JENA ECONOMIC RESEARCH PAPERS

2014 – 024

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www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich Schiller University and the Max Planck Institute of Economics, Jena, Germany. For editorial correspondence please contact markus.pasche@uni-jena.de.

Impressum:

Friedrich Schiller University Jena
Carl-Zeiss-Str. 3
D-07743 Jena
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Trust in generosity: An experiment of the repeated Yes-No game*

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October 16, 2014

Abstract

This paper reports results of a 100-round Yes-No game experiment conducted under the random matching protocol. In contrast to ultimatum bargaining, the responder in the Yes-No game decides whether to accept without knowing the proposer's offer. Although both games have the same solution outcome (i.e., the proposer offers the smallest possible amount and the responder accepts), the set of equilibria of the ultimatum bargaining game is rather large whereas the equilibrium of the Yes-No game is essentially unique. Avrahami et al. (2013) found an immediate convergence to proposers offering an equal split in their repeated ultimatum bargaining experiment. Our main interest is which dynamics emerge when proposers and responders repeatedly play the Yes-No game. We found neither convergence to offering an equal split nor to the solution outcome. Most participants display a surprising constancy of behavior but the categories of behavior are rather rich.

Keywords: Yes-No game; Repetition; Learning; Veto power; Laboratory experiment

JEL Classification: C72, C92

*Generous financial support from the Max Planck Society is gratefully acknowledged. The authors would like to thank Claudia Zellmann and Adrian Liebtrau for their excellent assistance in data collection.

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1 Introduction

We report results of implementing experimentally repeated play of the Yes-No game (Gehrig et al., 2007; Güth and Kirchkamp, 2012). The game proceeds as follows; the proposer suggests how to allocate the positive monetary pie p. Denote by x and y the shares for the proposer and the responder, respectively, such that $x + y = p$, $x > 0$, and $y > 0$. Then, without learning the choice of (x, y) by the proposer, the responder either accepts ($\delta = 1$) or rejects ($\delta = 0$). The final payoffs are δx for the proposer and δy for the responder.

Brief comments on the game are in order. First, the structure of the game is almost identical to the ultimatum bargaining game with one major distinction: unconditional veto power.[1] In the Yes-No game proposers suggest how to share a given positive monetary amount ("pie") and responders decide whether to say "Yes" (i.e., accept) or "No" (i.e., reject) *without* knowing the proposal. Thus, responders in the Yes-No game retain full but unconditional veto power. Second, knowing that only positive offers are possible, an opportunistic responder should accept the unknown offer.[2] Anticipating this, an equally opportunistic proposer should offer the smallest possible amount. Hence, there exists a unique equilibrium outcome in the Yes-No game; the proposer offers the smallest possible amount and the responder accepts.

Two experimental studies have investigated one-shot behavior in the Yes-No game. Gehrig et al. (2007) compared behavior in the Yes-No game and in closely related games, such as the ultimatum and the dictator game. The results revealed that offers are smaller than ultimatum offers and larger than dictator gifts and that responders never reject. Güth and Kirchkamp (2012) conducted a newspaper and its parallel laboratory experiments with two different pie sizes, €100 and €1000. Almost in line with the previous study, very low rejection rates were observed. Gehrig et al. (2007) provide two explanations of why responders are willing to 'buy

[1] For a recent survey of the experimental literature of the ultimatum game, see Güth and Kocher (2014).

[2] Allowing for negative offers would render the Yes-No game a dilemma game (for related findings, see Güth et al., 2012).

a pig in a poke':

1. *in dubio pro reo*: responders refrain from punishing, because they do not want to punish a possibly rare generous proposer, and

2. *in dubio pro meo*: responders refrain from punishing since the (even small) chance that the proposer is generous "excuses" selfish acceptance.

These studies are completely silent about how behavior evolves over time. Such overwhelming tendency of acceptance may not emerge in the repeated Yes-No game because repetition allows responders to "teach proposers fairness" by rebuffing after experiencing very low offers.

The main purpose is to study the dynamics that unfold when players repeatedly play the Yes-No game with randomly changing opponents. Experimentally implementing the repeated Yes-No game allows us to investigate whether experience helps behavior to converge to the unique solution outcome.

A recent experiment by Avrahami et al. (2013) studied behavior in a 100-round repeated ultimatum game under the stranger matching protocol: in each round the proposer decides on the offer to the responder who chooses an acceptance threshold before learning the offer. They observed an immediate convergence to proposers offering half of the pie and responders demanding at least half of the pie via their acceptance thresholds. We expect the dynamic behavior for the 100-round Yes-No game to differ. In the constituent game in Avrahami et al. (2013), all "pie" distributions are equilibrium outcomes.[3] This is in sharp contrast to the Yes-No game with a unique equilibrium: the proposer offers the minimum possible amount and the responder accepts the unknown offer. This suggests the first hypothesis.

Hypothesis 1. *There is no convergence to proposers offering an equal split.*

Repetition allows responders to become aware via information feedback of how greedy proposers are. If proposers offer nearly nothing, responders should learn this

[3]When the propser offers the acceptance threshold, this is mutually optimal.

and realize that punishing efficiency is quite high.[4] Thus, responders may sometimes veto to induce at least some proposers to abstain from very low offers.

Hypothesis 2. *There is no convergence to proposers offering the smallest amount.*

In our experiment, there are two treatments; N and I treatments. In the N treatment only the proposer knows the value of pie size p (how this value is determined is explained in the next section). In the I treatment both, the roposer and the responder, know p. The difference between treatments does not change the unique benchmark solution outcome of the Yes-No game. Thus, whether proposers' offers and responders' rejection rates differ between treatments is a purely empirical question.

2 Experimental Procedures

One hundred and twenty-eight students from various fields enrolled at the Friedrich-Schiller University of Jena were recruited via the ORSEE software (Greiner, 2004). We run a total of four sessions, two sessions for the N treatment and the remaining sessions for the I treatment. Each session involved 32 participants. None of the participants was allowed to take part in more than one session (between-subject design). All sessions were conducted in the computer laboratory of the Max Planck Institute of Economics in Jena, Germany. The experiment was programmed and conducted using the z-Tree (Fischbacher, 2007). A typical session lasted about 90 minutes, including 20 minutes of instruction and payment.

Upon arrival at the laboratory, participants were seated in individual cubicles separated from one another by partitions. Any form of communication between participants was strictly prohibited. Once all participants were seated, they began to read instructions (see Appendix) silently at their own pace. Then, an experimenter read the instructions aloud to induce their common knowledge. The experimenter answered questions individually.

[4]This effectiveness can be measured, for example, by the ratio of the proposer's and responder's payoff loss in case of a veto.

At the beginning of each session, four groups of eight participants each were randomly formed, and each participant was randomly assigned to one of two different roles, proposer and responder. Therefore each group consisted of four proposers and four responders, respectively. Participants retained their role throughout. The instructions emphasized that no interaction between groups was possible and that roles remained the same.

Participants played 100 identical rounds of the Yes-No game. A typical round proceeded as follows. At the beginning of a round, the computer randomly assigned an endowment of 24 points to each of three proposers and an endowment of 8 points to the remaining proposer. Hence, each group has three proposers with a large "pie" and one proposer with a small "pie." The computer informed each proposer of the size of her endowment. Next, a proposer and a responder in the same group randomly formed a pair. The computer informed each responder of the size of endowment given to the matched proposer in the I treatment but not in the N treatment.

Once a round began, each proposer was asked to choose how many point(s) out of her endowment to offer to the responder in her pair. The offer had to be an one of the following integers: $1, 2, 3, 4, \ldots, \text{endowment} - 1$. Without knowing the proposer's offer, the responder was asked to choose either "Yes" (i.e., accept the unknown offer) or "No" (i.e., reject the unknown offer). After all 32 participants in the session submitted their decisions, a results screen presented each player with the following information about her pair: (i) Proposer's decision, (ii) Responder's decision, and (iii) the point(s) earned in the current round.

At the end of a session, a summary screen displayed the total points participants had accumulated and the corresponding cash earnings in Euros. The total points were converted at the rate of €1.5= 50 points. The average individual payment as Proposer was €27.31 in the N treatment and €25.05 in the I treatment, respectively, including a €2.5 show-up fee. The corresponding value as Responder was €11.57 in the N treatment and €12.50 in the I treatment, respectively.

Treatment	Endowment	Proposer		Responder
		Mean Offer	Median Offer	Mean Rejection Rate
N	8	2.99 (0.374)	3 (0.375)	0.154
	24	6.112 (0.255)	4 (0.167)	
I	8	3.311 (0.414)	4 (0.5)	0.139
	24	7.015 (0.292)	8 (0.333)	0.194

Table 1: Summary of offers and rejection rates. Relative offers are in parentheses.

3 Results

There are eight independent groups per treatment. Since participants repeatedly interacted with each other over 100 rounds within a group, the assumption that all observations are independent does not hold. Therefore, each group constitutes one independent observation. Unless stated otherwise, all statistical tests are based on group-level measurement of the relevant variables. Also, we set the significance level at 5% throughout this section.

Table 1 summarizes offers and rejection rates for the different endowments by treatment. This table is based on data pooled across all rounds and participants. Informing responders about the size of endowment increased the mean offer. For each endowment size, the one-sided Wilcoxon rank sum test rejects the null hypothesis that the observed mean offers come from the same distribution ($p < 0.001$).

Figure 1(a) shows boxplots for relative offers across 100 rounds for different endowments (i.e., 8 and 24) by treatment. It indicates that variation of relative offers differs across treatments. Informing responders about the size of endowment slightly reduces variation of relative offers.

[**Insert Figure 1 about here.**]

Two observations are worth noting. First, the median offer of proposers with an endowment of 24 was 4 in the N treatment. This value is equal to half of the small endowment and only $\frac{1}{6}$ of the large endowment. In this treatment, responders could not judge how "rich" their matched proposers were. Anticipating this, rich proposers could disguise themselves as poor proposers by offering, say, half of the small endowment. This offer may have looked fair to responders, which confirms that rich proposers try to "hide their greed behind the small pie" (Güth et al., 1996).

Second, for the larger endowment responders rejected more frequently. In the I treatment, responders knew the size of endowment given to matched proposers when deciding whether to reject: the rejection rate is 0.139 for an endowment of 8 and 0.194 for an endowment of 24 (see the fourth column of Table 1). Thus, on average, responders rejected more often when the endowment was large than when it was small. Howerver, the one-sided Wilcoxon signed-rank test fails to reject the null hypothesis of no difference in the rejection rate ($p = 0.25$). But still our result is inconsistent with the findings of Hoffman et al. (1996) and Andersen et al (2011). In their ultimatum game experiments they found that the rejection rate went down with increasing pie.

3.1 First Round Behavior

Studying first-round behavior is of particular interest because no elements of learning and experience come into play. Figure 1(b) shows boxplots for relative offers in the first round for different endowments (i.e., 8 and 24) by treatment. The median relative offer for an endowment of 8 (24) is 0.375 (0.333) in the N treatment and 0.375 (0.333) in the I treatment, respectively; the majority of proposers offer strictly less than an equal split of the endowment in the first round.[5] In fact, only two of 64 proposers offer more than half of their endowment. We tested the hypothesis that the median relative offer is less than 0.5 using the one-sample Sign test. The null hypothesis that the median relative offer is equal to 0.5 is soundly rejected for each of the four combinations of treatments, N vs. I, and endowment sizes, 8 vs. 24 ($p < 0.01$ always).

[5]The mean relative offer for an endowment of 8 (24) is 0.344 (0.325) in the N treatment and 0.328 (0.311) in the I treatment.

	$N24$	$I8$	$I24$
$N8$	105 (0.7048)	35 (0.7389)	112 (0.4929)
$N24$		94.5 (0.9572)	294 (0.9053)
$I8$			99 (0.9068)

Table 2: The Wilcoxon W statistics for pairwise comparisons of offers in the first round across treatments (N vs. I) and endowment sizes (8 vs. 24). $p-$values are given in the parentheses.

Figure 2 also indicates that the treatments and the different endowment sizes did not significantly affect the distribution of relative offers. To investigate whether two relevant sets of relative offers came from the same distribution, we apply the two-sided Wilcoxon rank sum test to each of six pairwise comparisons of relative offers. Table 2 reports the results. For any pair, we fail to reject the null hypothesis that the observed relative offers came from the same distribution.

In the first round almost all responders accept the unknown offers. Only two of 64 responders reject (one in the N treatment and the other in the I treatment facing a proposer with an endowment of 8). It is obvious that response behavior does not differ across treatments and endowment sizes.

[**Insert Figure 2 about here.**]

3.2 Dynamic Behavior

First-round behavior is silent about how behavior evolves over time, whether it converges, and to what it converges, if at all. Thus, the findings of the previous subsection 3.1 only inform us about the starting points of learning processes.

Figure 2 illustrates the time trends of mean offers, mean relative offers, and mean rejection rates over 10 blocks (1 block = 10 rounds). All these variables are roughly constant over time. To check this observation statistically, we performed the linear mixed effects regression with individual offers as the dependent variable, *Round* (taking 1 to 100) as well as the two dummies, *Information* (0 for the N treatment and 1 for the I treatment) and *Endowment* (0 for the endowment of 8 and 1 for the endowment of 24), as independent variables. The regression model has

Independent variable	Coefficient	Std. error	t value	$p-$value
Round	-0.009	0.001	-8.005	< 0.001
Information	0.758	0.687	1.104	0.274
Endowment	3.507	0.074	47.245	< 0.001

Table 3: Results of the linear mixed effects regression on individual offers.

Independent variable	Coefficient	Std. error	z value	$p-$value
(N treatment)				
Round	-0.008	0.002	-4.263	< 0.001
Endowment	0.041	0.130	0.312	0.755
(I treatment)				
Round	0.003	0.002	1.727	0.084
Endowment	0.471	0.133	3.531	< 0.001

Table 4: Results of the generalized linear mixed effects regression on individual rejection decisions.

two random effects; one at the individual level and the other at the group level. The results reported in Table 3 confirm that (a) offers reveal a very slow but statistically significant decreasing trend over time, (b) responder information about the size of endowment does not influence offers, and (c) the large endowment induces higher offers.

We also performed generalized linear mixed effects regressions on individual responder decisions separately for each treatment. The model has two independent variables, *Round* (taking 1 to 100) as well as *Endowment* dummy (0 for the endowment of 8 and 1 for the endowment of 24), and two random effects as before. Table 4 reports the results. We find that (a) *Round* significantly reduces the probability of rejection in the N treatment but not in the I treatment, and (b) *Endowment* significantly increases the probability of rejection in the I treatment but, of course, not in the N treatment where responders are not aware of the endowment size.

3.3 Additional Findings: Individual Behavior

Our analysis so far reveals a clear difference to the learning dynamics observed for repeatedly played ultimatum games (Avrahami et al., 2013); rather than quick convergence to equal splitting, seen in the repeated ultimatum game experiment, we diagnose a (very) slow downward trend of offers and a small positive and slightly declining rejection rate in the repeated Yes-No game.

One might speculate that repeating the Yes-No game more than 100 rounds would result in convergence to unique solution behavior (i.e., lowest possible offer and acceptance). We argue that such speculation may be premature. One reason is that punishing proposers becomes very cheap and effective when offers are very low. Another reason is that behavior could become polymorphic, e.g., by proposers since and then offering something sizable and otherwise the lowest possible amount and responders once in a while rejecting to discipline proposers (for related findings, see Güth et al., 2010).

Studying individual heterogeneity supports our conjecture that different types of individuals might evolve.

[**Insert Figure 3 about here.**]

[**Insert Figure 4 about here.**]

Proposer Behavior: Let us begin with the N treatment where only proposers are aware of the pie size, 8 or 24.

Figure 3 displays the relative frequency distributions of individual offers in the N treatment. Thirteen proposers almost always offer less than or equal to 4, i.e., half of the small pie[6]. Six of them always or almost always offer the lowest amount (Proposers 4, 5, 8, 17, 18, and 30) and four of them "hide behind the small pie" by offering 4 or something near, regardless of the available pie size (Proposers 2, 9, 10, and 21).

Seven proposers seem to condition their offers on the available pie size.[7] Four of them almost always split the available pie in half (Proposers 3, 7, 20, and 31). Offers of the other three are slightly less than half the available pie.

The remaining proposers show a wide variety of offer patterns.

[6]Proposers 1, 2, 4, 5, 8, 9, 10, 17, 18, 21, 22, 24, and 30.

[7]Proposers 3, 6, 7, 11, 20, 31, and 32.

Finding 1. *In the N treatment proposer participants partly reveal a striking constancy of behavior where the range of categories is rather rich, e.g. by including constant offers of 1 as well as constant fair play.*

In our view, individual heterogeneity renders it doubtful that offer behavior will ever converge. At least across the 100 rounds proposer behavior in the N treatment is robustly polymorphic.

In the I treatment conditioning of offers on the commonly known pie size is more clearcut as revealed by the many bimodal offer patterns in Figure 4. But even in this category there is heterogeneity, e.g., by never offering more than 4 or less than half the pie as well as by displaying more or less variation. Only two participants (Proposers 40 and 49) are always offering very little as predicted by the equilibrium solution.

Finding 2. *In the I treatment the overwhelming tendency is to condition on the pie size by offering less when the pie size is small but not always half the pie. Thus, commonly known pie size reduces the variety of proposer behavior due to the better monitoring of responders.*

[**Insert Fig. 5 about here.**]

[**Insert Fig. 6 about here.**]

<u>Responder Behavior</u>: Figure 5 shows a wide variety of individual responder's acceptance/rejection patterns over 100 rounds separately for each treatment. It is clear that their behavior defies a simple classification. For example, some responder participants always chose to accept (6 responders in the N treatments and 5 responders in the I treatment). One possible explanation for such behavior is to earn as much as possible. Another possible explanation is to "free-ride" on other responders' effort to discipline greedy proposers. All other responders reject at least once (see Figure 6 displaying the frequency of rejections by individual responder participants). Some responder participants reject offers quite often, some reject in early rounds and switch to acceptance thereafter, some reject without any specific patterns. No responder always rejects offers.

Finding 3. *There is variety in response patterns with most responder participants trying to discipline proposer participants and few responder participants accepting always. Altogether, there are no "born punishers" but several "free riders" among responder participants.*

4 Conclusions

There are different dynamics between the current study for the Yes-No game and Avrahami et al. (2013) for the ultimatum game. In our view, this difference is important in two aspects. Conceptually, it appears crucial whether the same unique solution outcome is questioned by other equilibrium outcomes (ultimatum game) or not (Yes-No game). Behaviorally, conditional veto power (ultimatum game) seems to trigger individual responsibility attitudes of responder participants. These findings may not be unexpected but yield important insights into the long-run effects of conditional and unconditional veto power.

What else could be done in future research? In our view, the next learning study should use two-person generosity and envy games.[8] In both games with conditional veto power, proposer choices are essentially two modal already when played only once. This raises the question; will behavior converge to being uni-modal and, if so, will this be the equality or the efficiency mode?

[8] In both games, the proposer chooses the pie size $p \in [\underline{p}, \overline{p}]$ with $0 < \underline{p} < \overline{p}$. The choice can be accepted ($\delta(p) = 1$) or rejected ($\delta(p) = 0$) by the responder. Payoffs for the proposer and the responders are $\delta(p)x$ and $\delta(p)(p - x)$, respectively, in generosity games and $\delta(p)y$ and $\delta(p)(p - y)$, respectively, in envy games, with appropriate exogenous parameters $x, y, \underline{p}, \overline{p}$ (see Güth and Kocher, 2014). Thus, the games differ with respect to who is the residual claimant, namely the responder in generosity games and the proposer in envy games, respectively.

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Appendix: Instructions for the *I* treatment (originally written in German)

INTERACTIVE DECISION MAKING EXPERIMENT
SUBJECT INSTRUCTIONS

Introduction

Welcome to our experiment! During this experiment you will be asked to make several decisions and so will the other participants.

Please read the instructions carefully. Your decisions, as well as the decisions of the other participants will determine your payoff according to rules which will be explained shortly. The points that you earn during the experiment will be converted to euros at the rate of 50 points = €1.00. In addition to your earnings from your decisions over the course of the experiment, you will receive a show-up fee of €2.50 for having shown up on time.

Please note that hereafter any form of communication between the participants is strictly prohibited. If you violate this rule, you will be excluded from the experiment with no payment. If you have any questions, please raise your hand. The experimenter will come to you and answer your questions individually.

Description of the Experiment

This experiment is fully computerized. You will be making your decisions by clicking on appropriate buttons on the screen. All the participants are reading the same instructions and taking part in this experiment for the first time, as you are.

A total of 32 persons are participating in this experiment. Before the experiment starts, four groups of 8 participants will be randomly formed, and you will be interacting with the same 7 other participants of your group throughout the experiment (how to interact with them will be explained shortly). In other words, you will never be interacting with the participants of other groups.

Description of the Task

During the experiment, you will be interacting with another participant in your group in each round. At the beginning of the experiment, you and the 7 other participants of your group will be assigned to one of two different roles, Proposer or Responder, so that there are 4 Proposer participants and 4 Responder participants in your group. The computer will once randomly determine your role (Proposer or Responder), and your role will remain the same throughout the experiment.

During the experiment, you will participate in a series of **100** identical rounds, so will the other participants in your group. A typical round proceeds as follows:

- The computer will randomly assign an endowment of **24 points** to each of three Proposers in your group and an endowment of **8 points** to the remaining Proposer. The computer will inform each Proposer participant about the size of her endowment.

- Then, the computer will randomly match a Proposer participant with a Responder participant. **The computer will inform each Responder participant about the size of the endowment given to the matched Proposer participant**.[9]

- A Proposer participant will be asked to choose how many point(s) out of her endowment she offers to the Responder participant in her pair. The offer has to be one of the following integers: $1, 2, 3, 4, \ldots, (\text{endowment} - 1)$. **Without knowing the Proposer's offer**, the Responder participant will be asked to say either "Yes" (i.e., accept the unknown offer) or "No" (i.e., reject the unknown offer).

- If the Proposer participant offers X points and the Responder participant says "Yes,"

    – **the Proposer participant will earn (endowment** $- X$**) points**, and

[9] This sentence was replaced in the instructions for the N treatment as follows: **The computer WILL NOT inform each Responder participant about the size of the endowment given to the matched Proposer participant**.

  - **the Responder participant will earn X points**.

  If the Proposer participant offers X points and the Responder participant says "No," both of them will earn 0 points.

Information Feedback

Before proceeding to the next round, the computer will inform you of (i) Proposer's decision, (ii) Responder's decision, and (iii) your payoff for the current round.

End of the Experiment

After completing the experiment, a summary screen will display the total points you have accumulated and the corresponding earnings in euros. Please remain at your cubicle until asked to come forward and receive payment for the experiment.

Once you are ready to begin the experiment, please click on the 'OK' button on the screen. When everyone is ready, the experimenter will read the instructions aloud, and then the experiment will start. Please remember that no communication is allowed during the experiment. If you encounter any difficulties please raise your hand. The experimenter will come to assist you.

Figures

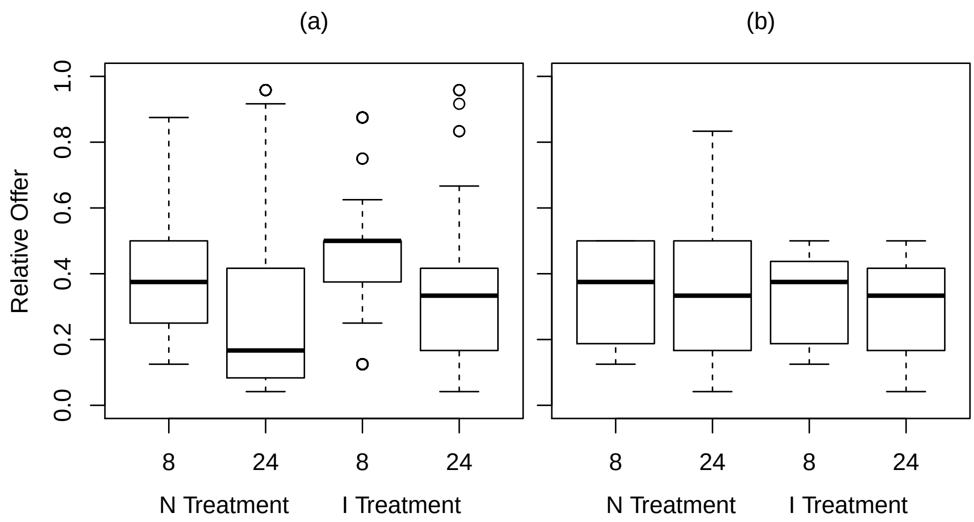

Figure 1: (a) Boxplots of relative offers across all rounds, and (b) boxplots of relative offers in the first round. Numbers on the horizontal axis are endowment sizes for each treatment.

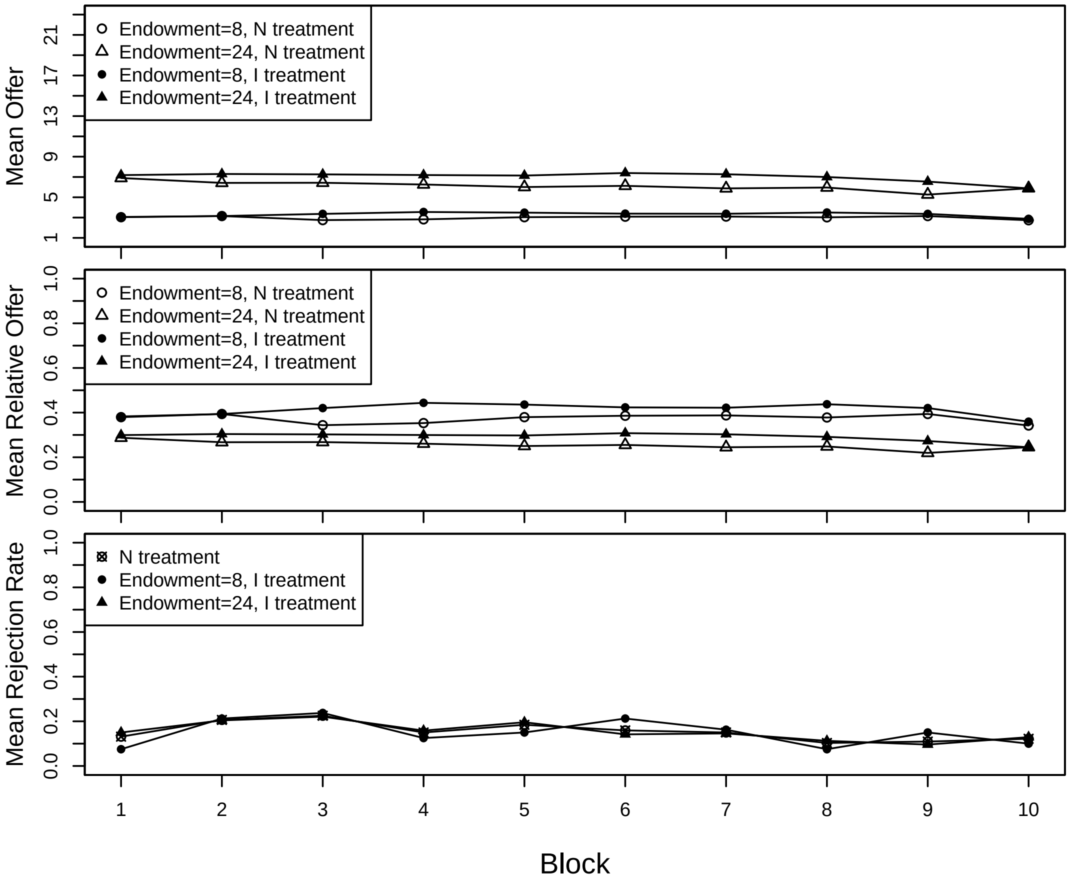

Figure 2: Time trends of mean offers, mean relative offers, and mean rejection rates (1 block = 10 rounds)

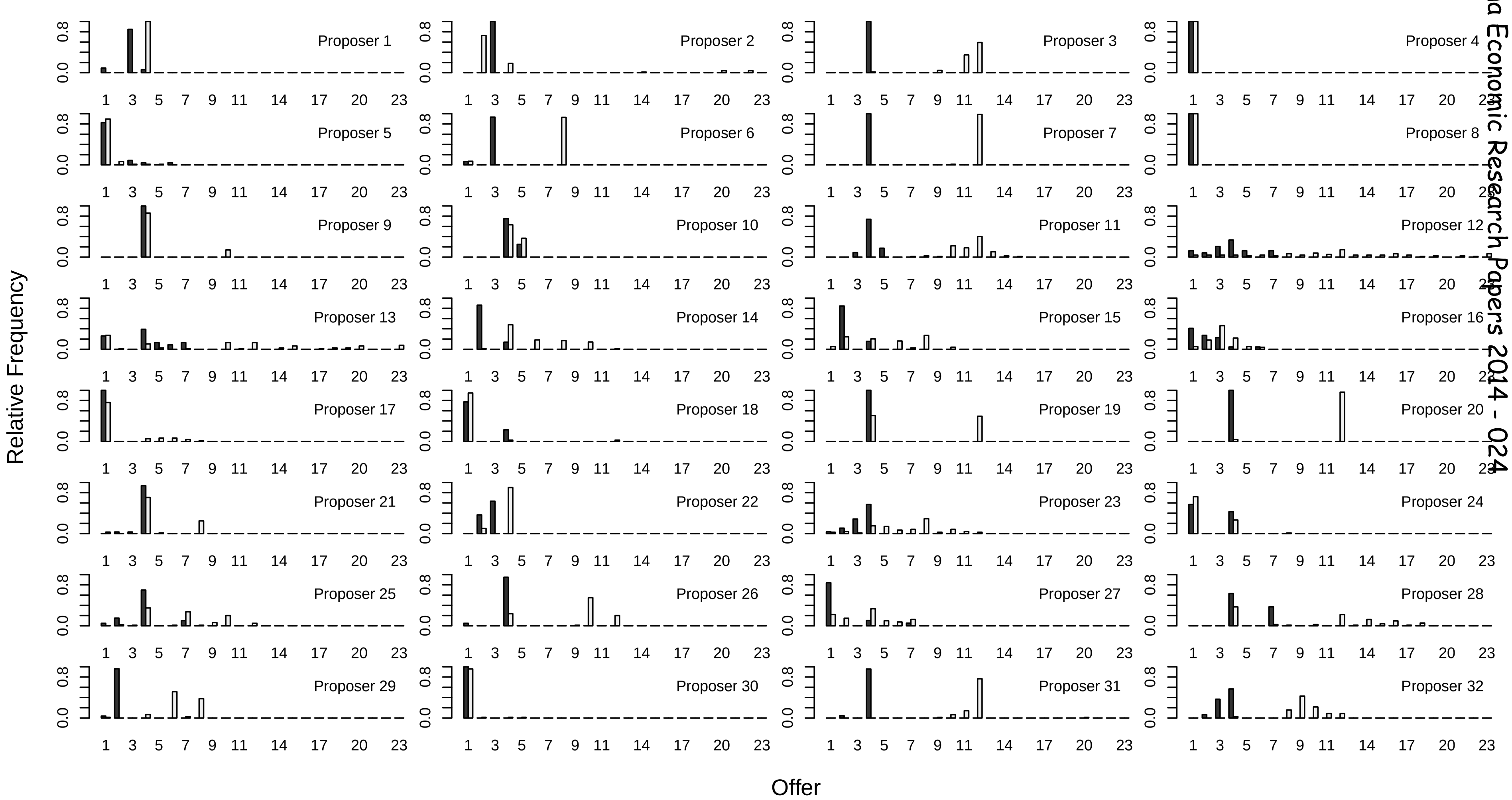

Figure 3: Relative frequency distribution of individual offers in the N treatment. Black bars for endowment $= 8$ and white bars for endowment $= 24$.

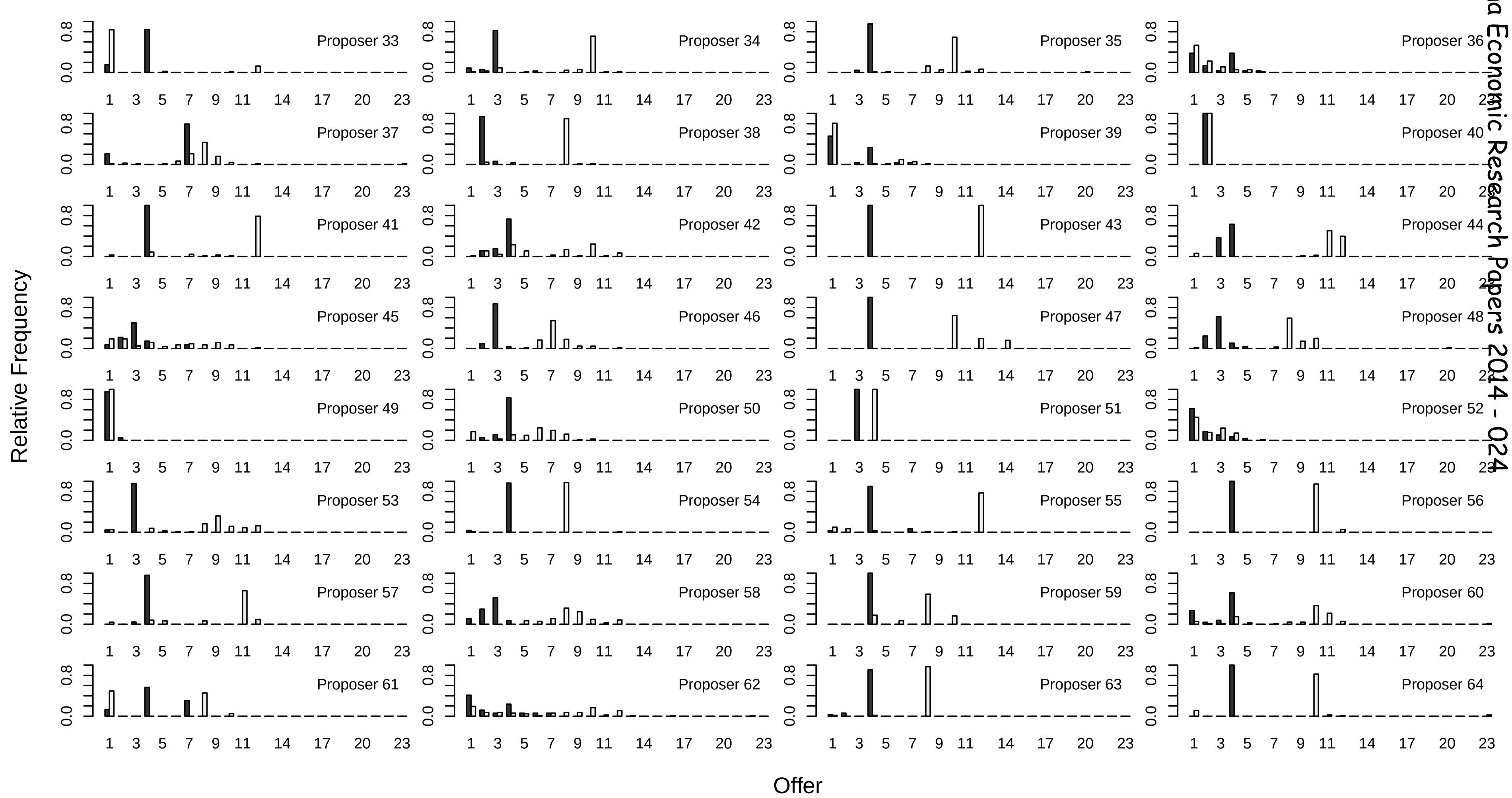

Figure 4: Relative frequency distribution of individual offers in the I treatment. Black bars for endowment = 8 and white bars for endowment = 24.

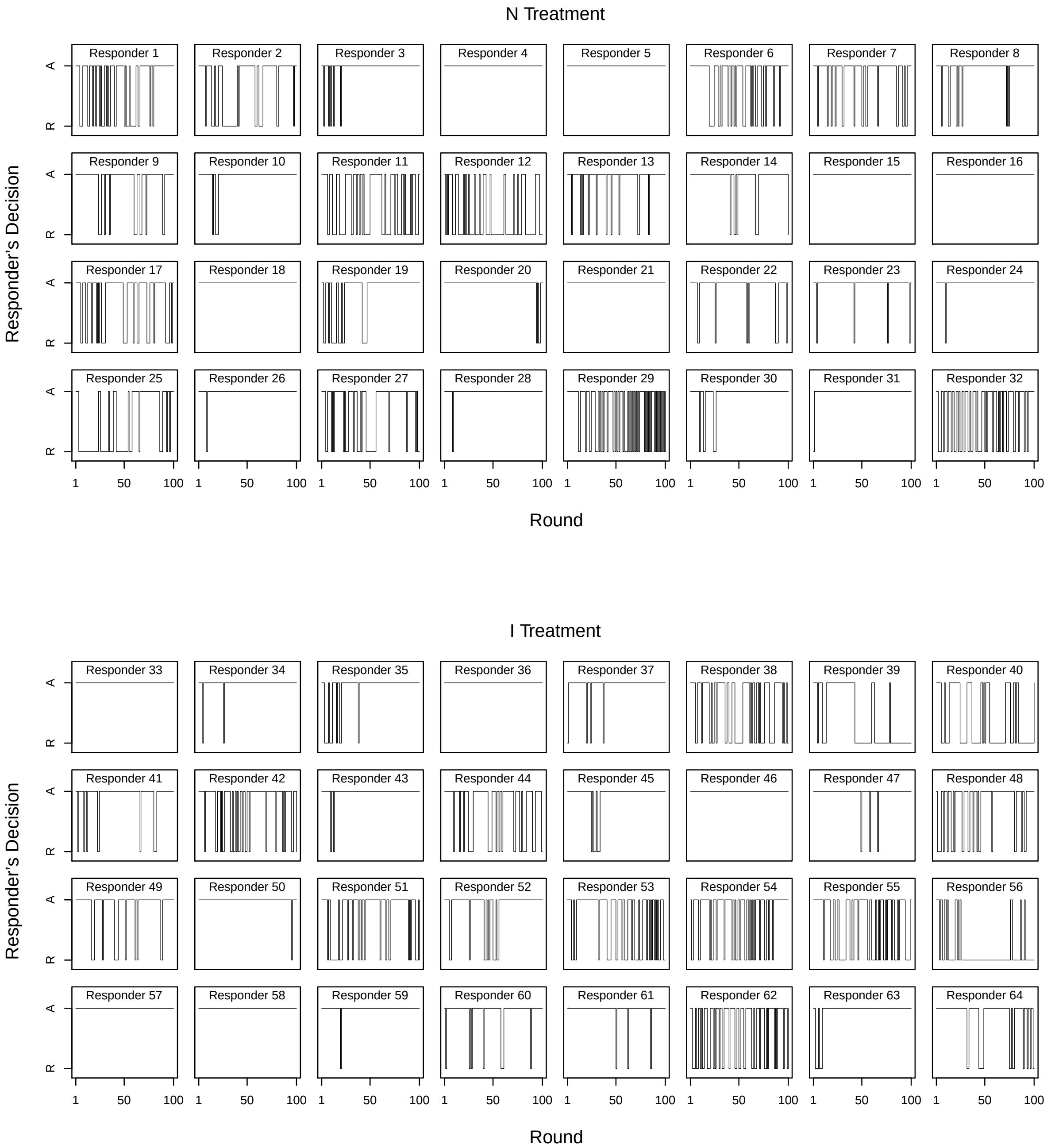

Figure 5: Individual responder's decision over 100 rounds (R = rejection, A = acceptance).

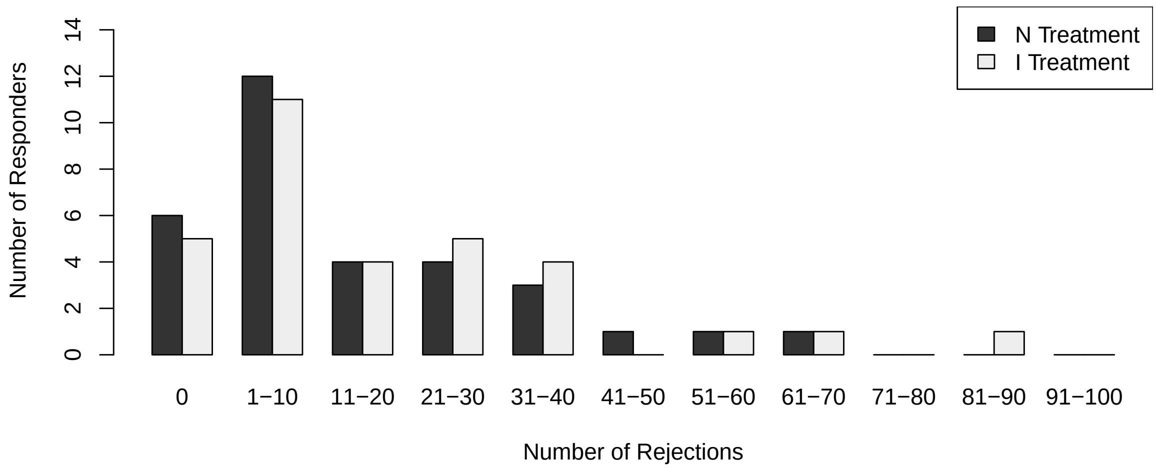

Figure 6: Frequency distributions of responders by the number of rejections.