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SENSE OF FAIRNESS OR HUNGER FOR REVENGE? IT DOES MAKE A DIFFERENCE

Mihály Ormos
Eötvös Loránd University,
Budapest, Hungary and
John von Neumann University
Kecskemét, Hungary
E-mail: ormos.mihaly@gtk.elte.hu
ORCID: 0000-0002-3224-7636

Dusán Timotity
WorldQuant LLC,
Budapest, Hungary
E-mail:
dusan.timotity@worldquant.com

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ABSTRACT. We analyze the driving factors of anomalistic patterns found in experimental studies related to bargaining games. In particular, we investigate whether the well-documented deviation from self-interested behavior can be partly, or entirely, attributed to revenge rather than fairness. Although, in general, related literature does not distinguish between the two latter notions, we highlight their differences and show that revenge significantly, and independently from the sense of fairness, contributes to decision-making in ultimatum games. Moreover, we show that, when controlling for various attributes, the hunger for revenge becomes the sole driving factor for both positively and negatively reciprocal behavior, rendering the sense of fairness insignificant. Our further cross-sectional analysis yields that gender differences are also very significant; however, the measured effects of fairness and revenge remain unaffected by this latter finding.

Keywords: ultimatum game, bargaining game, reciprocal behavior, revenge, fairness, gender differences

Introduction

Since the milestone paper of Güth et al. (1982), analysis of anomalistic behavior in experimental games has motivated a great number of papers in academia. The authors' proposed setting, called ultimatum bargaining, has evolved into the main workhorse of experimental analysis of fairness over the last thirty years. Despite the great deal of literature devoted to this topic, one of the key points in the analysis of determining factors behind anomalies has rarely been defined in a clear, unambiguous manner. In particular, the notion of fairness and its role in ultimatum games is often considered as the sole proxy variable for positive or negative reciprocity; hence, most studies define the sense of fairness as equal to the notion of hunger, or thirst, for revenge. Thus, experiments do not separate the effects of the latter two motivations when investigating individual choice.

To our knowledge, and in this context, there are only a couple of papers which discuss the difference between the aforementioned two definitions. The somewhat philosophical discussion of Clavien and Klein (2010) offers extensive definitions, however, the authors provide no specific empirical results in their experiment. The studies of Pillutla and Murnighan (1996) and Srivastava et al. (2009) also present an effect decomposition, including both anger and fairness in their analysis; however, their results may come with the following potential biases. First, their inclusion of anger and exclusion of emotions that lead to positively reciprocal behavior may yield upward biased results on the effect of anger. Second, their methodology extends the ultimatum game with a questionnaire on emotions, which may provide participants anchored results to their choice in the core game (i.e., participants' given offers could be more relevant in the subsequent emotional status than the obtained offers), as highlighted in Pillutla and Murnighan (1996). Third, their experimental design cannot capture the effects through the analysis of a single choice, but rather through multiple questions; therefore, answers can be cross-correlated due to anchoring, which may lead to biased results. We aim to address the aforementioned concerns and fill the gap in literature by separating the effects of fairness and revenge on a single choice in a repeated modified ultimatum game setting.

Sense of fairness, as measured by a desire for equal distribution of gains, and hunger for revenge, the tendency to punish negative or reward positive behavior, are very different human attributes; yet, experimental tests consider the two equal and measure their aggregate effect. Although, the original ultimatum game cannot differentiate between these attributes, as both contribute to the choice in a single-round ultimatum game, a repeated game can separate their contributions to choice. In order to isolate them, our setting is based on a three-stage ultimatum game, in which the second stage allows for revengeful behavior in one of the control groups, whereas, random repetition (thus, no revenge) is applied in the other.

Our results indicate that hunger for revenge plays a very important role in choice of the ultimatum games. In fact, with other control variables included, such as anchoring to previously given offers, acceptance and group type, revenge significantly increases positive and negative reciprocity, while sense of fairness becomes an insignificant variable.

This finding is in line with random offer experiments, in which proposers have no effect on the initial allocation, and, as the results of Falk et al. (2007) indicate, intentions do matter. In their study they compared intention-based and random allocations in a repeated proposal game, and found that, if the allocation was defined as an exogenous, random variable, it had no effect on the other participant's choice. This study has also been established for ultimatum games in Blount's paper (1995), in which the author underlines that "in the random condition subjects tended to behave in a classic payoff-maximizing manner." In our setting we find similar results: revenge punishes or rewards the intention; however, after controlling for this variable, fairness plays no additional role; participants will not punish or reward random, yet unfair allocations.

The importance of separating factors in decision-making is also highlighted by recent research in alternative fields. For example, since the millennium, findings in a new interdisciplinary field, neuroeconomics, have indicated that choice in ultimatum games depends on multiple more-or-less independent factors including biological ones (Sanfey et al., 2003). Moreover, Knoch et al. (2006)'s study has provided further evidence for separate structures in decision-making, by showing that transcranial magnetic stimulation of the dorsolateral prefrontal cortex significantly reduces the rejection rate.

In addition to factor decomposition, we provide an extended analysis of these effects by including socio-demographic variables of participants - which also serves as a robustness test. The necessity of this extension has recently been revealed by numerous papers related to the topic: gender differences in experimental results are well-documented by findings on fairness, weighing a lot more in women's choice than in men's (Solnick (2001), Eckel and Grossmann (2001)), a fact that is also confirmed by our empirical results. Furthermore, Wallace (2007) showed that genetic structure in twins also plays a highly relevant role in ultimatum games. The specific factors for this latter finding, however, are still unclear: Chew et al. (2013) analyzed whether the effect is due to specific hormones but found no robust evidence; García-Gallego et al. (2012) showed that the fairness difference is existent even if the gender difference in risk-aversion was controlled for. Other individual attributes, such as education, may also play an important role in choice, although, recent studies (Chew et al. (2013)) indicate no significant difference between acceptance rates for higher levels of education in ultimatum games.

Having conducted a repeated experiment, we also analyze the temporal dynamics of our sample. According to Cooper and Dutcher (2011), low (high) offers are more likely to be rejected (accepted) over time; therefore, convergence of offers to the fair value is present in games with random participating strangers (Avrahami et al., 2013). In addition, Schotter and Sopher (2007) found that advice from previous proposers facilitates convergence and yields a tighter distribution. Based on these results we search for temporal patterns in responses and compare the cases with random and known proposers; however, we find no significant convergence in time.

The paper is organized as follows. In section 2 we review the experimental setting used in this study; section 3 provides a detailed discussion of the subjects and attributes tested and the experimental design applied. Subsequently, in section 4 we turn to presenting the regression results along with an explanation and their interpretation. Finally, in section 5, we briefly summarize our main findings and the implications for potential avenues of research.

1. The experiment

We conduct a three-stage repeated ultimatum game experiment. In the first two steps a standard ultimatum game is played. First, the rules of the basic ultimatum game are explained carefully to the participants. Second, questionnaires are distributed each participant, in which he/she (proposer side) has to make an offer out of $100 to a randomly assigned pair and keep the rest. Third, the questionnaires are collected and redistributed in a random manner between the participants. Then, the receiver side decides to accept or reject the proposed offer. Our most interesting contribution, however, comes with the third stage. In this stage, receivers make an offer out of $100 again. In this last part, the sample is divided into two subgroups with different questionnaires: the first subgroup is told that the offer they make will be received by a random participant (that is most likely to be different from the proposer of their first received offer); in contrast, the second subgroup is told that the offer they make will be received by the same person proposing an allocation in the first stage. Therefore, those in the second experiment may follow positive or negative reciprocity through revenge. Hence, in this setting we can separate the effect of reciprocity from the effect of fairness by testing the difference between subgroups.

We underline here, that the existence of a second, further experiment is not announced in advance; therefore, a standard ultimatum game is played in the first experiment. This also implies that the results of the first two stages of the two subsamples should be similar, and coherent with the existing literature related to standard ultimatum games.

Although, in our experiment we use theoretical payoffs, we argue that these results are relevant and in line with findings in which actual money was used. This argument is confirmed by Berger et al. (2012) and Noussair and Stoop (2015), who show that non-financial rewards, such as waiting time, also yield the usual fairness pattern in ultimatum games.

We also underline that the two subsamples were tested in a different experiment, and therefore, this might have an effect on our results. As Grimm and Mengel (2011), Sutter et al. (2003), and Cappelletti et al. (2011) posit, temporal differences in the experimental period yield different acceptance rates. However, we find no evidence for any significant pattern based on acceptance rates that would highlight any sample difference, since the first two stages are similar in the two experiments.

2. Data and methodology

Our data consist of 178 responses given by graduate students at the Budapest University of Technology and Economics. Further decompositions show that the 86 participants of the first, random experiment, were MBA students, whereas the other group included graduate students in Engineering (mostly MSc in Information Technology). Cross-sectional data were only available for a restricted sample covering 97 participants of which 38 were female. Questionnaires contain four elements (the student ID, the offer received, the decision on rejection, and the offer proposed in the third stage). In the applied dataset we assign five variables to each participant: the offer given in the first stage, the offer received in the second stage, the dummy variable on rejection, the offer proposed in third stage, and the dummy variable on experiment type or the opportunity for revenge.

Our empirical investigation is based on OLS regression tests. First, we measure the main relationship tested in standard ultimatum games - the effect of the amount obtained on the probability of acceptance. This latter is shown in eq. (1)

$$\hat{A}_i = \hat{\alpha} + \hat{\beta}_1 O_{R,i}, \tag{1}$$

where $\hat{A}_i$ and $O_{R,i}$ stand for the acceptance dummy variable and the amount in the offer received by the ith participant respectively. This setting is similar to the standard ultimatum game framework; the proposer picks an allocation by giving $O_{R,i}$ dollars out of one hundred, then, the receiver can decide on rejecting or accepting the proposed offer, which leads to the zero outcome for both players or the allocation defined by the proposer respectively.

In order to control for a possible role of the first offer proposed as a reference point suggested by prospect theory (Kahneman and Tversky, 1979), we include the latter variable as $O_{P,1,i}$ in Model 2; hence

$$\hat{A}_i = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i}. \tag{2}$$

In the third model, we test for a difference between subgroups by including a revenge dummy $D_{R,i}$ that takes unit value for the second experiment and zero for the first. Then, Model 3 is estimated as

$$\hat{A}_i = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i}. \tag{3}$$

Subsequent to the analysis of acceptance rate, the temporal characteristics of our repeated game is tested. As mentioned above, convergence to a fair value and tightening distributions over time have been found in existing studies (Cooper and Dutcher, 2011; Avrahami et al., 2013; Schotter and Sopher, 2007). Therefore, we test whether there is a significant convergence of proposals. In order to do so, we run F-tests for the sums of squared residuals around fifty percent (the fair value) and the mean in the two periods. Hence, we can statistically test if the distribution is converging towards a fair allocation, or something else. This analysis is also tested for both the entire sample and the subsamples separately, since, in case of the second experiment where revenge is allowed, divergence might replace convergence due to negative and positive reciprocity.

The main contributions of this paper are tested in Models 4 to 6. There is a shift in the dependent variable from the probability of acceptance to the percentage proposed in the second offer (noted by $O_{P,2,i}$). We argue that, with no conditions changed, these two variables reflect similar effects, such as the fairness of the offer received. First, in line with eq. (4), we test this argument by analyzing the effects of the offer received, the first offer proposed, and the in-group difference defined by the dummy variable for revenge.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i}. \tag{4}$$

However, in order to control for both fairness and revenge in the same setting, we include a dummy variable for unfair offers $D_{U,i}$ as well. This latter term in the regression is defined as a unit value, if the offer received is less than 50 percent ($O_{R,i} < 50$), and is zero otherwise. Furthermore, since the second experiment allows for positive reciprocity following fair offers and negative reciprocity subsequent to unfair offers, we also have to add the cross-product of the revenge and unfair dummy variables $D_{R,i}D_{U,i}$. Hence, Model 5 becomes

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i}. \tag{5}$$

In this regression the specification of coefficients are as follows. The first three variables are simple to interpret: $\hat{\alpha}$ stands for constant effects not handled in this estimation, $\hat{\beta}_1$ and $\hat{\beta}_2$ define the sensitivity of the second offer proposed to the offer received and the first offer proposed respectively. However, the real contribution of this paper lies in the last three variables: $\hat{\beta}_3$ stands for difference of the second offer proposed by the subgroup that participated in second-type experiment and received a fair offer ($D_{R,i} = 1$ and $D_{U,i} = 0$) from proposal of the subgroup that participated in the first-type, random experiment and received a fair offer ($D_{R,i} = 0$ and $D_{U,i} = 0$). This coefficient shows whether or not there is positive reciprocity (higher offer) subsequent to fair offers in a setting where revenge is allowed.

$\hat{\beta}_4$ shows the difference of the second offer proposed by the subgroup that participated in first-type, random experiment and received an unfair offer ($D_{R,i} = 0$ and $D_{U,i} = 1$) from the percentage offered by the subgroup that participated in same experiment but received a fair offer ($D_{R,i} = 0$ and $D_{U,i} = 0$). Hence, this coefficient measures the effect of fairness on the allocation choice.

Finally, $\hat{\beta}_5$ quantifies the difference of the second offer proposed by the subgroup that participated in second-type experiment and received an unfair offer ($D_{R,i} = 1$ and $D_{U,i} = 1$) from proposal of the subgroup that participated in the first-type, random experiment and received a fair offer ($D_{R,i} = 0$ and $D_{U,i} = 0$). This coefficient reflects negative reciprocity (lower offer) subsequent to unfair offers in a setting where revenge is allowed.

Our dataset allows for the inclusion of yet one more control variable, the dummy variable of acceptance ($D_{A,i}$). One interpretation of this parameter is that, when controlling for every other effect, such as fairness and revenge, it acts as a proxy for the rationality of participants. This argument is based on the logic that rational, payoff-maximizing individuals, who are better off with any positive payoff, both accept and propose lower percentages in ultimatum games. Hence, we expect $\hat{\beta}_6$ in Model 6 to take on a negative value.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i}. \tag{6}$$

Subsequent to this effect decomposition, we search for cross-sectional dynamics of participants' sensitivity to fairness and revenge in our restricted sample. Model 7 is estimated exactly as the previous Model 6, but on the latter sample (with 97 participants for who we also have cross-sectional data) to account for sampling differences. In Model 8, as in eq. (8), we further include education as in Chew et al. (2013); however, our proxy variable is the grade point average (G_i) instead of an undergraduate/graduate dummy variable, since all participants are graduate students.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 G_i. \quad (8)$$

In Model 9, that is shown in eq. (9), we further specify the effect of education controlling for specific grades obtained in courses related to mathematics ($G_{M,i}$). This latter grade point might also serve as a proxy for more informed rational behavior.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 G_{M,i}. \quad (9)$$

Finally, in Model 10 we analyze the effect of education by shifting its proxy variable from average grades to fluency in foreign languages (F_i). This latter parameter in eq. (10) takes on unit value if the participant is fluent in at least one foreign language, and zero otherwise.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 F_i. \quad (10)$$

Apart from educational control variables, we also test the effects of age (through year of birth), urban socialization, a dummy for gender, and a cross-product of this latter female dummy with fairness, revenge, and their triple cross-product.

In Model 11, age (A_i) as the birth year is included as follows, in which we expect greater fairness (or more points given) to older people, in line with increasing maturity.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 A_i. \quad (11)$$

Model 12 extends the analysis to environment and socialization, which we aim to capture through a dummy variable ($D_{urban,i}$) taking on unit value if a participant has a permanent urban address, and zero otherwise. Here, we expect that the relationship between fairness (or given points) and urban socialization is negative, since prosocial and norm-following behavior is rather a property of rural people; hence, the coefficient should be negative.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 U_{urban,i}. \quad (12)$$

We have also mentioned above that gender has been analyzed in numerous studies and has been found to play an important role in decision in experimental games. Hence, we apply a dummy variable ($D_{F,i}$) in Model 13, which takes on unit value for female participants, and zero otherwise. Existing literature has found evidence for women being more sensitive to fairness and creating close-to-fair allocations in bargaining games; hence, we expect the coefficient of this latter dummy to be positive.

$$\hat{O}_{P,2,i} = \hat{\alpha} + \hat{\beta}_1 O_{R,i} + \hat{\beta}_2 O_{P,1,i} + \hat{\beta}_3 D_{R,i} + \hat{\beta}_4 D_{U,i} + \hat{\beta}_5 D_{R,i} D_{U,i} + \hat{\beta}_6 D_{A,i} + \hat{\beta}_7 D_{F,i}. \quad (13)$$

Previous studies on repeated games have found tightening distributions and the convergence of offers. We also test this hypothesis in our sample by providing two types of F test. First, we analyze the ratio of the sums of squared differences from the mean of the offered percentages in the two periods, which, if significantly less than one, stands for the simple convergence to a specific mean, or a tightening distribution. Second, we also test whether there is a convergence towards fair allocations by comparing the sums of squared residuals relative to the fifty percent offered.

Furthermore, in the second-type experiment, where the second proposer makes an offer to the same person by whom the first allocation was defined, participants are likely to behave according to negative or positive reciprocity as we allow for revenge. This subsample, therefore, might yield a divergence of offer prices instead of a convergence. Hence, in addition to the total sample, we also run the convergence tests for the separate samples.

To test the robustness of our results we rerun the final regressions applying only the significant variables and excluding the insignificant ones.

3. Empirical results

First, we present our results for the acceptance rate estimations. In Figure 1, the stacked bar chart of the number of accepted and rejected offers (vertical axis) is shown for the percentage received in the offer (horizontal axis). One can clearly see the well-documented patterns, such as the positive relationship between the acceptance rate and the percentage received, and the probability density hike around fifty percent. Again, we underline here that, although, theoretical payoffs have been used, we argue that, due to the following reasons, our results represent the same patterns as if actual money allocations had been proposed. On the one hand, as discussed in detail above, non-financial rewards (such as waiting time) yield a similar behavior to standard ultimatum games; hence, such hypothetical 'scores' should also reflect the documented patterns; on the other hand, during the experiment, the anonymized and average results were announced to be discussed after the game; therefore, participants rationally aimed to achieve a higher score (in line with a financial payoff) in order to avoid a lower-than-average performance realized as a loss. Moreover, the groups were allowed to discuss their results subsequent to the games, which further increases the competition between the participants.

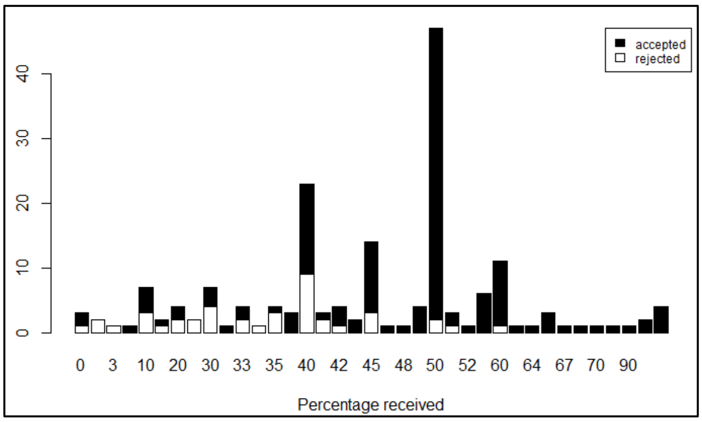

Figure 1. Number of accepted and rejected offers vs the percentage received.
Source: own *calculation*

Nonetheless, the most convincing evidence for the similarity to games with financial payoffs is the empirical pattern obtained during the first round, in which the standard ultimatum game was played with the theoretical payoffs. Our statistical analysis of this finding is presented in Table 1, in which results of Models 1 to 3 are included. The effect of the offer received increases the probability of acceptance with very high significance, even when controlling for the first offer proposed and the experimental setting; a one percentage point increase in the offer received roughly increases the probability of acceptance by one percentage point. Nevertheless, these two latter variables do not affect the acceptance rate. Model 3 also indicates that, in line with the identical first and second stage of the two experiments, on average there is no difference between the acceptance rates of our two subsamples.

Table 1. Probability of acceptance rate estimations

Dependent variable	**Probability of acceptance**		
	Model 1	**Model 2**	**Model 3**
Constant	0.3668*** (0.0770)	0.5156*** (0.1083)	0.4636*** (0.1194)
Offer received	0.0090*** (0.0016)	0.0088*** (0.0016)	0.0090*** (0.0016)
First offer proposed		-0.0031 (0.0016)	-0.0029 (0.0016)
Revenge dummy			0.0619 (0.0590)
Adjusted R^2	0.15	0.16	0.16

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001*
Source: own *calculation*

Having confirmed previous findings in bargaining games, which suggest our sample is similar to previous studies, we now turn to discussing our novel contributions to the topic. The effect decomposition illustrated in Table 2. Model 4 confirms that the change in dependent variable from the acceptance dummy to the percentage points offered in the second proposal yields no difference in the findings. In particular, the offer is received positively and very significantly affects the proposed second offer. Although, we find that in this model the first offer also plays an important role, which we attribute to anchoring to the first offer, we still find no difference between the subsamples as indicated by the revenge dummy. Moreover, the adjusted R-squared value also suggests a similar fit of the model, providing further support to our assumption of the similarity of the two dependent variables.

However, by including the revenge dummies for both positive and negative reciprocity, Model 5 clearly indicates that fairness is not the sole driving factor behind the bargaining decision. In particular, the revenge dummy for positive reciprocity with the fair offers, and the revenge-unfairness cross-product for negative reciprocity under unfair offers, indicate a significant, positive and negative effect respectively; this is in line with expectations: participants reward (punish) fair (unfair) previous offers by proposing higher (lower) offers if the participant-pairs remain the same. The positive and significant coefficient of the unfairness dummy might raise some concerns, as one would expect a negative effect on the second proposal; however, when controlling for the acceptance as a proxy for rational behavior in Model 6, this latter variable becomes insignificant. Hence, in addition to fairness, Model 6 also provides evidence for the relevance of revenge in bargaining decisions. In fact, our results indicate that, after filtering out various effects, positive and negative reciprocity are entirely due to hunger for revenge and are unaffected by the fairness of the received offer.

Table 2. Driving factors behind the second offer by Model 4, 5 and 6

Dependent variable	Second offer proposed		
	Model 4	**Model 5**	**Model 6**
Constant	13.90** (4.82)	9.52 (6.44)	14.19* (6.88)
First offer proposed	0.37*** (0.07)	0.37*** (0.06)	0.35*** (0.06)
Offer received	0.25*** (0.06)	0.24** (0.08)	0.27** (0.08)
Revenge dummy	-0.97 (2.38)	7.89* (3.33)	8.04* (3.31)
Unfairness dummy		8.95* (3.79)	7.35 (3.86)
Revenge-unfairness cross-product		-16.97*** (4.57)	-16.49*** (4.55)
Acceptance			-5.63 (3.03)
Adjusted R^2	0.19	0.24	0.25

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001*
Source: own *calculation*

In the following we discuss results related to cross-sectional effects. As mentioned above, cross-sectional data is only observable for a restricted sample; however, in this latter subsample, Model 7 also confirms the aforementioned findings of Model 6: positive and negative reciprocity remain significant, while fairness plays no statistically relevant role in bargaining.

Table 3. Driving factors behind the second offer by Model 7, 8, 9 and 10

Dependent variable	Second offer proposed			
	Model 7	**Model 7**	**Model 9**	**Model 10**
Constant	16.44 (10.26)	23.66 (13.23)	19.73 (10.95)	16.12 (10.33)
First offer proposed	0.35** (0.09)	0.35** (0.09)	0.35** (0.09)	0.35** (0.09)
Offer received	0.19 (0.11)	0.19 (0.11)	0.19 (0.11)	0.18 (0.11)
Revenge dummy	14.20** (4.33)	16.23** (4.93)	15.71** (4.67)	14.28** (4.35)
Unfairness dummy	4.24 (4.98)	4.72 (5.02)	4.54 (5.00)	4.09 (5.01)
Revenge-unfairness cross-product	-22.86*** (6.07)	-23.40*** (6.11)	-23.45*** (6.12)	-22.82*** (6.10)
Acceptance	-4.56 (3.96)	-5.03 (4.00)	-5.02 (4.00)	-4.65 (3.98)
Average grade		-2.12 (2.45)		
Average grade in mathematics			-1.20 (1.38)	
Fluency in foreign language				1.38 (3.10)
Adjusted R^2	0.28	0.28	0.28	0.28

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001*
Source: own *calculation*

Models 8, 9, and 10 indicate no significant cross-sectional effects for education. In particular, none of the properties of average grades, mathematics grades, or fluency in foreign languages seem to capture educational differences that could affect the second offer proposed. Still, our previous findings on revenge remain intact. Our robustness tests with restricted models also confirm the above patterns, which may be found in the Appendix; in these models only the significant variables are kept for re-estimation by iteratively dropping the least significant ones.

In Models 11 and 12 in Table 4, we analyze further cross-sectional effects of age and urban socialization; however, no statistically relevant differences are found. In contrast, the significantly positive dummy variable for female participants in Model 13 confirms previous findings: women offering higher percentage, and thus creating close-to-fair allocations. The magnitude of this effect indicates extremely high gender differences, yielding that, when accounting for every other variable in the model, women offer, on average, 10 percentage points more than men out of a hundred. While, it would be interesting to see the decomposed gender effects on sensitivity to fairness and revenge, our restricted sample contains only two female participants in the second-type experiment (in which we allow for revenge); therefore, only aggregate gender effects can be analyzed in our sample. Table A2 in the Appendix covers a further robustness check using the aforementioned methodology with restricted models.

Table 4. Driving factors behind the second offer by Model 11, 12, 13 and 14

Dependent variable	**Second offer proposed**			
	Model 11	**Model 12**	**Model 13**	**Model 14**
Constant	-3038.12 (2449.36)	16.89 (10.40)	8.62 (10.25)	4.02 (10.17)
First offer proposed	0.37*** (0.09)	0.35*** (0.09)	0.36*** (0.09)	0.35*** (0.09)
Offer received	0.19 (0.11)	0.18 (0.11)	0.22 (0.11)	0.20 (0.11)
Revenge dummy	14.70** (4.34)	14.28** (4.36)	19.95*** (4.63)	25.87*** (5.14)
Unfairness dummy	4.05 (4.96)	4.01 (5.05)	4.31 (4.79)	13.76* (6.58)
Revenge-unfairness cross-product	-22.07*** (6.08)	-22.51*** (6.19)	-22.29*** (5.84)	-30.90*** (7.37)
Acceptance	-4.55 (3.95)	-4.72 (4.01)	-5.41 (3.82)	-5.19 (3.72)
Age	1.53 (1.23)			
City dummy		-1.12 (3.46)		
Female dummy			10.33** (3.61)	
Female-unfairness cross-product				19.95*** (5.11)
Female-revenge-unfairness cross-product				-15.90* (7.43)
Female-revenge cross-product				13.18 (14.95)
Fluency in foreign language				-9.47 (21.33)
Adjusted R^2	0.29	0.28	0.34	0.28

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001*
Source: own *calculation*

In addition to the cross-sectional analysis above, we also present our results related to the repeated framework of our experimental setting. The box charts shown in Figure 2 confirm both the previously documented convergence of offers in the random-type experiment (left chart) and, in line with our explanation through positive and negative reciprocity, the divergence of offers in the second-type experiment (right chart).

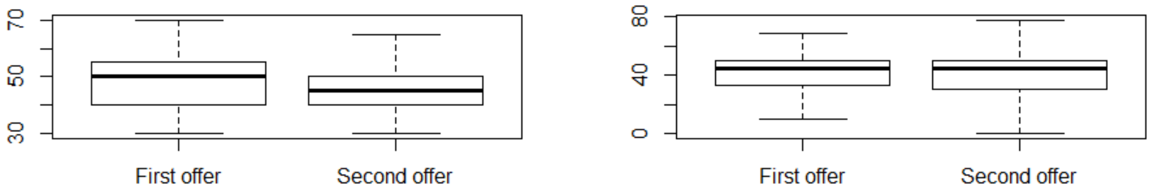

Figure 2. Convergence of offers with (right) and without reciprocity (left).
Source: own *calculation*

Particularly, in Table 5 we indicate the findings of F-tests for the ratios of the sum of squared errors of the second ($O_{P,2,i}$) and first ($O_{P,1,i}$) experiments. The first and third columns stand for the variance ratio and diffusion around the fair offer of fifty percent, while the second and fourth columns show the probability that we falsely reject their null hypothesis of equality to unit ratio. Although, in line with expectations and previous findings, in the random experiment we see a convergence of offers as the ratio is less than one, while in the non-random experiment divergence is present, regardless of the central value and none of the results are significant at reasonable probability levels. Hence, we cannot confirm the existing findings on repeated games having tightening distributions of offers.

Table 5. Convergence of offers in the second stage

	$\frac{\sum(O_{P,2,i}-\bar{O}_{P,2,i})^2}{\sum(O_{P,1,i}-\bar{O}_{P,1,i})^2}$	**p-value**	$\frac{\sum(O_{P,2,i}-50)^2}{\sum(O_{P,1,i}-50)^2}$	**p-value**
Aggregate sample	0.89	0.44	1.06	0.69
Random experiment	0.71	0.11	0.87	0.52
Non-random experiment	1.05	0.95	1.19	0.39

Source: own *calculation*

4. Conclusion

In this paper, we have provided evidence for alternative determinants of choice in ultimatum games. Although, the vast majority of existing studies assume that fairness is the dominant factor behind bargaining decisions, we show that when controlling for positive and negative reciprocity, fairness plays no significant role in determining the allocation. In our specific experiment, in which the effects of hunger for revenge and sense of fairness are separable, we find that, if revengeful behavior is allowed, fair propositions received are followed by higher-than-average, or positively reciprocal offers, and reaction to unfair propositions is realized in lower-than-average, or negatively reciprocal subsequent offers. However, in the case when revenge is not allowed (i.e. the proposer and receiver sides are randomly selected at each stage of the game), the pure effect of sensitivity to fairness indicates no significant role in allocation decisions.

Our cross-sectional analysis further confirms these findings, even when controlling for various individual properties. We find that, proxies of education (such as grade averages, grades in mathematics, or fluency in foreign languages), age or urban socialization, have no statistically relevant effect in determining the proposed offer. In contrast, gender differences are very significant and high in magnitude as well, indicating, on average, a substantially higher offer from women (ten percent). In a robustness test if we exclude the insignificant variables from the estimation, the strong and significant variables remain significant.

Finally, in our three-stage experiment we cannot find a significant convergence of offers in time, either to the mean values, or the fair, fifty percent proposal. Nonetheless, there are some traits, which might become statistically relevant with more repetitions.

Prospective avenues for further research could include various analyses related to this paper. First, decomposing the gender differences to sensitivity to fairness and hunger for revenge might reveal interesting reasons behind this very significant pattern, which could not be done in the current study due to the limited sample size of our second experiment. Second, a neuroeconomics approach to revengeful behavior, in addition to the fairness, may also reveal important findings on biological reasons behind the aforementioned patterns. Finally, the analysis of the effects shown in this paper could also contribute interesting findings to existing literature when using a larger sample with more repetitions.

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Appendix

Table A1. Factors behind the second offer by restricted models based on Model 7, 8, 9 and 10

Dependent variable	Second offer proposed			
	Model 7	**Model 7**	**Model 9**	**Model 10**
Constant	24.45*** (4.77)	28.52** (9.86)	26.51*** (6.27)	23.91*** (4.95)
First offer proposed	0.33*** (0.09)	0.33*** (0.09)	0.33*** (0.09)	0.33*** (0.09)
Revenge dummy	13.0** (3.92)	13.96** (4.42)	13.79** (4.22)	13.11** (3.94)
Revenge-unfairness cross-product	-21.66*** (4.74)	-21.72*** (4.76)	-21.87*** (4.77)	-21.71*** (3.11)
Average grade		-1.14 (2.42)		
Average grade in mathematics			-0.69 (1.37)	
Fluency in foreign language				1.35 (3.11)
Adjusted R^2	0.27	0.27	0.27	0.27

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001*

Table A2. Factors behind the second offer by restricted models based on Model 11-13

Dependent variable	Second offer proposed		
	Model 11	**Model 12**	**Model 13**
Constant	3029.0 (2463.0)	24.55*** (4.81)	18.51*** (5.21)
First offer proposed	0.35*** (0.09)	0.33*** (0.09)	0.34*** (0.09)
Revenge dummy	13.6*** (3.93)	13.11** (3.96)	18.21*** (4.34)
Revenge-unfairness cross-product	-21.11*** (4.75)	-21.48*** (4.81)	-21.61*** (4.61)
Age	1.53 (1.24)		
City dummy		-0.91 (3.44)	
Female dummy			9.13* (3.63)
Adjusted R^2	0.28	0.27	0.27

Notes: Standard errors in parentheses. **: p<0.05; **: p<0.01; ***: p<0.001; in Model 14 none of the detailed female-related variables proved significant*