Out of Sight, Out of Mind: an Experimental Investigation on Fairness, Bargaining and Social Context*

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May 2011

Abstract

Unlike economics, other social sciences have long recognized the importance of context in shaping decision-making. Game theory acknowledges social context only when it is strategically relevant, like the case of focal points. If such strategic dependence does not exist, most game theorists consider it desirable that theories of rational behavior ignore strategically irrelevant context. However, because fairness matters, social context may affect behavior. This paper analyzes the effect of social context on decision-making in a bargaining setting. We report experiments on two variations on the ultimatum game. In the first, one proposer makes four independent offers to four different responders. In the second, four proposers make four independent offers to a single responder. We find that in the multiple responder conditions, proposer shares of the pie are lower than in the baseline condition, but rejection rates are higher. In the multiple proposer condition, proposer shares of the pie are higher than the baseline, but rejection rates are not different. Importantly, introducing independent games significantly affects behavior of both proposers and responders, but only when information is given about what actions are taken in the other games and the resulting payoffs. This suggests that social context influences behavior in a non-trivial manner.

JEL – classification numbers: D03, C91

Keywords: Laboratory experiments, social context, ultimatum bargaining, multi-person game

*Financial support from the Nuffield Foundation is gratefully acknowledged. We thank Tim Miller for programming the software and helping to run the sessions. We are also grateful to Johannes Abeler and Ryan Murphy, as well as participants at seminars at the University of Exeter, ETH Zurich, the 2010 ESA meetings at Copenhagen and Tucson, as well as the 2010 IMEBE conference at Bilbao for insightful comments and suggestions. The usual disclaimer applies.

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1 Introduction

One of the defining characteristics of economic theory is the parsimonious nature of its models. Most economic theorists would agree that a good model should be devoid of context unless that context is strategically relevant. Experimental economics has followed a similar approach. Most experimental designs, either those explicitly testing a particular theory or trying to capture a particular feature of the real world, explicitly exclude as much of the context surrounding the decision making under scrutiny.

A case in point is bargaining. The most studied bargaining game in the experimental economics literature is the ultimatum game (Werner Guth, Rolf Schmittberger & Bernd Schwarze 1982), in which one player proposes how to split a fixed sum of money to another player. If the offer is accepted, the split is enforced; otherwise both players get nothing. Although any proposed split is a Nash equilibrium, non-cooperative game theory argues that the proposer has all the bargaining power. Since a rational responder accepts any positive offer, in the subgame-perfect equilibrium the proposer offers the split which maximizes his payoff and captures all the surplus.

Experimental evidence is in stark contrast with the subgame-perfect equilibrium prediction. Most observed offers give the proposer between 50 and 60 percent of the pie and proposals which offer the responder less than a fifth of the pie are often rejected. This stylized result is robust to different pie sizes (Robert Slonim & Alvin E. Roth 1998), as well as repeated interaction (Alvin E. Roth, Vesna Prasnikar, Masahiro Okuno-Fujiwara & Shmuel Zamir 1991). Although (John Gale, Kenneth G. Binmore & Larry Samuelson 1995) show that players in the ultimatum game can learn to play non-subgame-perfect equilibria, the most widely discussed explanations of ultimatum game data are based on players' aversion to inequality in monetary payoffs (Ernst Fehr & Klaus Schmidt 1999, Gary E. Bolton & Axel Ockenfels 2000) or players being driven by reciprocity motives (Armin Falk & Urs Fischbacher 2006).

This game, like all models, is a highly stylized version of reality. Insofar as the ultimatum game captures real-world bargaining situations, it is reasonable to argue that we do not play these games in isolation. In fact, we play a substantial number of ultimatum games with different individuals, firms and organizations every day. As such, it is natural to assume that some economic agents, like a large trader in a decentralized market, by their very nature will be engaged in more games than others. For instance, a supermarket plays hundreds of ultimatum bargaining games with its clients for each of its products every day. Governments of countries like the U.S. enter in bilateral negotiations on issues such as trade and foreign direct investment with multiple nations, often simultaneously.

If social preferences play no role, knowledge of these independent bargaining games is irrelevant. However, if social preferences matter, and there is substantial evidence to suggest it does,[1] then the knowledge that one player faces multiple counterparts in a number of independent games should affect behavior in a non-trivial way.

The purpose of this paper is to understand how the behavior in the ultimatum game is affected when one of the players is playing several independent ultimatum games with different players and this is common knowledge. In this sense, we augment the ultimatum game without altering its strategic nature. This is contrast with bargaining games with proposer or responder competition (Roth et al. 1991, Brit Grosskopf 2003, Urs Fischbacher, Christina M. Fong & Ernst Fehr 2009). The only change is that players are aware that one of them is playing multiple games at once.

The question of how information about strategically independent games influence behavior has only been recently approached by experimental economics. The most widely studied environment has been the gift-exchange game. The motivation to study the role of social context in this type of game is the effect of wage comparisons among workers and their effect on productivity.[2]

In the context of bargaining, the first paper to look at the impact of social context in bargaining was Knez Marc J. & Camerer Colin F. (1995), who study an ultimatum game with one proposer and two responders. Their experiment makes two simultaneous departures from the standard ultimatum game: not only do they introduce a second responder, but they also make the outside options to both responders positive and asymmetric. In other words, if a responder rejects his respective proposals, he gets a non-zero payoff, which differs from that of the proposer, and is also different from the outside value of the other responder.

[1]See John H. Kagel & Alvin E. Roth (1995) and Colin F. Camerer (2003) for reviews.

[2]The evidence to date in this class of games is mixed. While some studies find that providing information about wages and monetary payoffs of other workers has little effect on behavior (Gary Charness & Peter Kuhn 2007, Sandra Maximiano, Randolph Sloof & Joep Sonnemans 2007), other studies find worker-worker comparisons of wages to have significant effects (Johannes Abeler, Steffen Altmann, Sebastian Kube & Matthias Wibral 2010, Simon Gaechter, Daniele Nosenzo & Martin Sefton 2010, Daniele Nosenzo 2010). In the conceptually related trust game, Vincent Mak & Rami Zwick (2009) study the impact of introducing multiple trustees, as well as the impact of restricting the information available to trustees. They find that restricting trustees' information leads to higher total investment, as well as higher variance in investment across trustees. In markets, Lisa V. Bruttel (2009) finds that providing information about strategically irrelevant games increases prices in the Bertrand game.

The authors find that having different outside options to different players creates higher and persistent disagreement levels. Furthermore, half of responders demand more when they know other responders are being offered more.

Iris Bohnet & Richard Zeckhauser (2004) study the impact of social influence by informing responders in a standard ultimatum game of the average offer in the session. Providing information about the average session offer leads to a significant change in average offer as well as rejection rates. Teck-Hua Ho & Xuanming Su (2009) conduct an experiment where a proposer plays two ultimatum games in sequence with two different responders. In the second game, the responder receives an imperfect signal about the offer the proposer made to the first responder. They find that the likelihood of rejection in the second game is positively correlated with the signal from the first game. The proposers realize this, and adjust the offer in the second game as a function of the signal.

Our paper adds to this literature by looking at how the knowledge that one's bargaining counterpart is involved in other negotiations affects play in the ultimatum game. Furthermore, we are able to study the impact that information about actions and payoffs in those independent games has on behavior. By enriching the basic ultimatum game with multiple independent games, we are able to draw important insights that are beyond the scope of the original game. The first is to see how social preferences manifest themselves in an environment where some payoff comparisons are made with players whose actions do not directly impact the outcome of one's game. The second is to understand the importance of information regarding the actions and outcomes taken in those separate games. Theories of social preferences have nothing to say regarding how important is knowledge about others' actions and payoffs in different games when those games are strategically irrelevant.

We modify the ultimatum game in two ways, which correspond to our two treatments. In the first treatment, (Multiple Responders or MR), one proposer makes independent proposals to four different responders. The proposer gets a separate monetary payoff from each of the proposals, while the monetary payoff to each responder is only the outcome of his own game. We take advantage of the sequential nature of the game to introduce two conditions: MR-Open, where each responder knows the offer the proposer has made to the other three responders before deciding to accept or reject; and MR-Closed, where each responder only knows the offer the proposer has made to him before making his decision. In the second treatment, (Multiple Proposers or MP), four proposers make independent proposals to the same responder, whose financial reward is the sum of the payoffs from each proposal.

Our main finding is that introducing information about independent games significantly affects behavior of both proposers and responders, but only when information is given about what actions are taken in the other games and the resulting payoffs. When one proposer plays four independent games with different responders and responders are aware of the offers being made to others, proposers' average share in each pie is significantly smaller than in the standard ultimatum game. In addition, responder acceptance rates are no smaller in this case than in the standard ultimatum game. Interestingly, the distribution of proposer offers is quite close to optimal given responder acceptance rates. This still means a much higher degree of absolute payoff inequality across subjects, with Proposers earning six times more than Responders.

We also find some evidence to suggest that responders' acceptance decisions are influenced by horizontal fairness considerations. A responder is more likely to reject a given offer if that offer is below the average for the round, although he is not less likely to reject an offer if it is above the average. This finding, added to the large payoff inequality between proposers and responders in our treatment lead us to conjecture that social comparisons among peers may be different than comparisons made across roles in our experiment.

Although we do not aim to test for the predictive power of other-regarding preference models, standard theories of inequality aversion are not able to fully reconcile the behavior in the standard ultimatum game with our data. This suggests that notions of fairness are highly sensitive to contextual information. In short, we are able to better understand what drives subjects' wealth comparisons in the lab. When we constrain information regarding other actions and monetary payoffs, responders' behavior does not differ from the standard ultimatum even though this means quite large monetary payoff differences between proposers and responders. In a sense, even though subjects know that their counterpart in the ultimatum game is playing many games with many other players, and that this may mean he may be earning substantially more, if that information is not available, those concerns may not matter.

The following section describes the theoretical impact on behavior of introducing social context, as well as the underlying hypothesis. Section 3 outlines the experimental design and Section 4 presents the results. Section 5 concludes the paper.

2 Theory

The benchmark game in our paper is the Ultimatum Game (Guth, Schmittberger & Schwarze 1982). There, a player (the Proposer) makes an offer to another player (the Responder) concerning the split of an amount of money, which we normalize to be of size one. The Responder can either accept the offer, which enforces the proposed split, or he can reject the offer, in which case both players get zero. If players are self-interested, the Proposer will anticipate that the Responder will accept any positive amount. Hence, in equilibrium, he will offer the minimum amount possible, which the Responder accepts.

Before proceeding with the theoretical analysis, an important remark is important. The objective of this paper is not to test the predictive power of social preferences. We analyze the predictions social preference models make in our setup as we are interested in their predictions as benchmarks against which to contextualize the importance of social context. For explicit tests of social preferences, see Kevin A. McCabe, Mary L. Rigdon & Vernon L. Smith (2003), James C. Cox (2004), Dirk Engelmann & Martin Strobel (2004), or Armin Falk, Ernst Fehr & Urs Fischbacher (2008).

2.1 Social Context: Multiple Responders

A simple way to bring social context into this framework is to have one Proposer playing independent ultimatum games with several Responders at once. His monetary payoff is the sum of payoffs he gets from all parallel ultimatum games. (There is a separate pie to be split in each ultimatum game and the split can be different in each game.) In this sense the various ultimatum games are strategically independent, in that actions taken by any Responder do not impact on the payoff of other Responders. Therefore, the equilibrium prediction using players with self-interested preferences is the same as the standard game. We now will analyze the behavior in the Multiple Responder Game when players are averse to income inequality.

Fehr & Schmidt (1999) propose a utility function in which players incur disutility from payoff differences between different players and where such disutilities are additive. The functional form the authors propose is:

$$U(\pi_i, \pi_j) = \pi_i - \frac{\alpha_i}{n-1} \sum_{j \neq i} \max\{(\pi_j - \pi_i), 0\} - \frac{\beta_i}{n-1} \sum_{j \neq i} \max\{(\pi_i - \pi_j), 0\}. \quad (1)$$

The parameter α_i captures player i's aversion to disadvantageous inequality, while β_i captures player i's aversion to advantageous inequality.

Proposition FS - MR: As the number of Responders increases:[3]

i) The probability of rejection by a Responder of a given split will decrease;

ii) The average Responder per pie share will decrease.

PROOF: See Appendix.

The intuition for the first result is twofold. From the proposer's perspective, as the number of players in the game increases, the required β that induces the proposer to offer the split of the pie that equalizes payoffs across all players (i.e. offering the proposer a share $s = (n-1)/n$) becomes closer to one. This implies that, *ceteris paribus*, the larger the number of players, the less likely it is that the proposer will make that offer, and the more likely it is that he will offer the minimum offer that makes the responder indifferent between accepting and rejecting.[4]

From the responder's perspective, the share of the pie that makes him indifferent between accepting or rejecting will be a function of his α_R parameter, since that threshold share will give him a lower payoff than the proposer. The larger the number of players in the game, the *smaller* that threshold is. This is because by rejecting the offer, the responder is reducing the inequality between himself and the proposer, but at the same time increasing the inequality between himself and the other responders (this is of course not an issue in the standard ultimatum game.) As such, the more responders, the greater the disutility of rejecting the offer, and therefore the lower the minimum acceptable offer.

2.2 Social Context: Multiple Proposers

The complementary way to introduce social context into the ultimatum game is to have multiple Proposers playing independent games with one Responder. The payoff of each Proposer is the result of his own game, while the payoff to the Responder is the sum of payoffs from all games. Hence, like the Multiple Responders

[3] In proving both propositions in this paper, we assume α_i and β_i are uniformly distributed over a closed interval. However, we believe our result can be extended to a general distribution.

[4] In our setup with one proposer and four responders, the value of β that makes the proposer want to offer a split of $(n-1)/n$, which equalizes payoffs across all players is 0.8. Fehr & Schmidt (1999) estimate the highest value for β to be 0.6, and Mariana Blanco, Dirk Engelmann & Hans-Theo Normann (2010) estimate β to be no larger than 0.5. If those distributions apply to our subject pool, we should see no offers that equalize payoffs across all players.

case, each game is strategically independent, in that an action taken by a Proposer does not affect the payoff of other proposers.

Proposition FS - MP: As the number of Proposers increases:

i) The probability of rejection by a Responder of a given split will decrease;

ii) The average Responder per pie share will decrease; however his total share across all pies increases.

PROOF: See Appendix.

The reason for this prediction is that the minimum offer which makes the responder indifferent between accepting or rejecting is still $1/n$th of the pie, which implies that each proposer keeps $(n-1)/n$ of his respective pie (any split that gives the responder in excess of $1/n$ will always be accepted.) From the responder's perspective, the threshold offer that makes him indifferent between accepting and rejecting will be a decreasing function of the number of players in the game. Again this is because rejection increases payoff inequality between the responder and the proposers, rather than decrease it. This increase in inequality due to rejection is higher the greater the number of proposers in the game.

3 Experimental Design and Procedures

In our the baseline experiment, a proposer is matched with a responder. The proposer must offer a split of 10 Experimental Currency Units (ECU) between himself and the responder. If the responder accepts, the split is implemented; otherwise, both players get zero payoff. In our experiment, 1 ECU was worth £1, which meant that subjects were effectively bargaining over £10.

In order to test for the effect of social context we considered two main treatment conditions. The first is where one proposer plays four independent games with four responders, denoted by MR. In this treatment, the payoff to the proposer is the sum of payoffs from the four ultimatum games. The payoff to each responder is the outcome of his own ultimatum game only. The other treatment, which we denote by MP, consisted of the case where four proposers play independent games with the same responder. The payoff to each proposer is the outcome of his own ultimatum game, while the payoff to the responder is the sum of the payoffs resulting from each of the four ultimatum games.

Treatment	# of Proposers	# of Responders	Info	# of sessions
MR-Closed	1	4	No	6
MR-Open	1	4	Yes	6
MP	4	1	No	6
Control	1	1	No	6

Table 1: Experimental Design

Given the fact that the ultimatum game is a sequential-move game, we can also manipulate the information made available to Responders in the MR treatment before they decide whether to accept the offer or not. In the MR-Closed condition, each Responder only knew the Proposer was playing three other ultimatum games; Responders did not know what offers the Proposer made to the other three Responders before they decided whether to accept or to reject. In the MR-Open condition, Responders knew what the Proposer had offered to the other three Responders before making a decision. Table 1 describes the experimental design.

We report data from 24 computerized sessions.[5] Depending on the treatment, ten or fifteen participants took part in each session. A total of 330 participants took part in our experiments and no one participated in more than one session. Subjects had no previous experience with bargaining experiments.

In every session, we randomly assigned participants to the role of proposer or responder. Each participant retained his role throughout the sessions. The experiment consisted of ten rounds; proposers were randomly matched to responders from round to round. At the end of the experiment, two rounds were randomly drawn, and those determined the total payment for the session. There was no show-up fee. This was designed to maximize the salience of the decisions taken in the experiment: a responder who rejected all offers made to him in all ten rounds would leave the experiment empty-handed. Each session lasted for about 45 minutes and the average payment was £13 ($20.50.)

[5]We programmed the experiment using the software toolbox z-Tree (Urs Fischbacher 1997) and recruited subjects from the undergraduate student population using ORSEE (Ben Greiner 2004). Copies of the instruction sets are included in the Appendix.

4 Data

4.1 Proposer Behavior

Period	MR-Closed	MR-Open	MP	Control
1	5.90	6.03	6.06	6.18
	(1.49)	(1.70)	(1.21)	(0.78)
All	5.84	5.67	6.22	6.21
	(1.04)	(1.22)	(1.13)	(0.88)

Table 2: Average proposer share

We begin by looking at the behavior of proposers. Table 2 summarizes average offers by proposers in period one, as well as average offers across all periods. Focusing on the data across the 10 periods, average proposals in MR-Open are significantly lower than the average proposal in the Control treatment (MWU, $p = 0.02$.)[6] There is no statistically significant difference between average proposals in MR-Closed and Control as well as between MR-Closed and MR-Open (MWU, $p = 0.22$ and $p = 0.22$, respectively.) The modal proposer share is 6.00 in both MR-Closed and Control, and 5.00 in MR-Open, as well as MP. The share of pie which equalizes payoffs across players (50/50 in Control, 20/80 in MR and 80/20 in MP) is observed 11.67% in Control, but never in either MR-Open or MR-Closed treatments and 4.15% in the MP treatment.

A noticeable aspect of the data is that except for MR-Open and MP, the average proposer share in period one is quite close to the average proposer share across all periods. To investigate the impact of repeated play across the ten periods, we report a set of OLS regressions of the proposer share on a set of treatment dummies (keeping Control as the omitted category), a time trend perinv defined as 1/period and a set of interactions between treatment dummies and the time trend. Table 3 reports the results of our estimations.

Regression (1) addresses the same questions tackled by the non-parametric analysis with the added benefit of the extra power afforded by the larger sample size.[7] We again find negative coefficient on MR-Open and MR-Closed, both of which are now significant. The coefficient on MP is essentially zero. Regression

[6]We will use the acronym MWU to denote the two-sample Mann-Whitney U test of first-order stochastic dominance and KS to denote the Kolmogorov-Smirnov test of equality of distributions.

[7]We control for intra-session dependencies by clustering standard errors at the session level.

dep var: prop share	(1)	(2)
MR-Open	-0.54^{***}	-0.74^{***}
	(0.17)	(0.17)
MR-Closed	-0.37^{*}	-0.42^{*}
	(0.21)	(0.21)
MP	0.01	0.06
	(0.16)	(0.20)
perinv	-	-0.12^{*}
		(0.06)
perinv × MR-Open	-	0.67^{***}
		(0.21)
perinv × MR-Closed	-	0.15
		(0.12)
perinv × MP	-	-0.16
		(0.25)
constant	6.21^{***}	6.25^{***}
	(0.12)	(0.12)
R^2	0.037	0.043
Observations	4620	4620
Number of sessions	24	24
Standard errors clustered at session level in parentheses		
***: p<0.01, **: p<0.05, *: p<0.1		

Table 3: OLS estimation of proposer share

(2) introduces the learning effect. We find a negative but not significant coefficient on the time trend for the omitted treatment (Control). In contrast, the time trend for MR-Open is positive and significant, indicating that Proposers demand a smaller share of the pie in latter stages of the experiment. The time trend for MR-Closed is also positive, but insignificant. Finally, we find a negative time trend coefficient in the MP case, but that coefficient is also not significantly different than zero. This leads to the following observations.

Finding 1: The average proposer share in Multiple Responder treatments is lower than the standard ultimatum game; particularly if responders are aware of the offers made to responders.

Finding 2: The average proposer share in the Multiple Proposer treatment is no different than the standard ultimatum game.

Finding 3: We find almost no evidence of payoff-equalizing proposals.

Finding 4: We find evidence of learning only in treatments where Responders were aware of what other

Responders were being offered.

It is informative to look at the distribution of proposals in order to understand the effect of social context on Proposer behavior. Figure 1 shows the cumulative distribution plot of proposals for all treatments. We begin by looking at the effect of introducing multiple responders. The solid line denotes the distribution of proposer's share in Control. Comparing that distribution to the distributions in MR-Closed (solid gray) and MR-Open (short dash), we see that both distributions lie to the left of Control. Ignoring issues of within-session dependence, we use each proposal in a given period as an independent observation to test for the equality of distributions of offers. The proposal distributions for MR-Open and MR-Closed are significantly different than Control (KS, $D = 0.2772; p < 0.001$ and $D = 0.1525; p < 0.001$ respectively.) Likewise, we find the distribution of offers in MP significantly different than Control, but only at the 5% level (KS, $D = 0.0897; p = 0.025$.) We also find a significant difference between MR-Open and MR-Closed (KS, $D = 0.2083; p < 0.001$.)

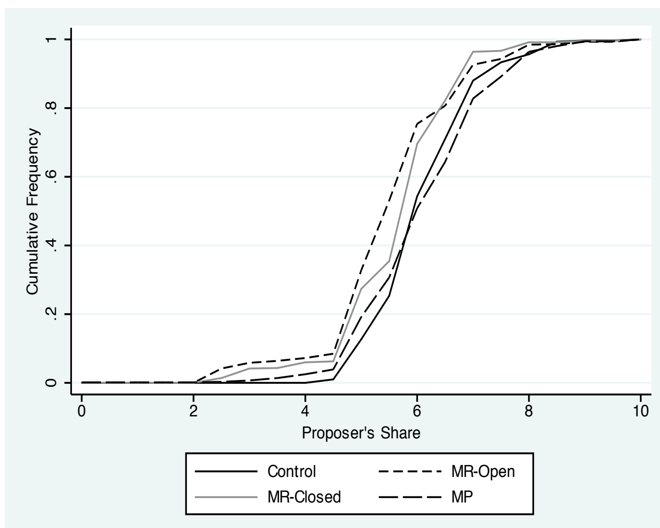

Figure 1: Cumulative distributions of proposer's share by treatment

We conclude the proposer analysis by comparing the dispersion of offers in the MR-Open and MR-Closed treatments. In other words, will a proposer in MR-Closed take advantage of the fact that responders are not aware of the other three offers and send different proposals to different responders in a given period? Table 4 presents the range and standard deviation of offers in a given period by each proposer, for both period 1 and all periods.

	Period 1		All Periods	
Treatment	Range	St. Deviation	Range	St. Deviation
MR-Open	0.97	0.42	0.64	0.29
	(1.18)	(0.48)	(0.58)	(0.25)
MR-Closed	1.88	0.82	0.79	0.36
	(0.98)	(0.40)	(0.70)	(0.31)

Table 4: Dispersion of proposer shares across responders in a given period, MR-Open and MR-Closed

The dispersion of offers in MR-Closed is twice that in MR-Open, irrespective of whether it is measured by the range or standard deviation of proposer share. In particular, we see that in MR-Closed there is an average difference of almost two units between the most generous split and the least generous split in a given period, which is substantial and statistically significant (MWU test; range: $p = 0.06$; st. deviation: $p = 0.05$.) When looking at all periods, we see the difference is much smaller and no longer significant (MWU test; range: $p = 0.42$; st. deviation: $p = 0.42$.) This suggests that proposers reduce the variability of their offers over the course of the experiment, in particular in MR-Closed.

Finding 5: There is a higher degree of dispersion of proposer share across the four responders in MR-Closed than MR-Open. However, this dispersion diminishes over time.

4.2 Responder Behavior

We now turn to Responder behavior. To analyze the decision by Responders to accept or reject a given proposal, we conducted a logit estimation, where the expression

$$Prob(\text{accept}_{i,t} = 1) = \frac{\exp(\boldsymbol{\beta}'\mathbf{x})}{1 + \exp(\boldsymbol{\beta}'\mathbf{x})}$$

is used to determine the probability of player where $\mathbf{x}$ is a vector of regressors, including proposer's share (Prop) and a set of treatment dummies. In a second estimation, we added a set of time trends and respective interactions with treatment dummies. Table 5 presents the results of the estimation.

Estimation (1) looks at the differences in behavior across treatments without accounting for time trends in acceptance rates. We find a negative and highly significant coefficient on Proposers' share. This indicates that the probability of a Responder accepting a given proposal goes down as the share of the

dep var: accept	(1)	(2)	(4)	(5)
Proposer share	-1.63***	-8.30***	-8.31***	-1.20***
	(0.43)	(1.39)	(1.45)	(0.18)
Proposer share^2		0.47***	0.47***	
		(0.10)	(0.11)	
MR-Open	-3.02	-22.24**	-20.55**	
	(2.96)	(8.58)	(8.32)	
MR-Closed	-0.69	-21.25***	-21.88***	
	(2.98)	(5.26)	(5.45)	
MP	-0.59	-22.00***	-20.17***	
	(3.26)	(7.68)	(7.53)	
Prop × MR-Open	0.49	5.97**	5.45**	
	(0.48)	(2.44)	(2.40)	
Prop^2 × MR-Open		-0.39**	-0.34**	
		(0.17)	(0.17)	
Prop × MR-Closed	0.12	6.00***	6.12***	
	(0.48)	(1.55)	(1.63)	
Prop^2 × MR-Closed		-0.41***	-0.42***	
		(0.12)	(0.13)	
Prop × MP	0.10	6.25***	5.73***	
	(0.50)	(2.16)	(2.13)	
Prop^2 × MP		-0.44***	-0.40***	
		(0.16)	(0.15)	
Perinv			-0.70**	
			(0.31)	
Perinv × MR-Open			-0.67	
			(0.49)	
Perinv × MR-Closed			0.85	
			(0.58)	
Perinv × MP			-0.25	
			(0.61)	
Better				-0.07
				(0.28)
Worse				-0.49**
				(0.25)
Better × MR-Open				0.11
				(0.35)
Worse × MR-Open				0.10
				(0.43)
Constant	12.20***	35.38***	35.65***	9.75***
	(2.62)	(4.75)	(4.97)	(1.15)
Pseudo R^2	0.28	0.28	0.28	0.21
Observations	4,620	4,620	4,620	1440

Standard errors clustered at session level in parentheses
***: $p < 0.01$, **: $p < 0.05$, *: $p < 0.1$

Table 5: Logit estimation of responder acceptance likelihood

Proposer increases, as theory would predict. However, the interactions between the treatment dummies and the Proposer's share are positive but not significant. However, this could be due to the non-linearities in the relationship between acceptance rate and proposer share. We added a squared term of the proposer share, as well as the relevant interactions with the existing dummies. The results are summarised in estimation (2.) We retain a negative and significant coefficient on the proposer share, as well as a positive and highly significant coefficient on its squared term, indicating that the likelihood of acceptance falls at a decreasing rate as the proposer's share increases. We also obtain significant coefficient on all treatment dummies and their interactions with proposer's share and squared proposer share. This is remarkable since for any split of the pie the level of inequality is higher the more Responders play with the same Proposer. Furthermore, the coefficients on the interactions dummies for MR-Open and MR-Closed are not significantly different (F-test, $p = 0.74$.)

This indicates that conditional on the level, a proposal is more likely to be accepted in MR-Open and MR-Closed than in Baseline. In other words, the existence of multiple parallel games leads to Responders being more likely to accept a given split of the pie. In order to better understand how the likelihood of acceptance changes as a function of the proposer's share, we estimated the probability of acceptance as a function of proposer's share treatment by treatment.

Figure 2 shows the estimates of the pr(accept) as a function of proposer's share for each treatment. We see that the probability of accepting an offer is very close to unity for any offer giving the proposer up to 60% of the pie in all treatments. Proposals giving the proposer in excess of 60% of the pie are more likely to accepted in MR-Open than in Control, MR-Closed and MP. For instance, a 80/20 split has a probability of acceptance of roughly 30% in Baseline and close to 50% in MR-Open.

Finding 6: The probability of acceptance of a given offer is higher in MR-Open than Control for offers which give the Proposer more than 60% of the pie.

Returning to the analysis in Table 5, estimation (3) investigates the potential effect of learning over the course of the experiment, by adding treatment-specific time trends. The variable Perinv is defined as 1/period, and accounts for the omitted category's time trend. The interactions between treatment dummies and perinv account for the other treatment-specific trends. We find only the Control trend is negative

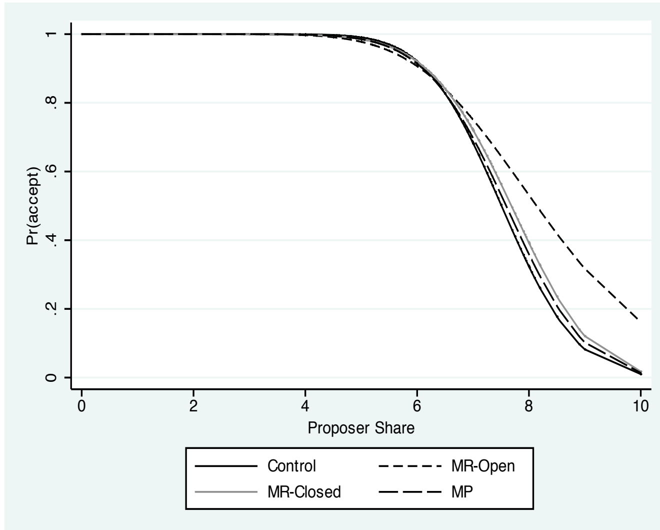

Figure 2: Acceptance probability - Treatment level

and significant. This indicates that acceptance rates increase as the experiment progresses. We find negative time trends for MR-Open and MP and positive time trend for MR-Closed, but these coefficients are insignificant.

Finding 7: We find limited evidence of changes in acceptance rates over the course of the experiment.

We conclude the analysis of responder behavior by focusing on the Multiple Responder treatments. In particular we are interested in understanding whether horizontal notions of fairness matter in determining responder behavior. In other words, are responders concerned only with what they are getting compared to their assigned proposer, or do they take into account what others (may) get?

Estimation (5) tackles this issue, by adding two new dummy variables, Better and Worse. The former takes a value of 1 if the responder's share is above the average for the group in a given period, while the latter takes a value of 1 if the responder's share is below the average offer for the group in a given period. The omitted category is of course the case when the responder's share is equal to the average offer. We find negative coefficients for both variables, but while the coefficient on Better is quite close to zero and insignificant, only the coefficient on Worse is significant. In other words, responders are assessing the fairness of the offer presented to them based on what other responders obtain, as well as based on how different their payoff is to the proposer's. We summarise this finding as:

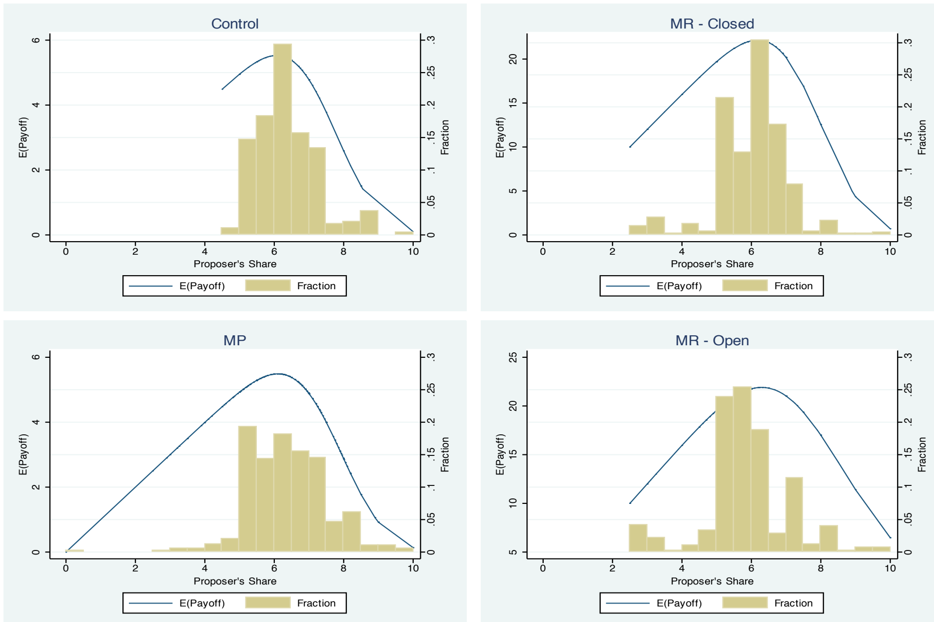

Figure 3: Expected Proposer Payoffs and Distribution of Proposer Shares by Treatment

Finding 8: For a given split of the pie, the likelihood of acceptance decreases if the responder's share is below the average proposer's share in that period.

4.3 Proposer Behavior Revisited

Having examined the behavior of proposers and responders in turn, it is clear that the subgame perfect Nash equlibrium under the assumption of money maximizing agents is rejected. It is therefore instructive to ask the question of whether the behavior we observe is in some sense optimal. In other words, given the observed behavior by responders, are proposers maximising their expected utility? We try to answer this question by computing the expected payoff to proposers conditional on the observed acceptance rates in the experiment. We then compare the distribution of proposer share to the estimated expected payoff function. This is displayed in Figure 3. The solid line represents the expected payoff to proposers, which is superimposed on the histogram of proposer shares.

In both Control and MR-Closed the mode of the histogram matches the maximum of the expected payoff function at 6. In MR-Open the mode is slightly to the left of the maximum expected profit, while in MP, the histogram does not have a clear mode but has a small support, and is centered around the maximum of the expected payoff. This, added to the very limited evidence of learning, suggests that proposer behavior in our experiments is indeed close to optimal.

Finding 9: Proposer behavior is close to the optimal, given acceptance rates by responders.

5 Discussion

This paper presents experimental evidence on two extensions of the ultimatum game. In one treatment, one proposer splits four different pies with four different responders. In the other treatment, four proposers propose simultaneous and independent splits of four different pies to the same responder. Importantly, adding the extra players in either treatment does not change the strategic nature of each game, as actions taken in one game do not affect the payment of players in other games.

Since it is by incorporating other-regarding preferences in player's utility function that we generate changes in predictive behavior relative to the standard ultimatum game, it is important to discuss our results in light of social preferences. A common feature of inequality aversion and reciprocity models is the fact that most rely on the equal split as the reference point to establish whether an offer is acceptable or not. This simplifies our analysis and our hypotheses, since we can rank proposals in terms of their inequality along one dimension only (the proposer's share in a given pie as a deviation from the equal split), as in equilibrium the responder(s) will get the same share of their respective pies.

Furthermore, our focus on symmetric equilibria means that while horizontal payoff comparisons matter in determining equilibrium splits, the only possible asymmetry in payoffs would be between proposer(s) and responder(s.) To some extent this focus is validated by the data, in that the impact of changes in payoff differences between proposer and responder have a higher impact on likelihood of acceptance than changes in payoff differences between responders.

However, the variance in offers had an important impact on responders. Interestingly that impact was asymmetric: fixing a given offer, when that offer was better than the average, that did not mean a higher acceptance rate. However, when that offer was below average, it meant that the likelihood of acceptance dropped significantly. This is consistent with Fehr and Schmidt's assumption that the disutility of being behind payoff-wise is higher than the disutility of being in front.

Let us return to vertical comparisons and how they affect both proposals and acceptance decisions. We find the standard result that the probability of accepting a given offer diminishes, the bigger the share of the proposer. The surprise is that in treatments with multiple games, the biggest difference came from the treatment where responders had information about all the offers being made to other responders. This was reflected in both the average proposer share, which was *lower* than in the standard ultimatum game, as well as the acceptance rates which were *higher* than in the standard ultimatum game.

This raises two interesting points. Firstly, responders in the MR treatments were willing to accept offers which created higher degree of payoff difference between proposer and responders, to the point where a proposer could make from six to sixteen times the payoff of each responder – we estimate the probability of acceptance of an 8/2 split in MR-Open to be 40%, which is surprisingly high. If the proposer made four such offers and all were accepted, the proposer's total payoff for that round would be 32, while each responder would only get 2! This indicates that responders are, to some extent, willing to accept the fact that in this treatment, the proposer will be able to earn a higher payoff. This is consistent with evidence from ultimatum games where different players have different endowment levels (Olivier Armantier 2006).

This will be of interest to those interested in understanding how decision making is shaped by social preferences and how those interact with the type of interactions in which people engage. Similar concerns arise when considering what wage structure to offer to employees of a firm. Will employer-employee payoff comparisons dominate, or will workers care more about how well they are paid relative to their peers? The gift-exchange literature has studied such issues in some detail, but conclusions are mixed. From a bargaining perspective, our data shows that social context and social comparisons matter in determining bargaining outcomes.

A second noteworthy point is that information about what is happening in unrelated games may be needed to trigger fairness considerations. Fairness theories rely solely on the fact that subjects base their decisions on payoff comparisons between themselves and other agents. In our experiment, we manipulate the ability of subjects to make explicit payoff comparisons. Although they know others are playing the same game as them (with the same counterpart), they must rely on beliefs about their actions and payoffs to calculate their utility.

By constraining information about other games, the proposers are able to get fractionally higher payoffs than when information is freely available. However, acceptance rates are higher when information is available than when it is not. This finding is particularly useful to negotiation scholars. An interesting application is plea bargaining when there are multiple defendants (Bruce H. Kobayashi 1992, Jeong-Yoo Kim 2009). Our findings suggest that public prosecutors may be able to successfully obtain concessions from defendants if they are aware of what is being offered to the other defendants in the case. At a different level, international trade agreements are often public information; our results suggest that a large country with multiple trading partners may benefit from making public announcements of the offers it is making to its trading partners.

Our findings are also of interest to those interested in bargaining over networks. In this paper, the network structure is fixed in the shape of a star. In the MR treatments, the proposer is the centre of the star, while in the MP treatment, the proposers are the tips of the star. Typically, the study of information dissemination and network structure is a separate issue from that of bargaining in a network. However, our findings suggest that information may have important interactions with network structure. An open question is precisely how network structure interacts with information availability when agents bargain over the network, and what are the structures that maximise surplus to the proposer or responder. We leave this issue for future research.

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Appendix

Proof of Proposition FS - MR: A responder of type α is indifferent between accepting share s and rejecting if

$$0 \leq s = \frac{\alpha_R}{n(1+\alpha_R)-1} < 1/n$$

For $s \geq \frac{1}{n}$ he will always accept. For given $s < \frac{1}{n}$ the type indifferent between accepting and rejecting is given by

$$\alpha_R(s) = \frac{(n-1)\,s}{1-ns}$$

where

$$\frac{d\alpha_R}{ds} = \frac{n-1}{(1-ns)^2}$$

Notice that all types with $\alpha_R < \alpha_R(s)$ will accept the offer s. Let $f(\alpha)$ be the density and $F(\alpha)$ be the distribution of α-types. A proposer who offers the share s to has the expected monetary gain

$$\Pi(s) = (n-1)(1-s)\,F(\alpha_R(s))$$

Assuming differentiability of the distribution F the first order condition for an optimum in the range $0 \leq s < 1/n$ is

$$\begin{aligned}
\Pi'(s) &= (1-s)\,F'(\alpha_R(s))\,\alpha_R'(s) - F(\alpha_R(s)) = 0 \\
\Pi'(s) &= (1-s)\,F'\left(\frac{(n-1)\,s}{1-ns}\right)\frac{n-1}{(1-ns)^2} - F\left(\frac{(n-1)\,s}{1-ns}\right) = 0
\end{aligned}$$

Assuming a uniform distribution of α over the interval $[0, A]$, i.e. $f(\alpha) = 1/A$ and $F(\alpha) = \alpha/A$ for $0 \leq \alpha \leq A$ and $f(\alpha) = 0$, $F(\alpha) = 1$ for $\alpha > A$ yields for $s < \frac{A}{n(1+A)-1}$

$$\Pi'(s) = \frac{(n-1)(1-s)}{A(1-ns)^2} - \frac{(n-1)\,s}{A(1-ns)} = 0$$

We claim that $\Pi'(s) > 0$ for all s in the interval. This is clear for $s = 0$.

$$\begin{aligned}
\Pi'(s) &> 0 \Longleftrightarrow (1-s) - s(1-ns) > 0 \\
&\Longleftrightarrow s^2 - \frac{2}{n^2}s + \frac{1}{n^2} > 0 \\
&\Longleftrightarrow s^2 - \frac{2}{n^2}s + \frac{1}{n^4} - \frac{1}{n^4} + \frac{1}{n^2} > 0 \\
&\Longleftrightarrow \left(s^2 - \frac{1}{n^2}\right)^2 - \frac{1}{n^4} + \frac{1}{n^2} > 0
\end{aligned}$$

where the latter inequality is always true. It follows that monetary expected gains are maximized at

$$\bar{s} = \frac{A}{n(1+A)-1} < \frac{1}{n}$$

since expected monetary gain is increasing up to that level and decreasing from there onwards because the offer is always accepted. Since $\bar{s}$ is decreasing it follows that all subjects with sufficiently low β will offer less if the number of responders increases.

Proof of Proposition FS - MP: A responder of type α is indifferent between accepting share s and rejecting if

$$0 \leq s = \frac{\alpha_R}{n(1+\alpha_R)-1} < 1/n$$

For $s \geq \frac{1}{n}$ he will always accept. For given $s < \frac{1}{n}$ the type indifferent between accepting and rejecting is given by

$$\alpha_R(s) = \frac{(n-1)\,s}{1-ns}$$

where

$$\frac{d\alpha_R}{ds} = \frac{n-1}{(1-ns)^2}$$

Notice that all types with $\alpha_R < \alpha_R(s)$ will accept the offer s. Let $f(\alpha)$ be the density and $F(\alpha)$ be the distribution of α-types. A proposer who offers the share s has the expected monetary gain

$$\Pi(s) = (1-s)\,F(\alpha_R(s))$$

Assuming differentiability of the distribution F the first order condition for an optimum in the range $0 \leq s < 1/n$ is

$$\begin{aligned}
\Pi'(s) &= (1-s)\,F'(\alpha_R(s))\,\alpha_R'(s) - F(\alpha_R(s)) = 0 \\
\Pi'(s) &= (1-s)\,F'\left(\frac{(n-1)\,s}{1-ns}\right)\frac{n-1}{(1-ns)^2} - F\left(\frac{(n-1)\,s}{1-ns}\right) = 0
\end{aligned}$$

Assuming a uniform distribution of α over the interval $[0, A]$, i.e. $f(\alpha) = 1/A$ and $F(\alpha) = \alpha/A$ for $0 \leq \alpha \leq A$ and $f(\alpha) = 0$, $F(\alpha) = 1$ for $\alpha > A$ yields for $s < \frac{A}{n(1+A)-1}$

$$\Pi'(s) = \frac{(n-1)\,(1-s)}{A\,(1-ns)^2} - \frac{(n-1)\,s}{A\,(1-ns)} = 0$$

We claim that $\Pi'(s) > 0$ for all s in the interval. This is clear for $s = 0$.

$$\begin{aligned}
\Pi'(s) &> 0 \Longleftrightarrow (1-s) - s(1-ns) > 0 \\
&\Longleftrightarrow s^2 - \frac{2}{n^2}s + \frac{1}{n^2} > 0 \\
&\Longleftrightarrow s^2 - \frac{2}{n^2}s + \frac{1}{n^4} - \frac{1}{n^4} + \frac{1}{n^2} > 0 \\
&\Longleftrightarrow \left(s^2 - \frac{1}{n^2}\right)^2 - \frac{1}{n^4} + \frac{1}{n^2} > 0
\end{aligned}$$

where the latter inequality is always true. It follows that monetary expected gains are maximized at

$$\bar{s} = \frac{A}{n(1+A)-1} < \frac{1}{n}$$

since expected monetary gain is increasing up to that level and decreasing from there onwards because the offer is always accepted. Since $\bar{s}$ is decreasing it follows that all subjects with sufficiently low β will offer less if the number of proposers increases.

Sample Instructions: MR - Open

Welcome to our experiment. Please remain silent during the course of the experiment. If you have any questions, please raise your hand.

You will now take part in a decision-making experiment. The amount you will receive for participating will depend on your decisions and the decisions of other participants.

The payoffs throughout the experiment will be denominated in Experimental Currency Units (ECU); 1 ECU is worth £1. Once the experiment ends, the computer will select two rounds at random for payment, your payoff will be calculated and you will receive your payment in cash.

There are two types of players in this experiment, Proposer and Responder. Roles are randomly assigned by the computer. Once you have been allocated to one of the roles, you will retain that role until the end of the experiment.

The task of the Proposer is to propose a split of 10 ECU between himself and a Responder. In other words, the proposal must specify two ECU amounts: one amount for each player. You may specify numbers up to two decimal places but the two amounts must add up to 10 ECU.

If the Responder accepts the proposal each player will receive the ECU amount as proposed. If the Responder rejects the proposal, both players receive 0 ECU.

There will be 10 rounds in this experiment. In each round, each Proposer will be randomly matched with four different Responders. The Proposer will therefore have to make four proposals, one to each of the different Responders.

The payoff of the Proposer will be the sum of the payoffs he receives from the four different proposals.

The payoff of the Responder will be the amount he gets from the proposed split of 10 ECU.

When deciding whether to accept or reject the proposal, the Responder will know what offers the Proposer has made to the three other Responders.

At the end of each round, the Proposer will be informed about whether each of the four Responders accepted his proposal to them. He will also be informed about the payoff to himself and to the Responder from each of the four proposals.

At the end of each round, the Responder will be informed about the payoff to himself and to the

Proposer from their proposed split of 10 ECU. The Responder will also be informed about whether the three other Responders accepted or rejected their proposals. He will also be informed about the payoff to the Proposer and to the other Responders from those proposals.

In order to fix ideas, we will run a practice round, in which you will play against the computer. The computers decisions have been pre-programmed and will be the same for every participant.

Sample Instructions: MR - CLOSED

Welcome to our experiment. Please remain silent during the course of the experiment. If you have any questions, please raise your hand.

You will now take part in a decision-making experiment. The amount you will receive for participating will depend on your decisions and the decisions of other participants.

The payoffs throughout the experiment will be denominated in Experimental Currency Units (ECU); 1 ECU is worth £1. Once the experiment ends, the computer will select two rounds at random for payment, your payoff will be calculated and you will receive your payment in cash.

There are two types of players in this experiment, Proposer and Responder. Roles are randomly assigned by the computer. Once you have been allocated to one of the roles, you will retain that role until the end of the experiment.

The task of the Proposer is to propose a split of 10 ECU between himself and a Responder. In other words, the proposal must specify two ECU amounts: one amount for each player. You may specify numbers up to two decimal places but the two amounts must add up to 10 ECU.

If the Responder accepts the proposal each player will receive the ECU amount as proposed. If the Responder rejects the proposal, both players receive 0 ECU.

There will be 10 rounds in this experiment. In each round, each Proposer will be randomly matched with four different Responders. The Proposer will therefore have to make four proposals, one to each of the different Responders.

The payoff of the Proposer will be the sum of the payoffs he receives from the four different proposals.

The payoff of the Responder will be the amount he gets from the proposed split of 10 ECU.

When deciding whether to accept or reject the proposal, the Responder will not know what offers the Proposer has made to the three other Responders.

At the end of each round, the Proposer will be informed about whether each of the four Responders accepted his proposal to them. He will also be informed about the payoff to himself and to the Responder from each of the four proposals.

At the end of each round, the Responder will be informed about the payoff to himself and to the

Proposer from their proposed split of 10 ECU. The Responder will not be informed about whether the three other Responders accepted or rejected their proposals nor will he be informed about the payoff to the Proposer or to the other Responders from those proposals.

In order to fix ideas, we will run a practice round, in which you will play against the computer. The computers decisions have been pre-programmed and will be the same for every participant.

Sample Instructions: MP

Instruction Set

Welcome to our experiment. Please remain silent during the course of the experiment. If you have any questions, please raise your hand.

You will now take part in a decision-making experiment. The amount you will receive for participating will depend on your decisions and the decisions of other participants.

The payoffs throughout the experiment will be denominated in Experimental Currency Units (ECU); 1 ECU is worth £1. Once the experiment ends, the computer will select two rounds at random for payment, your payoff will be calculated and you will receive your payment in cash.

There are two types of players in this experiment, Proposer and Responder. Roles are randomly assigned by the computer. Once you have been allocated to one of the roles, you will retain that role until the end of the experiment.

The task of the Proposer is to propose a split of 10 ECU between himself and a Responder. In other words, the proposal must specify two ECU amounts: one amount for each player. You may specify numbers up to two decimal places but the two amounts must add up to 10 ECU.

If the Responder accepts the proposal each player will receive the ECU amount as proposed. If the Responder rejects the proposal, both players receive 0 ECU.

There will be 10 rounds in this experiment. In each round, each Responder will be randomly matched with four different Proposers. The Responder will therefore have to respond to four proposals, one from each of the different Proposers.

The payoff of the Responder will be the sum of the payoffs he accepts from the four different proposals.

The payoff of the Proposer will be the amount he gets from his proposed split of 10 ECU if accepted.

When deciding whether to accept or reject the proposals, the Responder will be able to see the offers from all of the Proposers simultaneously.

At the end of each round, the Proposers will be informed about whether the Responder accepted their proposal. They will also be informed about their payoff and the payoff to the Responder from their split of 10 ECU.

In order to fix ideas, we will run a practice round, in which you will play against the computer. The computers decisions have been pre-programmed and will be the same for every participant.

Sample Instructions: Control

Instruction Set

Welcome to our experiment. Please remain silent during the course of the experiment. If you have any questions, please raise your hand.

You will now take part in a decision-making experiment. The amount you will receive for participating will depend on your decisions and the decisions of other participants.

The payoffs throughout the experiment will be denominated in Experimental Currency Units (ECU); 1 ECU is worth £1. Once the experiment ends, the computer will select two rounds at random for payment, your payoff will be calculated and you will receive your payment in cash.

There are two types of players in this experiment, Proposer and Responder. Roles are randomly assigned by the computer. Once you have been allocated to one of the roles, you will retain that role until the end of the experiment.

The task of the Proposer is to propose a split of 10 ECU between himself and a Responder. In other words, the proposal must specify two ECU amounts: one amount for each player. You may specify numbers up to two decimal places but the two amounts must add up to 10 ECU.

If the Responder accepts the proposal each player will receive the ECU amount as proposed. If the Responder rejects the proposal, both players receive 0 ECU.

There will be 10 rounds in this experiment. In each round, each Proposer will be randomly matched with a different Responder.

At the end of each round, the Proposer will be informed about whether the Responder accepted his proposal. Both Proposer and Responder will also be informed about their payoff from their split of 10 ECU.

In order to fix ideas, we will run a practice round, in which you will play against the computer. The computers decisions have been pre-programmed and will be the same for every participant.