937)	(22.067)	(22.138)
N	81	81	81	81	81	81
adj. R^2	−0.008	0.049	−0.012	0.518	−0.012	0.073

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively.

D Emotion after the instruction and after playing the game

Table 17 shows the emotion elicited after the instruction and comprehension quiz (but before knowing the assigned role and playing the game) in panel (a), as well as their changes from the initial emotions (panel b). Note that there are some significant differences in the changes in the emotion from the one elicited at the beginning of the experiment and after going through the instruction of the power-to-take games. In particular, while participants in PTG demonstrate significant increases in the intensity of irritation, anger, contempt, envy, jealousy, and sadness, such significant increases are not observed in other treatment, excpet anger in PTG+G+CLR. In fact, in terms of envy, in three other treatments, the change is the opposite (and significant in PTG+CLR and PTG+G). It is not clear to us the reason for these differences across treatments. For the change in joy, fear, and surprise, the changes are in the same direction in all four treatments and also significant, except for the surprise in PTG+CLR.

Table 18 shows the emotion elicited after playing the game separately for players 1 (panel a) and 2 (panel b).

Table 17: Mean (Std. Dev.) of emotions after instruction and their changes from the initial emotion

(a) Emotions after the instruction

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	2.571	2.167	1.690	2.262	1.929	2.190	2.095	1.548	3.000	2.405
	(1.713)	(1.560)	(1.297)	(1.754)	(1.488)	(1.565)	(1.226)	(1.131)	(1.963)	(1.901)
PTG+CLR	1.775	1.475	1.200	1.700	1.300	1.475	2.125	1.225	2.250	1.750
	(1.000)	(0.933)	(0.516)	(1.454)	(0.939)	(0.987)	(1.636)	(0.733)	(1.515)	(1.127)
PTG+G	1.976	1.571	1.405	1.500	1.357	1.595	1.786	1.262	2.048	2.000
	(1.220)	(1.016)	(0.828)	(1.088)	(0.879)	(1.270)	(1.220)	(0.544)	(1.361)	(1.498)
PTG+G+CLR	2.289	1.658	1.421	1.368	1.342	1.658	1.842	1.394	2.421	1.947
	(1.873)	(1.494)	(1.081)	(0.883)	(0.781)	(1.072)	(1.175)	(0.855)	(1.588)	(1.659)
p-value (KW test)	0.233	**0.041**	0.196	**0.026**	**0.074**	**0.045**	0.504	0.292	0.137	0.417

(b) Changes from the initial emotion

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	0.595***	0.690***	0.357*	0.548**	0.381*	0.548**	−0.500***	−0.048	1.071***	1.071***
	(1.326)	(1.522)	(1.284)	(1.596)	(1.268)	(1.626)	(1.132)	(1.188)	(1.866)	(1.930)
PTG+CLR	−0.015	−0.025	−0.200	−0.300*	−0.350*	−0.125	−0.675***	−0.400***	0.500**	0.275
	(1.001)	(1.310)	(0.853)	(1.091)	(1.099)	(1.067)	(1.248)	(0.709)	(1.359)	(1.320)
PTG+G	0.119	0.143	0.071	−0.238**	−0.071	0.048	−0.357***	0.000	0.500**	0.619**
	(1.452)	(1.095)	(0.921)	(0.692)	(0.407)	(1.188)	(0.821)	(0.442)	(1.581)	(1.592)
PTG+G+CLR	0.263	0.316**	0.105	−0.132	−0.158	0.105	−0.579***	−0.053	0.711**	0.553**
	(1.369)	(0.873)	(0.559)	(0.578)	(0.754)	(1.134)	(1.081)	(0.804)	(1.844)	(1.639)
p-value (KW test)	**0.057**	0.145	0.281	**0.035**	**0.090**	0.172	0.442	**0.024**	0.640	0.400

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively using the two tailed t-test.

Table 18: Mean (Std. Dev.) of emotions after playing the game

(a) proposer

	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	1.381	1.286	1.286	1.333	1.19	1.429	4.952	2.190	1.714	2.952
	(0.921)	(0.784)	(0.644)	(0.796)	(0.512)	(1.165)	(1.717)	(1.692)	(1.271)	(2.061)
PTG+CLR	2.400	1.900	1.800	1.350	1.250	1.950	2.650	1.600	1.450	2.150
	(1.536)	(1.410)	(1.361)	(0.745)	(0.716)	(1.432)	(2.110)	(0.940)	(0.999)	(1.268)
PTG+G	1.238	1.143	1.381	1.095	1.095	1.238	3.523	1.238	1.095	1.810
	(0.625)	(0.478)	(1.359)	(0.436)	(0.436)	(0.539)	(2.015)	(0.768)	(0.436)	(1.806)
PTG+G+CLR	2.053	2.105	2.000	1.579	1.421	1.526	3.158	1.316	1.263	2.632
	(1.682)	(2.024)	(1.826)	(1.261)	(1.121)	(1.073)	(2.035)	(0.820)	(0.733)	(2.033)
p-value (KW test)	0.009	0.040	0.209	0.366	0.683	0.172	0.004	0.021	0.114	0.090

(b) responder

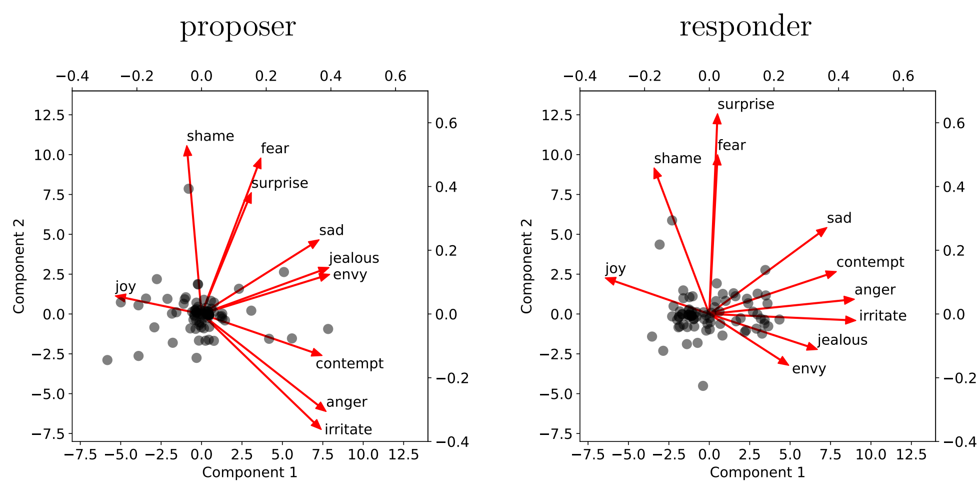
	irritate	anger	contempt	envy	jealous	sad	joy	shame	fear	surprise
PTG	3.476	3.476	3.095	3.190	3.238	3.810	2.095	2.095	2.238	3.048
	(2.639)	(2.542)	(2.700)	(2.600)	(2.587)	(2.400)	(1.758)	(1.758)	(1.868)	(2.459)
PTG+CLR	3.200	3.200	2.800	2.000	2.450	3.400	2.100	1.150	1.500	2.750
	(2.726)	(2.726)	(2.462)	(1.974)	(2.212)	(2.563)	(1.651)	(0.489)	(1.395)	(1.803)
PTG+G	3.619	3.476	2.333	3.000	2.714	3.333	1.714	1.381	1.476	2.238
	(2.269)	(2.294)	(1.983)	(2.236)	(2.053)	(2.033)	(1.384)	(0.669)	(0.873)	(1.786)
PTG+G+CLR	2.368	2.105	2.474	1.737	2.158	2.474	3.000	2.053	1.842	3.158
	(2.006)	(1.941)	(2.366)	(1.558)	(1.864)	(2.038)	(2.082)	(2.068)	(1.834)	(2.363)
p-value (KW test)	0.194	0.073	0.807	0.060	0.438	0.227	0.116	0.413	0.219	0.590

E Result of principle component analysis of emotional changes

The results of the principal component analysis are shown in Table 19. Analyzes identify four main components that jointly account for more than 70% contributions. However, following Afifi et al. (2019, Ch. 14), we retain two components in the analyses because the eigenvalues of the third and later components are small and level off than those of the first two components for both roles.

Figure 5 shows, with the arrows, the loadings of ten emotions in these two components for the proposer (left) and the responder (right). We observe that for each role, the second component consists mainly of changes in shame, fear, and surprise. The first component mainly consists of the remaining seven emotional changes, with joy having the opposite sign.

Figure 5: Biplot of proposer's (left) and Player2's (right) emotional changes



Note: Arrows show the loadings (top and right axis represent the scales) so that sum of squared values of ten emotions is equal to one. Each dot corresponds to the score for each participant (bottom and left axis represent the scale).

Table 19: Summary of principal component analysis for emotion changes before and after playing the game

(a) For proposer

Variable	Component 1	Component 2	Component 3	Component 4
Δirritate$_{32}$	**0.370**	**−0.362**	−0.101	0.057
Δanger$_{32}$	**0.385**	**−0.306**	**0.345**	−0.138
Δcontempt$_{32}$	**0.373**	−0.130	**0.456**	−0.037
Δenvy$_{32}$	**0.396**	0.124	−0.225	**0.323**
Δjealous$_{32}$	**0.394**	0.146	−0.081	**0.330**
Δsad$_{32}$	**0.364**	0.233	−0.037	0.198
Δjoy$_{32}$	−0.267	0.057	**0.433**	**0.500**
Δshame$_{32}$	−0.046	**0.528**	**0.319**	0.299
Δfear$_{32}$	0.183	**0.490**	**−0.365**	−0.278
Δsurprise$_{32}$	0.154	**0.381**	**0.427**	**−0.555**
Eigenvalue	3.777	1.759	1.136	0.953
Cum. Prop.	0.378	0.554	0.667	0.763

(b) For responder

Variable	Component 1	Component 2	Component 3	Component 4
Δirritate$_{32}$	**0.453**	−0.020	−0.180	0.214
Δanger$_{32}$	**0.449**	0.046	−0.083	0.161
Δcontempt$_{32}$	**0.393**	0.133	−0.193	0.156
Δenvy$_{32}$	0.246	−0.161	**0.609**	0.070
Δjealous$_{32}$	**0.334**	−0.111	**0.474**	0.010
Δsad$_{32}$	**0.364**	0.271	0.075	−0.079
Δjoy$_{32}$	**−0.322**	0.113	0.160	**0.613**
Δshame$_{32}$	−0.171	**0.458**	**0.501**	0.105
Δfear$_{32}$	0.026	**0.500**	0.070	**−0.630**
Δsurprise$_{32}$	0.025	**0.629**	−0.201	**0.330**
Eigenvalue	3.691	1.639	1.204	1.037
Cum. Prop.	0.369	0.533	0.653	0.757

Note: Loadings with absolute values greater than 0.3 were highlighted.

F Emotional change of proposers

Finally, we observe the change in the proposer's emotion in response to the responder's decision. Table 20 shows the result of the regressing components 1 (regression 1) and 2 (regression 3) of proposer's emotional changes on treatment dummies and decreases in payoffs of players 1 and 2 due to responder's decision. In regressions 2 and 4, we control for proposer's degree of inequality aversion (α and β).

Regressions (1) and (2) show that while the impact of responder's action on proposer's payoff ($(1-g)rY_1 + tdY_2$) positively and significantly affects component 1 of proposer's emotional changes, its impact on responder's payoff ($grY_1 + (1-t)dY_2$) does not. Recall that component 1 consists of changes in negative emotions (including those toward the opponent). Thus, as we considered, proposer's emotions are indeed influenced by the severity of responder's reaction. Furthermore, the estimated coefficients of three treatment dummies, PTG+G, PTG+CLR, and PTG+G+CLR, are all positive and significant. Thus, emotional reactions are significantly stronger in these treatments than in baseline.[15] The result remains the same when we control for the degrees of inequality aversion.

Component 2, on the contrary, is not significantly related to the decision

[15] There is no significant differences across these three treatments. P-values are 0.775 (PTG+G vs PTG+CLR), 0.412 (PTG+G vs PTG+G+CLR), 0.604 (PTG+CLR vs PTG+G+CLR) based on Wald tests for regression 1.

Table 20: Changes in emotions of proposer in response to responder's decision

	Component 1		Component 2	
	(1)	(2)	(3)	(4)
$I_{+\mathrm{CLR}}$	1.447**	1.620**	−0.885*	−1.032**
	(0.603)	(0.644)	(1.453)	(0.486)
$I_{+\mathrm{G}}$	1.269**	1.311**	−0.602	−0.630
	(0.559)	(0.564)	(0.420)	(0.425)
$I_{+\mathrm{G+CLR}}$	1.746***	1.673***	−1.192***	−1.151***
	(0.558)	(0.565)	(0.419)	(0.426)
decrease in proposer's payoff	0.0013**	0.0011**	0.0003	0.0005
$((1-g)rY_1 + tdY_2)$	(0.0005)	(0.0005)	(0.0004)	(0.0004)
decrease in responder's payoff	−0.0050	−0.0046	−0.0030	−0.0033
$(grY_1 + (1-t)dY_2)$	(0.0064)	(0.0065)	(0.0049)	(0.0049)
α		3.415		−2.206
		(2.680)		(2.021)
β		−0.208		0.090
		(0.375)		(0.283)
const.	−1.447***	−1.428***	0.574**	0.568*
	(0.380)	(0.390)	(0.285)	(0.294)
N	81	80	81	80
adj. R^2	0.212	0.210	0.044	0.034

Note: ***, **, and *: statistically significantly different from zero at 1%, 5%, and 10% levels, respectively.

of the respondent (regressions 3 and 4). Recall that component 2 consists mainly of surprise, shame, and fear. It is lower in PTG+G, PTG+CLR, and PTG++G+CLR than the baseline, and significantly so in PTG+CLR and PTG+G+CLR.[16]

[16] There is no significant difference among PTG+G, PTG+CLR, PTG+G+CLR. P-values are 0.549 (PTG+G vs PTG+CLR), 0.180 (PTG+G vs PTG+G+CLR), 0.480 (PTG+CLR vs PTG+G+CLR) based on Wald tests for regression 3.