Anonymous sharing behavior in Web experiments with different balance of power

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Abstract

We study the joint influence of anonymity and power balance on sharing behavior in bargaining interactions. To reach such a goal, we perform an innovative Web experiment based on the Ultimatum Game. The proposed experimental setting ensures strict anonymity conditions, prevents the 'wind-fall effect' and includes three different scenarios of power balance, which were designed to clearly differentiate self- and fairness-oriented preferences. Our results suggest a heterogeneity of players. Some present a behaviour according to selfish preferences, others to fairness-oriented ones, and some to other, to context-based principles like the exercise of 'the power of the last word' to punish unfair proposals. This study raises a number of further questions that need to be addressed in future experiments on bargaining behavior. For example, it is shown that the currently most established behavioral theories may need to be further improved or revised.

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1 Introduction

Social groups are known for their ability to attain shared goals, even if the individual interests are barely overlapping. In groups with clear boundaries, coordination and cooperation may be fostered through a variety of mechanisms that make members accountable for their actions [18]. However, when (social) exchange is anonymous (as in financial market or, to a certain extent, in the Internet), accountability is not given. Anonymity removes the possibility of sanctioning non-cooperative behaviours, which creates incentives to defect and free-ride, thus decreasing the amount of sharing behavior that is vital for the survival of the group [12]. Nonetheless, cooperative behavior is often observed in those settings where anonymity is the norm rather than the exception. A good example is Wikipedia, where records of contributions are kept and publicly accessible [6, 11]. Techno-social systems like this are by nature geographically dispersed and decentralized and thus require self-organization of mechanisms to create cooperative outcomes.

One simple scenario that may allow us to get a better understanding of the joint effects of anonymity and power on sharing behavior is that of two individuals bargaining over some kind of resource. Traditionally, this scenario has been studied by economists by means of the Ultimatum Game (UG) [14]. In the classical UG, one person (the *proposer*) receives a certain amount of money and is asked to make an offer to another person (the *responder*) on how to share it. If the responder accepts the offer, they share the money accordingly and keep it. If the responder does not accept, neither keeps any money. Therefore, to gain a benefit, proposer and responder need

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to establish a successful transaction. Rational choice theory suggests that self-regarding responders will accept *any* offer – as this is better than nothing – and that proposers will make an offer as low as possible, in order to gain the biggest benefit themselves [14]. If the responder is fairness-oriented, however, very different predictions are expected.

In fact, it has been experimentally observed that responders tend to reject disappointingly low offers and that proposers tend to make almost fair offers, about 60:40 in slight favor of the proposer [14]. Based on these observations, some authors [15, 5, 22] suggest that, in this kind of exchanges, people may have an inherent preference towards fairness [8, 4]. Recent literature suggests that the emergence of this fairness might be related to mistakes made by players when judging the situation [21]. However the influence of different experimental conditions on the emergence and robustness of other-regarding behaviour in bargaining situations is still widely unexplored.

In this paper, we will study the joint influence of anonymity and power balance on sharing behavior in the Ultimatum Game, since one may hypothesize that people would make less fair offers under conditions of anonymity. To reach such a goal, we propose an innovative experimental setting which prevents the 'wind-fall effect' [1] and includes three different treatments regarding the power balance to better assess self- and fairness-oriented preferences.

Besides contributing to a better understanding of anonymous bargaining interactions in techno-social systems, our experimental setting could be an interesting model for studying bargaining relationships in situations with power imbalances (e.g. producers and customers, or employers and employees, for instance). This applies particularly if we assume a different number of alternatives for the producer or employer on the proposer's side and for the customer or employee on the responder's side. Would it be possible to explain overpriced products or precarious working conditions from anonymity and too little power of responders?

2 Methodology

2.1 Anonymous Web Experimental Setup

In the classical Ultimatum Game, experimental subjects have to share money they receive from the experimenter. To avoid the effect of windfall gains, Berger et al. proposed to share waiting time [2]. Extending their principle, we asked players to share work – 300 elementary calculations. Even more than in Berger et al. [2], high levels of anonymity and confidentiality were ensured by disallowing direct, personal contact between participants and experimenters, and among participants, see Figure 1. In our case, we chose to perform a Web experiment. This was done for a number of reasons: first, a setup with multiple separated spatial areas within a laboratory facility would have been too complicated; second, it would have limited the number of participant that could simultaneously take part in each experimental session; and third, it would have not prevented participants from meeting at the precincts of the laboratory before or after the experiment.

In our Web experiment, participants were not required to disclose any personal information to access the website of the experiment and were not assigned any data that could potentially allow experimenters to individually

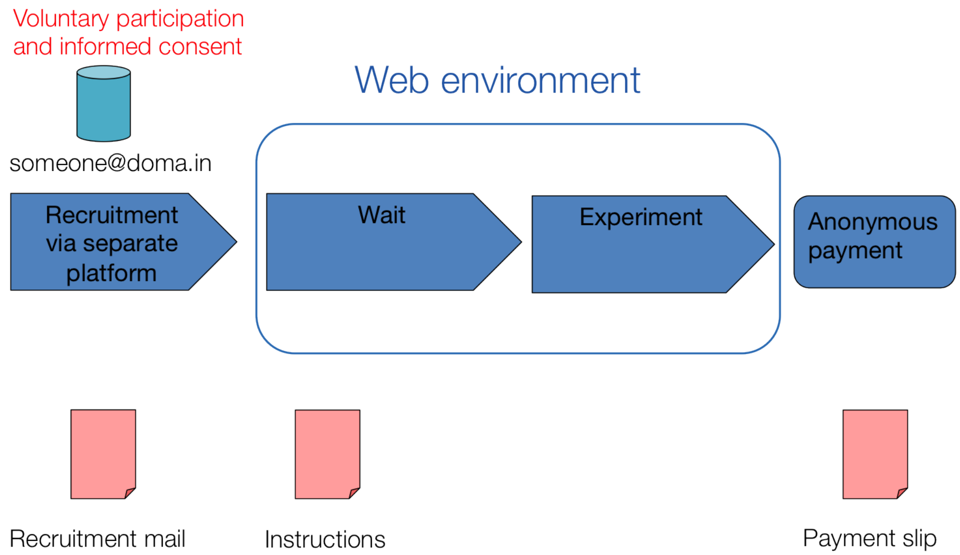

Figure 1: Setup of the experiment performed (see also [16]). The on-line part of the experiment, during which subjects played the Ultimatum Game, is within the solid line. The Appendix presents details about the recruitment message and the instructions provided to the subjects.

track their actions, such as cookies or a personalized URL.

Participants were randomly drawn from the student body of the Swiss Federal Institute of Technology (ETH) in Zürich. They were contacted via email, using a generic, anonymous message (see Appendix). For each experimental session 1,000 participants were randomly selected and contacted. Participants invited to an experimental session were never contacted again for other sessions.

All participants of the same session received the same session password, which was composed of randomly-drawn terms from the Basic English vocabulary. For each session a different password was generated. This made each session password useless for accessing subsequent sessions. Of course having no control of participants, we could not fully exclude that some might share their invitation emails with other people, thus we explicitly asked participants not to disclose the invitation email to any third party.

2.2 Ultimatum Game with different power structure

The ultimatum game itself was implemented as an interactive web application written with Django[1]. The application featured different phases in which participants, depending on their role, would either be requested to perform some action or wait for the input of the other participant.

Because a long waiting time could influence the behavior of participants, we measured the duration of such time spans and controlled for it in the subsequent analysis. Additionally, we measured opportunity costs in terms of the average outside temperature and the day of the week (all sessions occurred in the first part of the week and for comparable, non-sunny weather conditions). Table 2 summarizes all control variables used in the subsequent analysis. We introduce the other variables in the following.

After signing in with the session password, participants were asked to read the instructions of the experiment (see Appendix for details), to confirm that they had fully read and understood them, and to wait to be matched with another person ('login wait', see Table 2). Participants were matched into (gaming) pairs following their order of arrival, thus ensuring that at every moment there was at most one participant waiting to be matched.

Once matched, the server would randomly assign roles (proposer or responder) and the experimental treatment under which that specific instance

[1] http://www.djangoproject.com.

Table 1: Payoff functions for proposers and responders in the three experimental treatments. Top row: amount of work (elementary calculations) x_p and x_r assigned, respectively, to the proposer and the responder in case of acceptance, as a function of the slider position X. Note that the resolution of X is $1/30$, so that $x_p \in [30, 270]$. Bottom row, inner table: number of additions x'_p and x'_r assigned in case of rejection in each experimental treatment.

Proposed share (offer)	$x_p = 30 \cdot X, \quad x_r = 30 \cdot (10 - X), \quad X = 30/30, 31/30, \ldots, 270/30$		
In case of rejection	Weak proposer	Weak responder	Balanced
	$x'_p = 30 \cdot (X + 11)$ $x'_r = 30 \cdot (9 - X)$	$x'_p = 30 \cdot (X + 8)$ $x'_r = 30 \cdot (12 - X)$	$x'_p = 30 \cdot (21 - X)$ $x'_r = 30 \cdot (X - 1)$

of the Ultimatum Game would be performed (see Table 1).

The two players were next asked to solve three test calculations, to get an idea of the workload and of the interactive interface. Once completed, the proposer was presented with the proposal screen, while the responder was asked to wait.

At this point of the game, proposers could choose how to share the workload by selecting with a slider the number of additions x_p they were willing to do, ranging from a minimum value of $x_p = 30$ a maximum of $x_p = 270$, see Table 1, top row. For each choice of x_p, the interface would also show the associated value x_r of additions assigned to the responder, as well as the values $\left(x'_p, x'_r\right)$ that the two would have to perform in case the responder rejected the offer. Table 1 shows the payoff functions for proposers and responders in the three treatments. By default, the total number of additions to share was $x_p+x_r = 300$. In case of rejection, the total amount was doubled ($x_p + x_r = 600$) and split according to the experimental treatment; the rules for computing x'_p and x'_r in each treatment are shown in the bottom part of Table 1. In order to avoid possible biases in the choice of x_p, the handle was not shown until the proposer clicked on the slider. Consistently with the literature on Ultimatum Games, in the following we normalize x_p by the total amount of additions $x_p + x_r = 300$, and report results for the percentage share of workload proposed.

Next, the responder was asked to review the whole quadruple $\left(x_p, x_r, x'_p, x'_r\right)$ and to decide whether to accept or reject the offer. The proposer would then be notified of the decision of the responder and both were taken to the work screen, where they had to solve all sums assigned to them.

Because we could not control how long subjects would take to formulate their choices, we recorded the time it took proposers and respectively responders to take their decisions, and controlled for it in the subsequent analysis ('waiting time', see Table 2).

During the work phase, we monitored the progress of both players in solving their share of the workload, and let each player see how fast the other was at solving his or her workload. Using a Javascript code on the client side we collected, with milliseconds accuracy, the time stamp at which each calculation was correctly entered by each player. With this information we computed the speed at which participants performed their workload (i.e. number of correctly solved calculations per second, see Table 2), and considered it in the subsequent analysis, both as a possible confounding factor, and as a measure of perceived cost.

After entering correctly all calculations to be performed, each player was taken to a final debriefing screen that congratulated to their completion of the experiment. To measure other-regarding preferences, players were at this

Table 2: Control variables included in the analysis of proposed workloads and responses.

Variable	Description
temp. (°C)	Average outside temperature
day	Day of week
login wait (min.)	Time waited before matching occurred
treatment	Factor: 'balanced', 'weak proposer', 'weak responder'
waiting time (min.)	*Proposers*: time spent during proposal phase. *Responders*: time spent during proposal and response phase.
trials speed (s^{-1})	Average calculation speed
donation	Fraction of reward donated to ICRC
payment received	Was the reward collected after 30 days?

point asked whether they wanted to donate part of their monetary reward to the International Committee of the Red Cross (ICRC). Participants could also choose not to donate any amount, in which case they had to insert an amount of 0 CHF. A printable voucher would then be generated, showing the amount to be paid, namely 17 CHF minus the donation. Participants could redeem their voucher at the cash desk of the main building of ETH Zürich. In order to avoid counterfeiting, each voucher carried a unique, random code. At the cash desk, the cashier would insert the code in our database to check if genuine, and mark the voucher as paid. This also enabled us to track which participants collected their rewards and which did not. In order to ensure the anonymity of subjects with regards to us also in this stage of the experiment, no signature or personal identifying information was required to cash the voucher. We also chose not to administer any debriefing survey at the end of the on-line part of the experiment in order to avoid the feeling that personal data might be revealed.

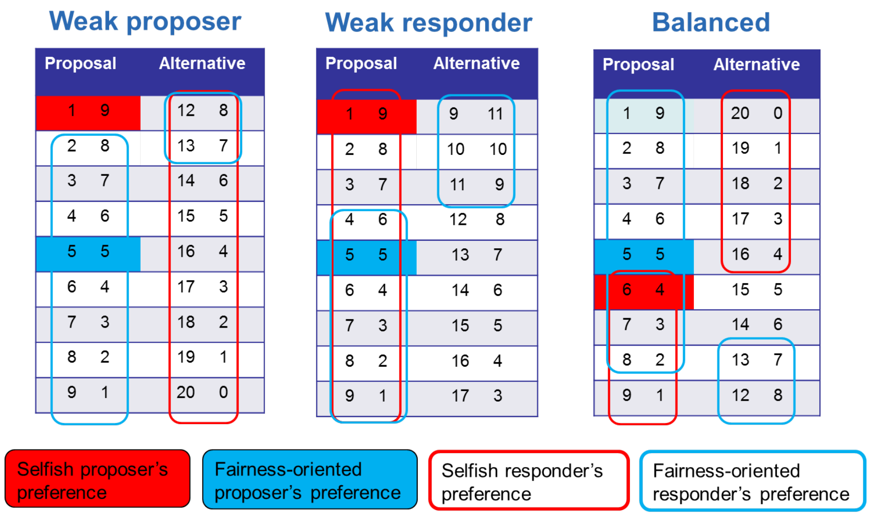

Figure 2: Rational choice predictions for self- and fairness-oriented preferences. For each panel, the proposal and the alternative workload in case of rejection are shown, as a function of the proposal X, for each treatment. Colors code the predicted proposals (solid cells) and responses (outlined cells).

2.3 Rational choice theoretical predictions for self-regarding and fairness-oriented players

For the three treatments of our modified Ultimatum Game experiment, we derived the expected behaviors of proposers and responders according to self- and fairness-oriented rational choice theory. From a self-oriented choice perspective, responders should always reject, if this would reduce their number of calculations to do. A self-oriented proposer is assumed to make the offer that is best for him or her (i.e. minimizes the number of calculations to be done), assuming that the responder accepts or rejects offers based on self-oriented reasoning as well. According to our specification of treatments, rational responders would reject all offers in the 'weak proposer' treatment and accept all offers in the ‘weak responder’ treatment, while in the ‘balanced’ treatment, the response depends on the concrete offer (see Fig. 2).

Our fairness-oriented theoretical predictions were based on the assumption that proposers and responders would try to maximize fairness, i.e. minimize the difference in the number of tasks to be performed by both players. The payoff structures were chosen to have significant differences in expected behaviors.

3 Results

3.1 Experimental turnout and rate of completion

We performed four experimental sessions, sending out 4,000 invitation emails in total. Weather conditions and time of the day were similar in all sessions. Altogether, 246 participants visited the website of the experiment. This amounts to a 6.15% show-up rate. To our knowledge, the literature on Web experiments is too scarce to let us determine the significance of this rate. Typical response rates in Web surveys are slightly higher [7], but Web experiments are usually also more demanding in terms of involvement requested from participants.

A total of 98 games were completed, such that both players stayed until the end of the experiment. Split by treatment these are: 38 games in the ’weak proposer’, 30 in the ‘weak responder’, and 30 in the ‘balanced’ treatment. Not all participants completed the experiment: 32 left before being matched to another player: 13 during the proposal phase (‘weak proposer’: 7, ’weak responder’: 3, and ‘balanced’: 3), and 5 after the game started ('weak proposer': 2, 'balanced': 3). Given the large number of additions to be solved, this is an astonishing number of participants who stayed until the end.

3.2 Comparison with theoretical predictions

When comparing the predictions of rational choice theory for self- and fairness-oriented preferences in Section 2.3 with our experimental results, our main findings are:

1. Despite the high level of anonymity and the differences in the payoff functions, there were a large number of fair offers (equal distribution of workload) in all three treatments. More concretely, the percentages of such offers were 43%, 25% and 30%.

2. In treatment 1 ('weak proposer'), two altruistic offers (i.e. putting 90% of the workload on the side of the proposer) were made. One of them was nevertheless rejected, which would speak for a self-oriented rational response.

3. In treatment 2 ('weak responder'), 60% of the offers made were unfair (to the benefit of the proposer).

4. The rate of rejection was highest in treatment 2 ('weak responder'). Specifically, rejection rates were 15%, 34% and 26%, respectively.

5. We also note that the rejection of some offers in treatments 2 (and also in treatment 3) was neither consistent with self- nor fairness-oriented rational preferences.

One might interpret the last observation such that responders may have tried to compensate for the feeling of weakness by rejection, thereby executing something similar to the 'power of the last word'. Figure 3 summarizes the proposals offered and the relative responses across all treatments.

The mean proposal was $45.65\% \pm 5.11\%$ (136.97 trials, standard dev. 46.05), and the median proposal was 50%. Broken down by treatment, the mean proposal was $44.87\% \pm 7.86\%$ (134.6 trials, s.d. 46.6 trials) in case of 'weak proposer' (treatment 1), $40.31\% \pm 8.96\%$ (120.9 trials, s.d. 50.9) in case of 'weak responder' (treatment 2), and $52.00\% \pm 9.27\%$ (156.0 trials, s.d. 33.0 trials) in case of the 'balanced' treatment.

3.3 Analysis of proposed workloads and rate of acceptance

Since our predictions based on rational choice were not able to fully explain the results, we performed a regression analysis of the proposed workloads, controlling for possible confounding factors due to our experimental setup. Because the variable x_p is a proportion, we consider a model with beta-distributed errors [9].

The results of the regression analysis are reported in Table 3. To perform this analysis, we take into account only proposers. The overall effect of the treatment is significant ($\chi^2 = 9.8, p = 0.0074$) The log-likelihood of the model is 45.81 on 11 degrees of freedom, with pseudo $R^2 = 0.1862$. This quantity can be interpreted as the amount of variance explained by different treatments, after controlling for other confounding factors. In particular, we see that relative to a 'balanced' scenario, proposer make smaller (i.e. more selfish), proposals in both the 'weak proposer' ($p < 0.05$) and the'weak

Table 3: Results of the regression analysis of the proposals offered and the responders' reactions.

	Estimate	Std. Error	z value	$Pr(>\|z\|)$	
intercept	2.23171	1.46985	1.1518	0.12893	
weak proposer	−0.32142	0.15851	−2.028	0.04258	*
weak responder	−0.53402	0.17220	−3.101	0.00193	**
waiting time	−0.22138	0.08879	−2.493	0.01265	*
donation	−0.03724	0.20682	−0.180	0.85711	
payment received	−0.19019	0.15971	−1.191	0.23372	
day = Tue	0.23832	0.21784	1.094	0.27396	
day = Wed	1.01440	0.90191	1.125	0.26071	
login wait	−0.12042	0.12854	−0.937	0.34887	
temp.	−0.18093	0.15027	−1.204	0.22858	

Notes: 'day' coefficients relative to day = Mon.

responder' ($p < 0.005$) treatments. A longer waiting time is also associated to smaller proposals ($p < 0.05$). This means that proposers who took longer to formulate their proposals also offered to do less work themselves (−22% for each extra minute). Besides these factors, neither the fraction of donated reward, nor whether the payment was collected, the variables representing opportunity costs have a significant effect on the choice of the proposed workload.

Table 4: Logistic regression analysis of responses to proposals.

	Estimate	Std. Error	$Pr(>\|z\|)$	
intercept	3.614	2.88	0.2091	
proposal	−4.638	5.01	0.3544	
weak proposer	−5.067	3.16	0.1091	
weak responder	−4.456	3.04	0.1421	
proposal:weak proposer	13.006	5.97	0.0294	*
proposal:weak responder	8.011	5.50	0.1456	

Figure 4 shows frequencies of rejection and acceptance along with error bars, computed as the square root of the frequencies. The rejection rates were 16%, 36%, and 27% for the 'weak proposer', 'weak responder', and 'balanced' treatments, respectively.

In order to understand possible causes of rejection we performed a logistic regression of the response variable. We used only observations related to responders. Because we want to understand the effect of different proposals for each experimental treatment, we tested an interaction between the proposal x_p and the treatment factor. The inclusion of control variables (see Table 2) did not significantly increase explained variability, so we decided to report only a simpler model without them.

Table 4 reports the estimated coefficients as well as robust standard errors obtained via a heteroscedasticity-consistent estimator. The residual deviance of the model is $D = 89.5$ with 88 degrees of freedom, thus indicating a significant fit over the null model ($p = 0.44$). The regression shows a mild effect due to the treatment ($\chi^2 = 8.9$, df $= 4$, $p = 0.07$), mostly due to higher chances of acceptance for higher proposed workloads in the 'weak proposer' treatment, though the estimate is too noisy to be considered reliable ($e^\beta = 3 \cdot 10^3$, 95%CI $= [3.69 \cdot 10^{-1}, 7.79 \cdot 10^7]$).

3.4 Workload distribution

We analyzed the resulting workloads across treatments and roles by plotting the histograms of the number of additions that participants eventually did. The results are shown in Fig. 5. The 'weak proposer' treatment is characterized by roughly comparable distributions between proposers and responders (see top panels in Fig. 5), with the exception of a number of proposers with high workloads due to rejection. This thus confirms the weaker negotiating power of proposers in this treatment.

Quite surprisingly, the ‘weak responder’ treatment (see middle panels in Fig. 5) revealed a balanced situation between proposers and responders, instead of the expected disadvantage to responders.

In the ‘balanced’ treatment (Fig. 5, bottom panels) the workload distribution of proposers is markedly bimodal due to rejected offers. While most rejections were in response to unfair offers, a number of fair offers were rejected as well. Consequently, the responders never ended up with heavy workloads. We consider this as remarkable, given that the treatment was expected to represent a balance of power between proposers and responder. This result suggest that the responders may be driven by self-oriented preferences.

3.5 Donations and Payments

In order to measure other-regarding preferences without compromising the perceived level of confidentiality of our experimental subjects, we asked them whether they wanted to donate part of their financial compensation to the International Committee of the Red Cross (ICRC). While the majority of subjects did not make any donations, which speaks for self-oriented preferences, 30% of them donated part of their money, and their average donation was 8.40($\pm$6.79) Swiss Francs. If non-donors are also taken into account, the average donation was 2.63($\pm$5.44) Swiss Francs.

Table 5 provides detailed information by treatment. No significant differences are observable across treatment, suggesting that the balance of power did not affect donating behavior. To better understand the interplay be-

Table 5: Average donations and percentage of donors across treatments.

	'weak proposer'	'weak responder'	'balanced'
Donation	2.37 ± 5.35	2.84 ± 5.45	2.77 ± 5.62
Donation (only>0)	8.24 ± 7.23	8.68 ± 6.38	8.31 ± 7.05
Donors (%)	29%	33%	33%

tween the response, role, and treatment in determining how much money subjects donated, we plot the actual number of calculations performed versus the fraction of money donated, see Fig. 6. Interestingly, there is a clear linear separation among rejected and accepted proposals (right panel). Moreover, almost no donation above 30% of the financial compensation is observed for rejected proposers whose workload exceeded 300 calculations. This is consistent with the hypothesis of self-oriented rational proposers. In terms of discriminating power, the fraction of donated money could be regarded as a good measure of the level of other-regarding preferences. At the same time, however, the correlation between low donation and selfish preferences can only be considered a necessary condition, since responders (left panel) do not show any discernible separation nor pattern. This also explaining why the donated amount was a poor predictor in our regression analyses (see Tab. 3).

4 Summary and conclusions

With the goal of learning more about the role of anonymity and power balance between proposers and responders on the surprisingly fair outcomes of experiments about sharing behavior [4], we have performed a Web experiment considering three variants of the Ultimatum Game. One treatment assigned low bargaining power to proposers, another one low to responders, and the third one was expected to be balanced. The whole experiment (from the recruitment of subjects to the payment of their economic compensations) was conducted under strict anonymity conditions. Besides, in order to avoid 'windfall gains', we made the subjects to bargain over workload. Notice that other options already tested in lab experiments, like bargaining over waiting time, would be useless in a Web environment.

The choice of treatments, power, and payoffs was made in such a way that the difference between the predictions for both rational choice variants would be large, thus distinguishing between self- and fairness-oriented preferences by experimental results would be possible. However, neither theory could explain all experimental results in a consistent way.

Despite the large variation of power in our experiments and the high level of anonymity, we observed a surprisingly large number of fair proposals. Donations at the end of the experiment were partially supportive of a rational choice interpretation and partially of fair behavior. However, certain rejections of offers could neither be explained by rational choice nor by fairness theory. This is clearly the case for all rejections made in the 'weak proposer' treatment, as well as for some in the 'balanced' treatment, which were very costly to proposers.

Our experimental results thus suggest a heterogeneity of players – some behaving according to selfish preferences, others to fairness-oriented ones, and some to other, unknown principles [10, 23, 13]. For example, in some cases responders might want to exercise "the power of the last word", to compensate for their feeling of weakness or unfair treatment.

The experimental setting was also design to ensure high level anonymity. This did promote non-cooperative behavior on the side of responders, sometimes with dramatic consequences. Anecdotally, in the ‘balanced’ treatment we observed a proposer offer a perfectly fair split ($x_p = 150$ calculations), whose offer was rejected – thereby being assigned with a particularly heavy workload of $x'_p = 480$ calculations. That proposer terminated his or her participation right after starting the workload. While we cannot exclude a merely technical reason for the dropout (such as a loss of Internet connectivity), the case is nonetheless symptomatic of the extent to which some responders strategically exploited the situation to their advantage, in spite of any norm of fairness.

Since our predictions, based on rational choice theory, were not able to fully explain the results, we performed regression analyses of the proposed workloads and responders' reactions, controlling for possible confounding factors due to our experimental setup. The list of such independent variables included factors such as the waiting times at different stages of the experiment and the payment received. Besides the treatment, only the time taken by proposers to make their offer showed a significant correlation with the workload proposers offered to do. Specifically, proposals that took longer to be formulated were slightly more self-oriented ($p < 0.05$).

Our study raises a number of further questions that need to be addressed in future experiments on bargaining behavior, possibly also conducted on Web environments like Amazon's Mechanical Turk [19, 3, 20, 17]. For example, our Web experiment indicates that the currently most established behavioral theories may need to be further improved or revised. Moreover treatments that were thought to establish a balance of power rather resulted in unbalanced outcomes, while conditions that were expected to put responders into a weak position actually produced balanced outcomes (thanks to the possibility to sanction bad offers by rejection). From the perspective of mechanisms design, this is an interesting lesson.

Author contributions

SL, GLC, and DH performed the UG Web experiment; the experimental platform was developed by GLC during his affiliation at ETH Zürich; the experiment was was designed by DH, with the support of SL, Heiko Rauhut and Silvana Jud; data were analyzed by GLC and SL; the paper was written by GLC, SL, and DH.

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A Sample of invitation email sent to potential participants

Hello,

we would like to invite you to take part in an online experiment. All you have to do is to login to http://www.hermes.ethz.ch/experiment today, Thursday 12, between 20:00 and 20:30 with this password: seem-degree-rail-debt-wat You will be randomly matched with another participant and will play the game online. The experiment takes normally less than an hour. At the end of it you will receive a coupon worth 17.- CHF. You can exchange the coupon for cash at the official ETH cashier desk in the main building without providing your name or signature. Please do not talk with anyone about this experiment if you decide to join it. Thank you very much

The Decision Science Laboratory (www.descil.ethz.ch)

B Instructions provided to participants

The following instructions were given to all participants before assigning them a role of the ultimatum game (i.e. proposer or responder).

Introduction

Dear participant,

you are currently taking part in a scientific experiment on sharing work (distributing tasks). **The experiment is estimated to take less than an hour, possibly much less**. Please make sure that you have enough time for this experiment. In order to receive the payment of 17 CHF, it is required that you finish the experiment according to these instructions. You will then receive a coupon with a code that can be exchanged for cash without disclosing your name or signature.

The experiment

This experiment involves two participants. We will call them **participant A** and **participant B** from now on. There are a number of simple tasks that have to be solved. Each of these tasks is a simple arithmetic calculation, like "$2+2=4$".

Participant A will make a proposal how to divide the work between both participants. Participant B will be asked to accept or reject the proposal of participant A.

In case of rejection, a higher number of tasks will be distributed. This distribution is coupled to and varies with the proposal of participant A. It will be shown to him/her when making the proposal but cannot be independently controlled.

Starting the experiment

After reading all pages of these instructions, please click on the START button below on this screen. If the other participant has not done so yet, you will have to wait for him or her to do so.

IMPORTANT: It might take a several minutes for the other participant to log on and read the instructions, so please wait. The screen will refresh automatically. During this period, you can read a book, but please keep an eye on the screen. A sound will be played to notify you that the experiment has started.

Next, you will be taken to this screen (see picture below), where you will have to solve 3 example tasks. This test will familiarize you with the tasks. After solving the 3 example tasks, you will be taken to the proposal phase.

Proposal phase

If you are participant B, you will have to wait. The page will refresh automatically.

If you are participant A, you will see the screen below.

If you are participant A, you can use the slider in the middle of the screen to select how to share the work.[2]

[2] In order to avoid influencing the decisions of proposers, the control bar to determine the offer showed up only after the proposer clicked on the scale that represented the full parameter range.

The left panel lists your proposal. The right panel shows the amount of work that both of you will have to solve if participant B rejects the proposal.

To submit your choice to participant B, please click the button SEND PROPOSAL.

This will take you to the Reply phase.

Reply phase

At this point, if you are participant A, you will have to wait. If you are participant B, this is the screen you will see:
Participant B must now click ACCEPT or REJECT to reply to the proposal of participant A. After this, the work phase will begin.

Work phase

Both participants will be taken back to the calculation screen. If you are participant A, you will be notified of the decision of participant B. After that, both participants can start solving the calculations.

If a wrong value is inserted, you will be asked again to insert the correct value. Please note that you will receive the payment only if you solve all calculations that you have been assigned.

Thank you for participating in this experiment!

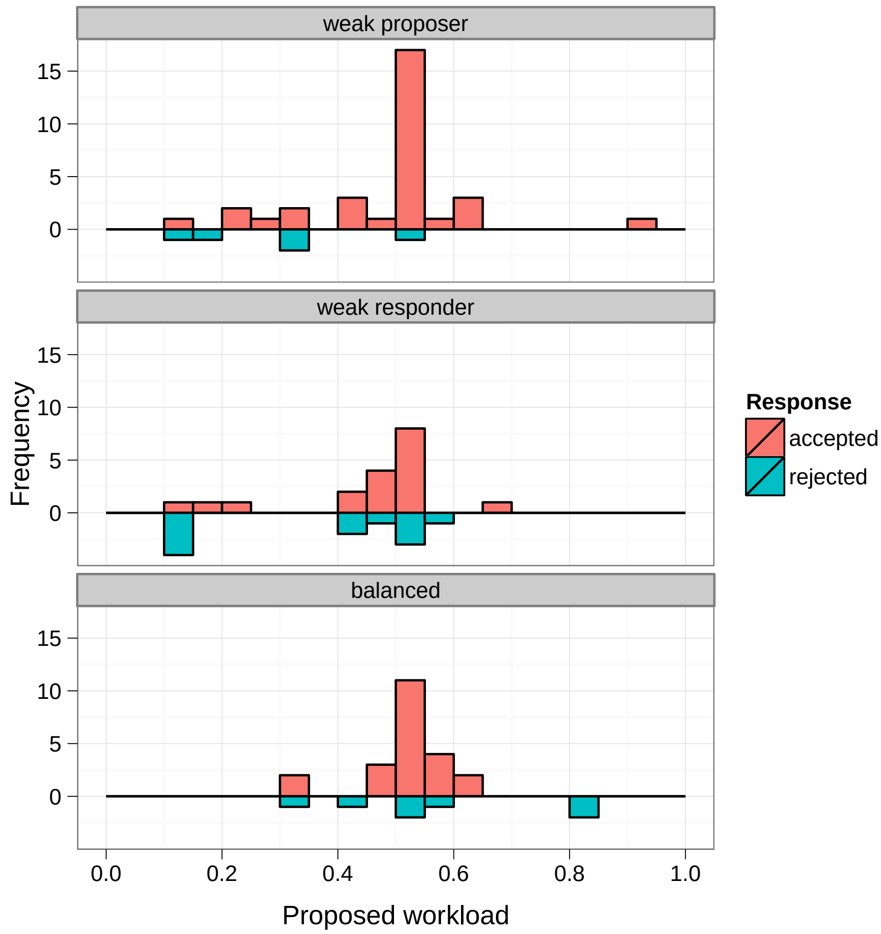


Figure 3: Proposals offered. Frequency of proposed workloads, color-coded and stacked by response. Red bars, positive stacking: accepted proposals. Green bars, negative stacking: rejected proposals.

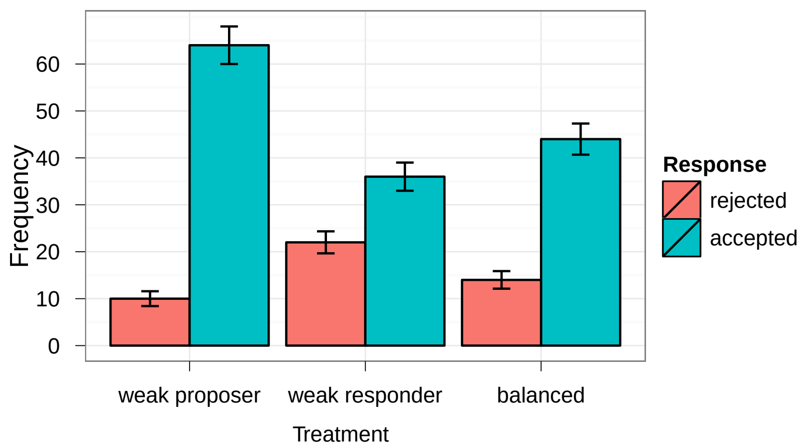


Figure 4: Frequencies of responses by treatment. Red: Rejected response; cyan: Accepted response. Error bars have been computed as the square root of the frequencies.

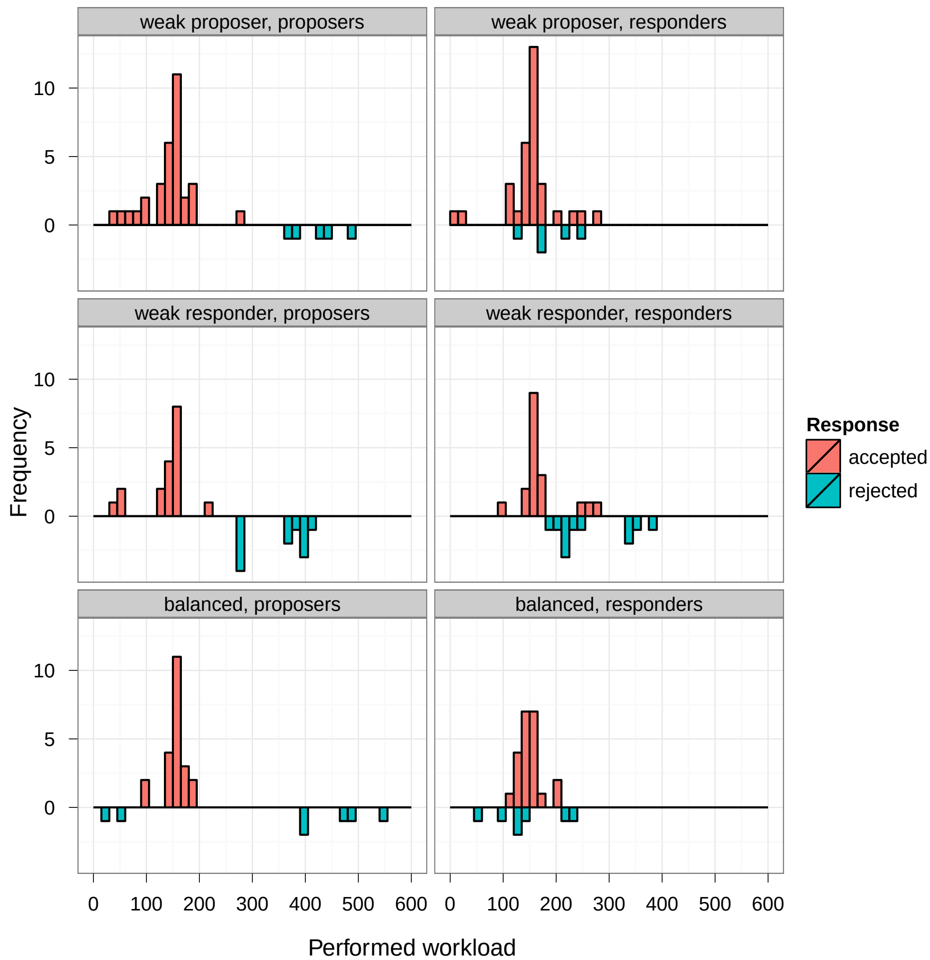


Figure 5: Performed workloads. Frequency of performed workloads by treatment and role, color-coded and stacked by response. Red bars, positive stacking: accepted proposals. Green bars, negative stacking: rejected proposals. The bin width in this plot is comparable to that used in Fig. 3.

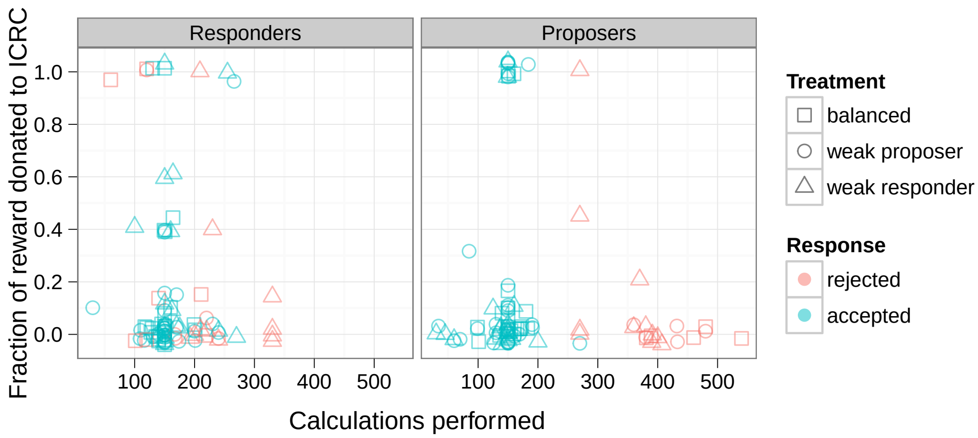
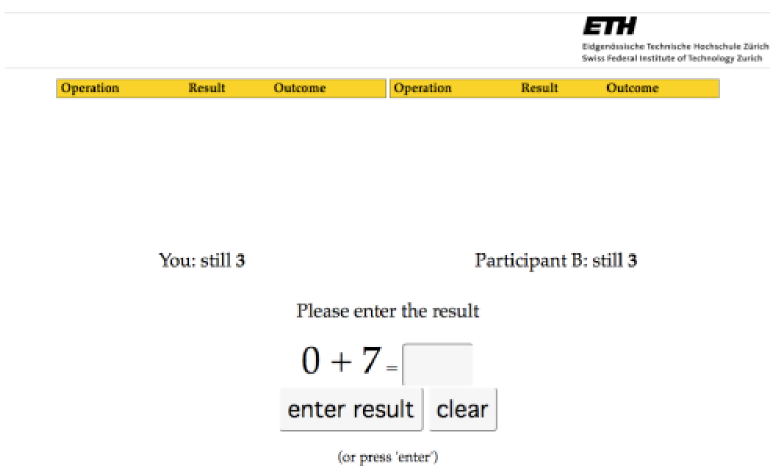
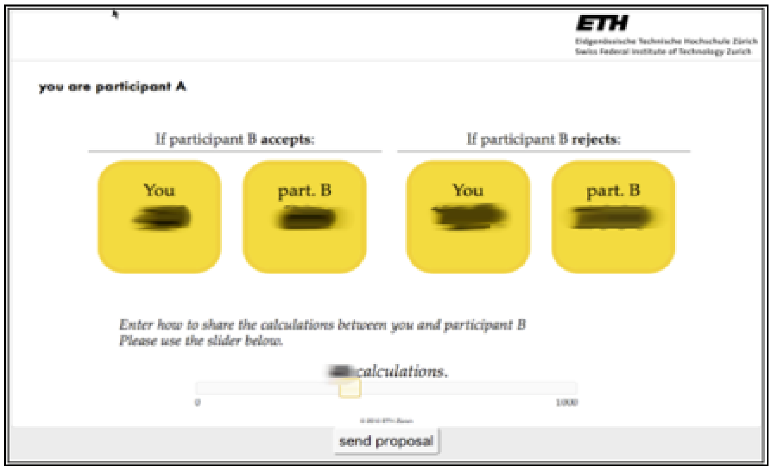


Figure 6: Donations by actual workload and role. Fraction of money donated to the ICRC versus the absolute number of calculations performed. Each point corresponds to one participant. The symbol shape represents the experimental treatment, the color the response (blue: accepted, red: rejected). A small amount of random noise was added to the points in order to improve readability.




ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
you are participant A
If participant B accepts:
If participant B rejects:
You
part. B
You
part. B
Enter how to share the calculations between you and participant B
Please use the slider below.
calculations.
0
1000
send proposal


ETH
Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich
you are participant B
If you accept
If you reject
You
part. A
You
part. A
accept
reject