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Riedl, Arno; Vyrastekova, Jana

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# Responder Behavior in Three-Person Ultimatum Game Experiments

Arno Riedl<sup>‡</sup> and Jana Výrašteková<sup>§</sup>

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## Abstract

We extend the standard ultimatum game to a three person game where the proposer chooses a three-way split of a pie and two responders independently and simultaneously choose to accept or reject the proposal. We investigate whether a responder perceives the other responder as a reference person. We do this by varying the *other* responder's payoff in case the responder rejects. Hence, we explore whether reciprocal behavior towards the proposer is affected by the presence of the third player. In three treatments, the third player is either negatively affected, unaffected, or positively affected by the responder's choice to punish the proposer. We find that responders are very heterogeneous in their actions. Around one half of subjects submit strategies showing no concern for the other responder's payoffs. Another half of the subject pool submits strategies sensitive to the distribution of the pie among all three players. Preferences for equal splitting of the pie are expressed by less than 10 percent of all responders.

*JEL* Classification Number: A13, C72, C91, D63, Z13

Keywords: behavioral game theory, laboratory experiment, social preferences, three-person ultimatum game

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<sup>‡</sup>CREED, Faculty of Economics and Econometrics, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands; email: a.m.riedl@uva.nl

<sup>§</sup>Department of Economics, Tilburg University, P.O. Box 90153, 5000 LE Tilburg, The Netherlands; email: J.Vyrastekova@uvt.nl

# 1 Introduction

There is now a considerable amount of experimental evidence indicating that even in anonymous interactions people do not only care about their own material well-being but also about the well-being of others. Unraveling the structure of such social preferences and utilizing the existing evidence for developing a theory of motivation that could explain the behavioral regularities has become a fascinating enterprise.

However, much of the experimental evidence has been collected in the context of two-player games. In particular, in bargaining environments almost only data from two-player bargaining situations are available.<sup>1</sup> But there is also a wide recognition that multi-player interactions are important and that they open a new field of research questions concerning persons' disposition towards others. For example, the evaluation of a player's relative position in the group, an important ingredient in fairness judgments and outcome valuations, is anything else than straightforward. Therefore, it is important to extend the experimental database to include data from multi-player games in a systematic way. With this paper we contribute to this undertaking and explore multi-player interactions in one of the basic bargaining environments - the ultimatum game.

In the standard two-player ultimatum game, one person, the proposer, makes a take-it-or-leave offer to one other person, the responder. If the responder accepts the offer is implemented, otherwise both get nothing. When experimental subjects are put in such a bargaining situation it is usually observed that subjects acting in the role of the 'responder' frequently reject small but strictly positive offers. Subjects being 'proposers' make rather generous offers that are often in the neighborhood of the equal split. (The experimental research on the two-player ultimatum game was initiated by Güth et al., 1982; for a recent literature overview, see Camerer, 2001.)

Extending the standard ultimatum game to a bargaining situation with more than two players raises several interesting issues about distributional concerns. In contrast to the two-player situation where the equal split is focal in multi-player situations the norms of fairness may be altered depending on the relative position in the group. This position of a player depends on the set of reference players and, hence, whose payoff is perceived as important for the evaluation of one's position. Also, the willingness to punish proposer's behavior perceived as unfair may be altered if (other) reference players are positively or negatively affected by a punishment move.

In this paper we present data from a strategy method<sup>2</sup> experiment on a three-person ultimatum game with one proposer and two responders. The proposer makes a three-way proposal how to allocate a given pie between himself and two responders. Each responder can either reject or accept the proposal. We conduct three treatments with varying consequences of responder's rejection for the *other* responder's payoff. For

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<sup>1</sup>We discuss the few exceptions shortly below.

<sup>2</sup>The so-called strategy method was introduced by Selten, 1967. In our experiment this method has the advantage of providing more information about responder behavior, particularly of offers rarely observed in behavioral experiments. A disadvantage of this method is that participants make their decisions in a 'cold' state as opposed to a 'hot' situation where they face an actual offer by a proposer. In ultimatum games this may lead to an underestimation of rejection rates. Since we are more interested in the qualitative than quantitative pattern of responses and in the comparison across treatments where the position vis-à-vis the proposer stays constant this concern is not important in our experiment.

the proposer the material consequences of a rejection by any responder do not change across treatments. (The details of our experimental design are described in Section 3, below.)

To the best of our knowledge, our experiment delivers for the first time players' complete strategies in three-person ultimatum games. Among other things, this allows us to categorize them in a consistent way with respect to different kinds of dispositions towards others. In addition, we investigate if and how these strategies change across treatments where rejection of an offer affects the other responder's payoff but does neither alter the responder's ability of punishing the proposer nor the material costs of punishment. Therefore, any adjustment of responder's strategy across the three treatments will reflect the relevance of the other responder's payoff. When analyzing the basic treatment, we also comment on the predictive performance of recently developed models based on (outcome oriented) social preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002).<sup>3</sup>

### Related studies

Only few experimental studies exist that extend the ultimatum game to more than two players. In these studies, mostly a third inactive player is added as a 'dummy' with an empty strategy space (Güth and van Damme, 1998, Kagel and Wolfe, 2001, Bereby-Meyer and Niederle, 2001). The first study investigates the role of information about payoff consequences on proposer and responder behavior. In the latter studies the dummy-player's material payoff is varied in order to investigate the role of distributional consequences of rejections. A behavioral regularity observed in these experiments is that the payoff consequences for the dummy-player are largely ignored by the active players. In particular, the payoff received by the inactive player seems to be of no or only very minor relevance for the active responder's choice. This third-party neglect is also observed in a three-person coalition formation ultimatum game experiment with two (potentially) active responders by Okada and Riedl, 2002.<sup>4</sup>

Knez and Camerer, 1995, collect responders' strategies in a game where proposers simultaneously make proposals in two ultimatum games with asymmetric outside options. Each responder is either not informed or informed about the proposal in the parallel ultimatum game. In the latter case, one responder can condition her acceptance thresholds on the offer made to the other responder. About half of the responders vary their minimal acceptable amount with the offer made to the other responder, indicating some kind of between-responder payoff comparison.

In the study presented in this paper we also find that in our three-person ultimatum game about half of all responders submit strategies consistent with payoff comparison not only with the proposer, but also with the other responder. Importantly, however, the concern for the other responder's payoff is not uni-directional. Some of the responders exhibit altruistic behavior towards the other responder in the sense that they accept relatively low offers to themselves as long as the other responder receives a relatively large share of the pie. Similarly, some responders reject offers that give too

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<sup>3</sup>For experiments designed to test these theories see e.g. Kagel and Wolfe, 2001, Bereby-Meyer and Niederle, 2001, Deck, 2001, and Engelmann and Strobel, 2002.

<sup>4</sup>Two other ultimatum game experiments involving three players in a two-stage design were conducted by Güth et al., 1996 and Güth and Huck, 1997.

little to the other responder. Others, on the contrary, submit strategies consistent with spite against the other responder by rejecting offers that give too much to the other responder. The other half of responders in our experiment submit strategies exhibiting acceptance thresholds, independent of the offer to the other responder. These thresholds vary largely across responders indicating pronounced heterogeneity about what is perceived as an acceptable offer. Interestingly, only a surprisingly small minority of responders submit strategies that refer to the equal split of the pie as the only acceptable proposal.

Furthermore, we observe that the rejection rates decrease across experimental treatments when a rejection makes the other responder considerably better off. Hence, the choice to reciprocate negatively towards the proposer by rejection is less likely when it worsens the responder's relative standing vis-à-vis the other responder in case of such a rejection.

The remainder of the paper is organized as follows. In Section 2 we describe the three-person ultimatum game with the three different payoff treatments, define some plausible strategy-types of responders, and formulate behavioral hypotheses for the basic treatment. In Section 3 we describe the experimental design and in Section 4 our results are presented. Section 5 summarizes and concludes.

## 2 The game and behavioral hypotheses

The implemented game is a three-person (simultaneous move) ultimatum game with one proposer and two responders. The proposer proposes a split of a fixed amount of money between himself and the two responders. Both responders simultaneously decide whether to accept or reject the proposal. If both responders accept all players' earnings are according to the proposal. If at least one responder rejects the proposer earns zero. The earnings of the responders in case of any rejection depend on the treatment. We implemented three different treatments.

- Treatment *T1*: Upon rejection of at least one responder all players earn zero.
- Treatment *T2*: Upon rejection of at least one responder, the proposer earns zero. A rejecting responder earns zero, while a non-rejecting responder earns according to the proposal.
- Treatment *T3*: Upon rejection of at least one responder, the proposer earns zero. The amount proposed to a rejecting responder is earned by the other responder. Hence, in case only one responder rejects, the non-rejecting responder earns the amount proposed to her *plus* the amount proposed to the other (rejecting) responder. If both responders reject each earns the amount offered to the other responder.

In all three treatments, both responders have a unilateral power to punish the proposer by rejection. The pecuniary cost of such punishment is the same in all treatments. The three treatments differ only in the monetary consequence of rejection for the other responder. The other responder is either negatively affected by a rejection (treatment *T1*), or unaffected (treatment *T2*), or positively affected (treatment *T3*).

In the experiment, the proposer makes a proposal  $X = (X_P, X_i, X_j)$  such that  $X_P + X_i + X_j = K$ , with pie size  $K = 3000$  points.  $X_P, X_i, X_j$  are the points offered to the proposer, responder  $i$ , and responder  $j$ , respectively. For convenience, we represent the strategy of a proposer in terms of shares of the pie:  $x_k := \frac{X_k}{K}$  for  $k \in \{P, i, j\}$  and  $x_P + x_i + x_j = 1$ . Table 1 shows the material shares for responder  $i$  (the row player) for the simultaneous move decision of the two responders, for all three treatments, given a proposal  $x = (x_P, x_i, x_j)$ .

Table 1 – Material payoff shares of responder  $i$  (row player)

	T1		T2		T3	
	Accept	Reject	Accept	Reject	Accept	Reject
Accept	$x_i$	0	$x_i$	$x_i$	$x_i$	$x_i + x_j$
Reject	0	0	0	0	0	$x_j$

## 2.1 Responder behavior

In this section, we analyze the behavior of responders under various behavioral assumptions. For treatment  $T1$ , we derive behavioral predictions for responders that are independent of subjects' beliefs about the behavior of the other players. Thereafter, we present a comparative hypothesis about responder's behavior *across* the three treatments when distributional motivations (with respect to both the proposer and the other responder) matter.

Let us first introduce some plausible types of responder strategies derived from possible motivations in treatment  $T1$ . For the definition of these strategy types we fix the material payoff offered to the responder. The strategy types differ with respect to the responder's reaction to the distribution of the remainder of the pie between the proposer and the *other* responder. In the following we present an informal description of the various strategy types. Figure 1 offers a graphical representation of these types and a formal definition can be found in the footnote below.<sup>5</sup>

If the responder's decision to accept a proposal in treatment  $T1$  depends only on the own offer (i.e. is independent of the distribution of the remaining pie between the

<sup>5</sup>Denote the probability with which responder  $i$  accepts proposal  $x$  by  $q_i(x)$ . Then, responder  $i$  follows:

*A(a)*-type strategy if  $\forall x, x_i \geq a \Rightarrow q_i(x) = 1, x_i < a \Rightarrow q_i(x) = 0$ .

*RA*-type strategy if (i)  $\exists x, x'$  such that  $x'_i = x_i, x'_j < x_j, q_i(x) = 1, q_i(x') = 0$ ; and (ii)  $\forall x, x'$  such that  $x'_i \geq x_i, x'_j \geq x_j, q_i(x) = 1 \Rightarrow q_i(x') = 1$ .

*RS*-type strategy if (i)  $\exists x, x'$  such that  $x'_i = x_i, x'_j > x_j, q_i(x) = 1, q_i(x') = 0$ ; and (ii)  $\forall x, x'$  such that  $x'_i \geq x_i, x'_j \leq x_j, q_i(x) = 1 \Rightarrow q_i(x') = 1$ .

*W*-type strategy if  $\exists \hat{x}_j$  such that  $\forall x, x_j < \hat{x}_j$ , responder  $i$  follows the *RA*-type strategy, and  $\forall x, x_j > \hat{x}_j$  responder  $i$  follows the *RS*-type strategy.

*V*-type strategy if  $\exists \hat{x}_j$  such that  $\forall x, x_j < \hat{x}_j$ , responder  $i$  follows the *RS*-type strategy, and  $\forall x, x_j > \hat{x}_j$  responder  $i$  follows the *RA*-type strategy.

*F(E)*-type *fair strategy* if  $\forall x \in O(E), q_i(x) = 1, \forall x \notin O(E), q_i(x) = 0$ , where  $O(E)$  is a neighborhood of the equal split  $x = (\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$  with radius  $E$ .

proposer and the other responder), then we say that the responder submits an *aspiration level*  $A(a)$ -type strategy with an *aspiration level* (or threshold)  $a$ . Two important strategies of this type are  $A(+)$ , the strategy of a money-maximizing responder who accepts any strictly positive offer, and  $A(0)$ , the strategy according to which all proposals are accepted, including proposals giving nothing to the responder.

If the responder reacts to the distribution of the remainder of the pie by accepting only proposals that offer a sufficiently high payoff to the other responder (or, equivalently, sufficiently low payoff to the proposer), we say that the responder submits an *RA*-type strategy with *altruism towards the other responder*.

If the responder reacts to the distribution of the remainder of the pie by accepting only proposals that offer a not too high payoff to the other responder (or, equivalently, sufficiently high payoff to the proposer), we say that the responder submits an *RS*-type strategy with *spite towards the other responder*.

Two more complicated strategies denoted by  $V$  and  $W$  according to their graphical representation are combinations of the *RA*- and *RS*-types. A responder using strategy type  $W$  switches from altruism towards the other responder to spite towards the other responder when the offer to the other responder exceeds a particular level. A responder submitting a  $V$ -type strategy switches from spite towards the other responder to altruism towards the other responder in such a case.

Finally, a responder accepting only proposals treating all three players approximately equally is said to submit a ‘fair’ *F*-type strategy.

All these strategy types are represented graphically in Figure 1. In the figure, the strategy types of responder  $i$  are presented in the space of the shares to responder  $i$  and responder  $j$ ,  $x_i$  and  $x_j$ , respectively. The shares are increasing in the direction of the arrows. (This representation corresponds to the ‘Decision Sheet’ used in the experiment; see Section 3.) The grey areas depict the proposals that are rejected by responder  $i$  using a strategy of the respective type.

In the derivation of behavioral hypotheses we assume that responder  $i$  expects that responder  $j$  will accept a proposal  $x$  with some subjective probability  $p_i(x) \in ]0, 1[$ . It is quite natural to assume that a participant in an experiment cannot be sure about the motivation and behavior of the other participants. The subjective acceptance probability lying strictly between 0 and 1 captures this uncertainty. Additionally, we make a monotonicity assumption: keeping other things equal, more money is preferred to less money. These two assumptions lead to a first simple hypothesis concerning a responder’s strategy in  $T1$ .

**Monotonicity in own material payoff in  $T1$ .** For each fixed amount  $x_j$  offered to responder  $j$ , responder  $i$  submits in  $T1$  a strategy that is monotonous in the amount  $x_i$  offered to her.

(For a formal proof of this and all other hypotheses we refer the reader to Appendix A.) As can easily be seen from Figure 1, all introduced strategy types, except the *F*-type, satisfy this criterion. (Obviously, the *F*-type violates the assumption of monotonicity in own material payoff.) As a benchmark we also present the behavioral prediction for a responder who is a purely selfish money-maximizer.

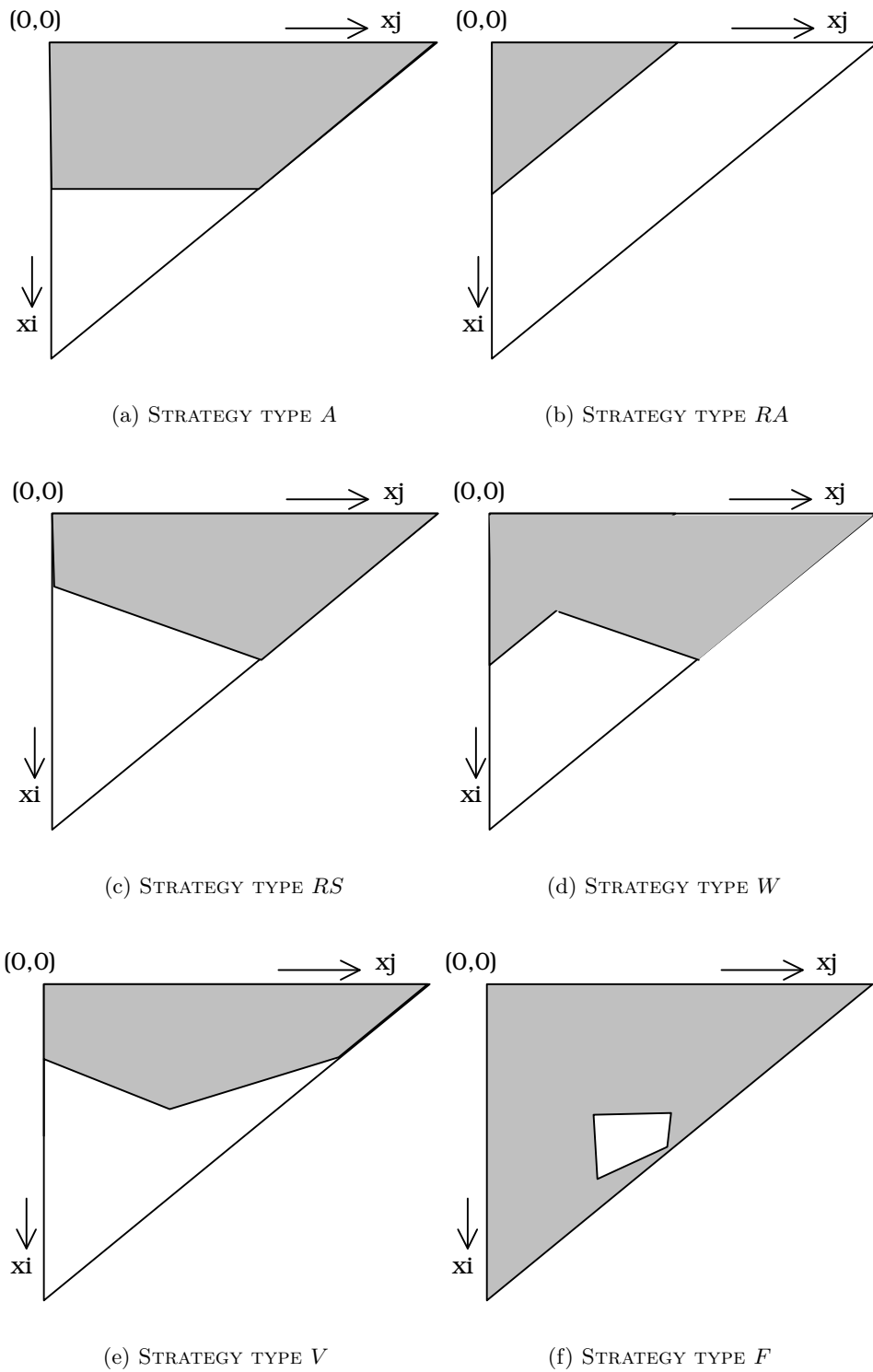


FIGURE 1 – STRATEGY TYPES IN THE THREE-PERSON ULTIMATUM GAME



**Money maximization.** If responder  $i$  is purely motivated by the own material payoff, then  $i$  chooses strategy  $A(+)$  in all three treatments. That is, in each treatment responder  $i$  accepts any proposal  $x$  with  $x_i > 0$ .

In the following we address predictions of behavioral theories in treatment  $T1$  allowing for responder  $i$ 's utility, denoted by  $u_i$ , to depend not only on the own material payoff, denoted by  $\pi_i$ , but also on the payoffs received by the other responder,  $\pi_j$ , and by the proposer,  $\pi_P$ . We write  $u_i = v_i(\pi_i, \pi_j, \pi_P)$  when we want to stress that  $u_i$  is some function of the material payoffs  $\pi_i, \pi_j, \pi_P$  received by all three players. Table 2 presents a general motivation matrix for the row player, responder  $i$ , in treatment  $T1$ , given a proposal  $x = (x_i, x_j, x_P)$ . Basic player-role oriented attitudes as spite (the utility of a responder decreases in the payoff of the reference player) and altruism (the utility of a responder increases in the payoff of the reference player) take into account the payoff received by a reference player. Distributional models account more generally for the comparison of player's payoff to the payoffs of others. For example, in the context of our game Bolton and Ockenfels, 2000 assume  $u_i = v_i(\pi_i, \pi_i/(\pi_i + \pi_j + \pi_P))$ , Fehr and Schmidt, 1999 assume  $u_i = v_i(\pi_i, \pi_i - \pi_j, \pi_i - \pi_P)$ , and Charness and Rabin, 2002 (in the distributional form of their model) assume  $u_i = v_i(\pi_i, \min(\pi_i, \pi_j, \pi_P), \pi_i + \pi_j + \pi_P)$ .<sup>6</sup>

Table 2 – General motivation matrix of responder  $i$  (row player) in  $T1$

	Accept	Reject
Accept	$v_i(x_i, x_j, 1 - x_i - x_j)$	$v_i(0, 0, 0)$
Reject	$v_i(0, 0, 0)$	$v_i(0, 0, 0)$

We now state how different possible motivations of a responder  $i$  in treatment  $T1$  shape the used strategy. Our focus is on qualitative predictions, without resorting to quantifying the parameters of the alternative motivation models. The following predictions hold for all proposals  $x$  satisfying  $x_P \geq x_i, x_j$  and  $x_i \leq 1000$ .

**Distributional effects in  $T1$ .** Keeping fixed the amount  $x_i$  offered to responder  $i$ ,  $i$ 's sensitivity concerning the distribution of payoffs between the other responder and the proposer depends on different aspects of  $i$ 's motivation function.

Responder  $i$  submits

- (i)  $A(0)$ -type strategy if only efficiency maximization enters  $i$ 's motivation function in addition to own payoff maximization;
- (ii)  $A(a)$ -type strategy if  $i$ 's motivation function has an aspiration level, or if it satisfies the assumptions of the model by Bolton and Ockenfels;
- (iii)  $RA$ -type strategy if spite of responder  $i$  against the proposer is stronger than spite against the other responder  $j$ , and simultaneously the inequality aversion in the sense of Fehr and Schmidt is not too strong;

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<sup>6</sup>In a pure pie splitting game as in treatment  $T1$ , the issue of efficiency maximization does not affect responder's behavior. The pie size is fixed and any efficiency related effect in itself only strengthens the monetary payoff maximization motivation of a responder. This means that the predictions of the basic model of Charness and Rabin, 2002 coincide with those of pure selfish money maximization. We will therefore not refer to that model in the remainder of this analysis.

- (iv) *RS*-type strategy if responder  $i$ 's spite against the other responder  $j$  is stronger than spite against the proposer, and/or if responder  $i$  is motivated by self-centered inequality aversion in the sense of Fehr and Schmidt.

Additionally, it is worth mentioning that the inequality aversion effects (for proposals with  $x_i < x_P$  and  $x_j < x_P$ ) are asymmetric in the following way. For any such proposal with  $x_i < x_j$  no inequality aversion effects concerning the payoff distribution between  $x_j$  and  $x_P$  are present. Therefore, the  $A(a)$  strategy type is predicted in that case. For any such proposal with  $x_i > x_j$  a trade-off between advantageous and disadvantageous inequality aversion takes place. If the latter is assumed to be stronger than the former an  $RA$  strategy type is predicted. Hence, the inequality aversion model of Fehr and Schmidt implies in treatment  $T1$  different modes of behavior for proposals with  $x_i < x_j$  and for proposals with  $x_i > x_j$ .<sup>7</sup>

The behavioral hypotheses derived above are based on motivations in treatment  $T1$  and relate them to strategy-types for this treatment. We will now compare behavior of the responders across the three treatments. This comparison will be based on the fact that the only motivational aspect that varies across the treatments is the payoff consequence of rejecting an offer for the other responder. Hence, responders whose relevant reference player is not only the proposer but also the other responder are bound to change their behavior across the three treatments. Another way of looking at the different treatments is that they vary the non-pecuniary cost of punishing the proposer. When moving from  $T1$  to  $T3$  the punishing responder incurs higher costs in terms of more inequality with respect to the other responder.

**Treatment effect.** Only responders motivated by payoff comparisons with the other responder submit different strategies across the three treatments.<sup>8</sup>

Finally, we present one more specific possible treatment effect that can be derived without resorting to particular parameter values of the underlying motivational model.

**Aspiration level hypothesis.** A responder  $i$  motivated by the material payoff with some fixed aspiration level will submit the same strategy type  $A(a)$  in  $T1$  and  $T2$  and a strategy type  $RS$  in  $T3$ .

## 2.2 Proposer behavior

In all three treatments of the three-person ultimatum game presented in this paper both responders can unilaterally punish the proposer by rejecting a proposal. In analogy with the two-person ultimatum game, the proposer's expectation that too low offers will be

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<sup>7</sup>In Riedl and Vyrastekova, 2002 we present more detailed predictions concerning optimal strategies using the model by Fehr and Schmidt.

<sup>8</sup>We have to note here that besides the directly outcome oriented motivational aspects, also the beliefs of the deciding responder might change across the three treatments. However, this again takes place only if the deciding responder takes the distributional consequences for the other responder in some way into account. For example, if the responder believes that the other responder is affected by distributional concerns or some of his or her higher order beliefs involve such distributional motivations. Without taking the distributional motivations for the other responder into account somehow, the same behavior is predicted across all three treatments. In this sense, the statement about the treatment effect extends to the players' beliefs about other responders' sensitivity to responder-responder comparisons.

rejected may make him reluctant to offer only small amounts to any of the responder. We expect therefore that the proposers, in anticipation of some form of distributional concerns by the responders, will give up non-negligible amounts in all three treatments  $T1$ ,  $T2$  and  $T3$ .

### 3 Experimental design and procedures

We conducted two experimental sessions at the Institute for Advanced Studies in Vienna (henceforth, we refer to these sessions by  $S1$  and  $S2$ ). In each of the sessions, 34 undergraduate students of law, economics, and business administration participated.<sup>9</sup>

Since we are particularly interested in the behavior of responders we applied the strategy method introduced by Selten, 1967. This method allowed us to collect complete strategies of all three players in each of the three treatments of our three-person ultimatum game. In particular, it gives us the possibility to collect a sufficient number of observations concerning acceptance and rejection behavior for proposals rarely made in behavioral ultimatum game experiments.

After arriving in the reception room the participants were randomly assigned (by drawing a card) one of the three letters A, B and C. One participant drew a card “observer”. During an experimental session material was carried from one room to another and it was the publicly announced role of the observer to monitor the experimenters. With this procedure we minimized subjects’ doubts that the decision sheets could be manipulated.

Then the participants were randomly and anonymously matched in such a way that one individual with letter A, one individual with letter B and one individual with letter C formed a group. The letter A participants were assigned the role of the proposer. The letter B and C participants were in the role of the two responders. During the whole experimental session neither the roles nor the group composition changed. The proposers were seated in a different room than the responders. Furthermore, the room for the responders was separated by a shield into two parts, such that the groups B and C could not see each other. Any kind of communication was prohibited.

An experimental session consisted of three ‘rounds’. In each round, each participant had to submit a strategy for the game played in that round. The proposers had to choose a proposal from a menu of feasible proposals, and the responders indicated on a decision sheet (see Figure 2) all proposals they wanted to accept. All feasible proposals were stated in points. In each round the total number of points to be allocated was 3000. In money terms this was worth approximately USD 20.– (100 points equaled ATS 10.–  $\approx$  67 US cents). Since the responder’s decision sheet involves a relatively large number of decision nodes we were very careful in explaining the consequences of the decisions. In each round, all subjects had to go through a quiz checking for proper understanding of the instructions and the consequences of choices. Additionally, we asked the participants to take their time when indicating their choices on the decision sheet.<sup>10</sup>

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<sup>9</sup>All subjects participated previously in an unrelated bargaining experiment; the subjects of  $S1$  had experienced a three-person coalition decision ultimatum game, and the subjects of  $S2$  were experienced in computerized unstructured bargaining.

<sup>10</sup>There was a minor change in the decision sheets between sessions  $S1$  and  $S2$ . The smallest unit

		Offer to person C														
		0	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400
Offer to me	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200
	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300	300
	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600	600
	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700	700
	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800	800
	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900	900
	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100	1100
	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200	1200
	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300	1300
	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400	1400

Please, circle in the grey field all offers you accept.

Please notice that all offers that you will NOT CIRCLE are taken as REJECTED!

FIGURE 2 – DECISION SHEET OF A RESPONDER

Participants were informed that they will play three rounds but will learn the results (i.e. decisions of other players and earnings) only after the end of the whole experiment. In round 1, subjects received and read the instructions for the treatment  $T1$ . As mentioned above they also had to answer questions to demonstrate their understanding of the instructions. The round was not started before all participants had answered the questions correctly. Thereafter, each subject had to indicate his or her strategy. The proposers by circling one of the feasible proposals and the responders by circling all proposals they want to accept. Then the decisions sheets were collected and the next round was announced. Rounds 2 and 3 were organized in exactly the same way. In round 2 subjects received the instructions for  $T2$  and in round 3 they received the instructions for  $T3$ .<sup>11</sup> After the third round an experimenter - monitored by the observer - evaluated the results of the game in each round for every player. Subjects were then individually and anonymously paid out.

In addition to the money earned in two randomly selected rounds each participant also received ATS 70, – as show-up fee. The average earning inclusive the show-up fee was ATS 220, –  $\approx$  USD 15, –. Each session lasted approximately 90 minutes.

Note that the participants did not receive any information about the decisions of the other players between rounds. In this way we approximated a true one-shot situation for each treatment as closely as possible. The subjects were also told that this experiment is the last one they will participate in. In this way we avoided possible super-game considerations across experiments.

of divisibility was 50 points in S1 and 100 points in S2. The change was made to simplify the task of filling the tables for the responders inexperienced in three-person ultimatum games.

<sup>11</sup>The complete set of instructions used in the experiment can be found in Appendix B.

## 4 Experimental results

We shall first shortly report on the proposals made in the three treatments and then switch to the more interesting and richer observations concerning the strategies of responders. In the following we shall make use of the pooled data set from both sessions S1 and S2.<sup>12</sup>

### 4.1 Proposer behavior

Table 3 depicts all proposals made in sessions S1 and S2, together with the averages and standard deviations for each treatment. For convenience they are sorted in descending order with respect to demands in treatment  $T1$ . On average, proposers keep the same share of the pie (43 percent; approximately 1300 out of 3000 points) in all three treatments. Most often proposers keep exactly 1000 points, i.e. one third of the pie. The number of equal distributions decreases slightly over treatments (11 in  $T1$ , 8 in  $T2$ , 7 in  $T3$ ). However, according to the Page test for ordered alternatives there is no difference in proposals between treatments ( $z = 0.754$ ,  $N = 22$ ).<sup>13</sup> Furthermore, nearly all proposals (91 percent; 60 out of 66) treat responders symmetrically. 4 out of the 6 asymmetric proposals occur in treatment  $T3$ , with a maximal difference of 400 points between the responders. This leads us to the following observation.

#### **Observation 1.** PROPOSER BEHAVIOR

*On average, proposers give up a considerable portion (57 percent) of the pie in all treatments. In general, they treat the responders symmetrically. The modal offer is the equal split of the pie among all three players. There is no significant difference across treatments.*

The observation of equal splits and symmetric treatment of responders is in line with findings in other three-person ultimatum game experiments where both responders have equal veto power (see Okada and Riedl, 2002). Moreover, the modal egalitarian proposal is the money maximizing proposal. To verify this, we used the empirical acceptance frequency of any feasible proposal to calculate the proposer's expected payoff.

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<sup>12</sup>One might argue that this is not without problems because the two sessions slightly differ in two respects. Firstly, the subjects in S1 had some experience in a three-person ultimatum game whereas those in S2 did not. Secondly, the responders' decision sheet was 'coarser' in S2 than in S1 (In S1 the feasible proposals increased in steps of 50 whereas in S2 they increased in steps of 100 points.). We therefore investigated for both, proposers and responders, whether there are any differences between sessions. For proposers the Kolmogorov-Smirnov test does not reject the null hypothesis of identical proposals in both sessions for all three treatments. (The two-sided  $p$ -values are never smaller than 0.8.) For responders we created an 'individual aggregate' acceptance rate by calculating for each responder the percentage of accepted proposals out of all feasible proposals. The Wilcoxon-Mann-Whitney-U test does not reject the hypothesis that these acceptance rates are the same in both sessions for each treatment (two-sided  $p$ -values are always larger than 0.3). We also ran additional tests for the 'semi-aggregated' acceptance rate at a given material payoff. That is, for each feasible share offered to the responder in question we calculated the acceptance rate across the shares to the other responder. In only three cases (at 800 points in  $T1$  and  $T3$  and 900 points in  $T2$  and  $T3$ ) we can reject the hypothesis of no difference between the two sessions. In our view this is rather weak evidence for a session effect and we therefore decided to use the pooled data in the empirical analysis. All empirical results we present also hold when looking at the two sessions separately.

<sup>13</sup>As the number of observations is large enough, we use the large-sample approximation of test statistics, see Siegel and Castellan Jr., 1988, p.185.

Table 3 – Proposers’ decisions

Proposer	Treatment $T1$			Treatment $T2$			Treatment $T3$		
	$x_p$	$x_i$	$x_j$	$x_p$	$x_i$	$x_j$	$x_p$	$x_i$	$x_j$
S1_P3	3000	0	0	1400	800	800	1400	800	800
S1_P5	3000	0	0	3000	0	0	3000	0	0
S1_P9	1600	700	700	2000	500	500	1800	400	800
S2_P11	1500	800	700	1700	600	700	1800	600	600
S1_P8	1500	750	750	1700	650	650	1500	850	650
S1_P2	1200	900	900	1200	900	900	1200	900	900
S1_P6	1200	900	900	1200	900	900	1000	1050	950
S2_P5	1200	900	900	1200	900	900	1200	900	900
S2_P6	1200	900	900	1000	1000	1000	1000	1000	1000
S2_P10	1200	900	900	1200	900	900	1200	900	900
S1_P11	1100	950	950	1200	900	900	900	1050	1050
S1_P1	1000	1000	1000	1000	1000	1000	1000	1000	1000
S1_P4	1000	1000	1000	1200	900	900	1100	950	950
S1_P7	1000	1000	1000	1000	1000	1000	1000	1000	1000
S1_P10	1000	1000	1000	1000	1000	1000	1000	1000	1000
S2_P1	1000	1000	1000	1000	1000	1000	1200	900	900
S2_P2	1000	1000	1000	1200	900	900	1100	1000	900
S2_P3	1000	1000	1000	1000	1000	1000	1000	1000	1000
S2_P4	1000	1000	1000	1000	1000	1000	1000	1000	1000
S2_P7	1000	1000	1000	1400	800	800	1600	700	700
S2_P8	1000	1000	1000	1000	1000	1000	1000	1000	1000
S2_P9	1000	1000	1000	1200	900	900	1400	800	800
Mean	1305	850	846	1309	843	848	1291	855	855
St.dev.	579	289	290	464	234	230	465	248	227

Note:  $Sx_Py$  stands for Proposer  $y$  in Session  $x$ .

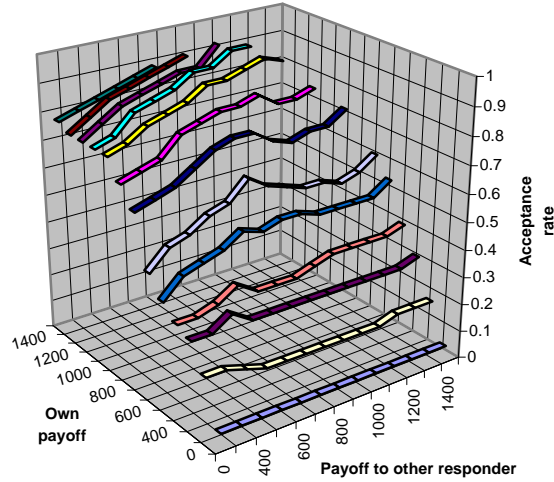
It turns out that the equal split indeed maximizes the proposers expected earnings in each treatment.

## 4.2 Responder behavior

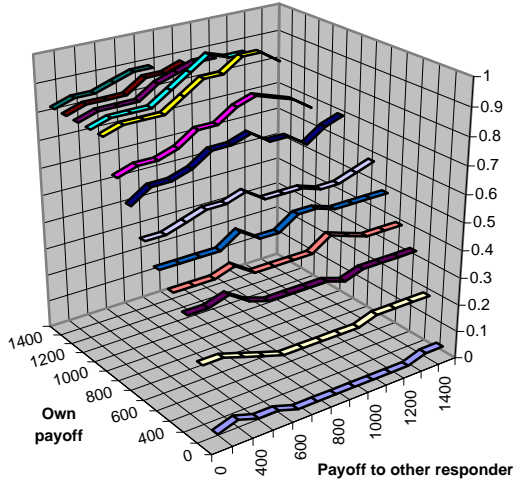
We first describe responder behavior in and across the three treatments. Thereafter, we shall have a closer look at treatment  $T1$  and relate the observed strategy types to the underlying motivations.

Figures 3(a)-(c) depict the average acceptance rates in treatments  $T1$  to  $T3$ , respectively. They nicely show that - for any given payoff to the other responder - acceptance rates are increasing with the own payoff, in all three treatments. This behavioral pattern is consistent with the findings in standard two-person ultimatum game experiments where the acceptance rate is also increasing with the offer. However, our three-person set-up offers more information. Holding constant the own payoff the acceptance rate exhibit some kind of inverse V-shape supplemented with an increase in acceptances at high payoffs for the other responder. Furthermore, the acceptance rates have a peak at equal allocations for both responders. This pattern is most strongly pronounced in treatment  $T1$  but to a lesser extent also present in the other two treatments. Hence, on average responders seem to prefer offers treating the responders symmetrically.

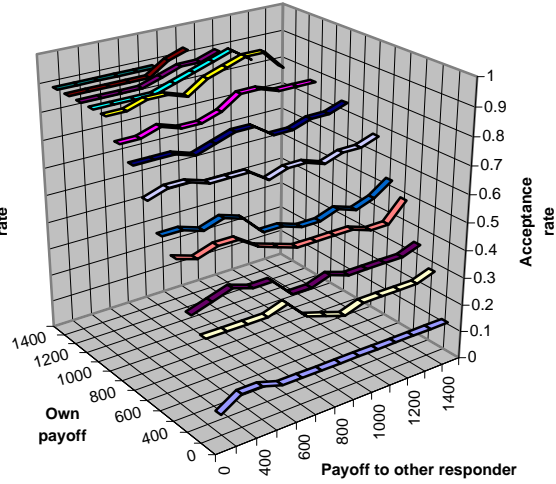
Besides these patterns common in all treatments the figures also indicate some differences in responder behavior across treatments. In particular, acceptance rates in  $T3$  seem to be somewhat higher than in the other two treatments. To test the



(a) TREATMENT  $T1$



(b) TREATMENT  $T2$



(c) TREATMENT  $T3$

FIGURE 3. AVERAGE ACCEPTANCE RATES

conjecture of different acceptance behavior in the three treatments we calculated for each responder the ‘individual aggregate’ acceptance rate. This rate is defined as the number of accepted proposals divided by the number of feasible proposals. Table 4 depicts these acceptance rates (in descending order for  $T1$ ) for all 44 responders in each treatment.

On average, the individual acceptance rates increase from 55 percent in  $T1$  and  $T2$  to 63 percent in  $T3$ . In our view a non-negligible change in behavior. The Page test for ordered alternatives rejects the null hypothesis of equal acceptance rates in the three treatments in favor of the alternative hypothesis for increasing acceptance rates across the treatments ( $L = 493$ ,  $z = -3.73$ ,  $p < 0.001$ , one-side). A pairwise comparison of acceptance rates with the help of the Wilcoxon sign test reveals a statistically significantly higher acceptance rate in  $T3$  than in  $T2$  ( $p = 0.03$ , one-sided).

Table 4 – Responders’ acceptance rates (in percent)

Responder	Treatment $T1$	Treatment $T2$	Treatment $T3$
S2_R4	100	100	100
S2_R13	100	93	100
S1_R14	91	82	100
S1_R18	91	91	99
S2_R8	91	91	92
S2_R15	91	91	91
S2_R16	91	91	91
S1_R9	82	91	72
S1_R15	82	82	91
S2_R3	82	82	82
S2_R18	82	82	84
S1_R22	80	81	80
S2_R17	77	72	72
S1_R13	72	82	82
S1_R5	67	62	71
S1_R1	65	52	32
S1_R17	63	63	55
S1_R20	59	59	70
S1_R11	58	57	75
S2_R7	56	28	100
S2_R20	53	63	59
S1_R3	52	59	72
S1_R12	52	91	54
S1_R4	50	60	44
S1_R16	45	45	53
S1_R19	45	36	36
S1_R21	45	82	99
S2_R10	45	28	63
S2_R12	45	45	45
S2_R9	43	43	43
S1_R2	41	59	72
S2_R6	40	14	37
S1_R7	38	38	91
S1_R8	36	54	45
S2_R22	36	45	32
S2_R21	35	28	28
S2_R1	28	30	38
S2_R11	28	28	28
S1_R10	26	11	7
S2_R14	13	17	14
S2_R5	11	43	52
S2_R19	7	15	15
S2_R2	6	9	9
S1_R6	4	9	56
Average	55	55	63

Note:  $Sx_Ry$  stands for Responder  $y$  in Session  $x$ .

Between  $T1$  and  $T2$  no significant difference can be detected ( $p = 0.16$ , one-sided). We summarize these findings in the following observation.

**Observation 2.** ACCEPTANCE RATES

*There is no difference in individual aggregate acceptance rates between treatments  $T1$  and  $T2$ . However, a proposal is statistically significantly more likely accepted in treatment  $T3$  than in treatments  $T1$  and  $T2$ .*



Though reasonable, the individual aggregate acceptance rate is a relatively rough measure of individual acceptance behavior. To obtain a deeper understanding of responder behavior and to relate it to the various behavioral hypotheses developed in Section 2 we investigate individual responder behavior more closely now.

The submitted strategies by the responders reflect quite some heterogeneity and, at the same time, exhibit lots of structure. This structure allows us to classify almost all strategies into one of the strategy types introduced in the previous section. Table 5 shows this classification by responder and treatment and Table 6 summarizes this information for each treatment. With the help of these tables we can state the following observation.

**Observation 3. HETEROGENEITY AND STRUCTURE**

*In each treatment, around one half of the responders (22 out of 44, 25 out of 44, and 23 out of 44 in T1, T2, and T3, respectively) use an A-type strategy with an effective aspiration level ranging from 0 to 1000 points. The remaining responders submit strategies that condition acceptance on the distribution of payoffs among the other two players. Among these responders, less than 10 percent use the egalitarian strategy type F.*

The observed heterogeneity among responders is perfectly in line with empirical evidence from other experiments. The most prominent examples in this respect are the different giving rates in dictator games and the differences in acceptance thresholds in two-person ultimatum games (see e.g. Güth and Huck, 1997). Besides the heterogeneity the observed structure in the submitted strategies is striking. Only four of the 132 submitted strategies do not fall into one of the intuitively plausible strategy types presented in Section 2.

From Table 5 and Table 6 we can also extract information in how far the effect of a rejection of one responder on the other responder influences responder behavior. It leads us to the following important observation about the strategies chosen by responders in the different treatments.

**Observation 4. TREATMENT EFFECT**

*More than half of the responders (27/44, 61 percent) are sensitive with respect to the treatments. They submit different strategies in the different treatments.*

This observation indicates that the behavior of more than half of the responders is influenced by the non-pecuniary cost of punishing the proposer, affecting their willingness to reject a proposal. In addition, there seem to be some interesting patterns along which responders change strategies across treatments. Firstly, the frequency of *RA*-type strategies decreases by more than 50 percent from *T1* to *T2* and *T3* while the use of *RS*-type and more complex *V*- and *W*-type strategies slightly increases from *T1* to *T2* and *T3*. This indicates that the change in the rejection consequences for the other responder shifts the behavior of some responders from altruism towards the other responder to more spite towards the other responder.<sup>14</sup> Secondly, from *T1* and *T2* to

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<sup>14</sup>Alternatively, one might explain the decrease in *RA*-type strategies with altruism towards the responder and some taste for revenge towards the proposer. In *T1* altruism towards the other responder implies that one rejects a bad offer not that easily when the other responder receives a relatively high offer, like under the *RA*-type strategy. In *T2*, however, a badly treated responder has not to be considerate of the other responder and can punish the proposer without affecting the other responder, implying an *A(a)*-type strategy instead of the *RA*-type. A similar reasoning can be applied for *T3*.

Table 5 – Submitted strategy types by responders

Responder	Treatment $T1$	Treatment $T2$	Treatment $T3$
S2_4	A(0)	A(0)	A(0)
S2_8	A(+)	A(+)	A(+)
S2_15	A(+)	A(+)	A(+)
S2_16	A(+)	A(+)	A(+)
S1_18	A(+)	A(+)	A(+)*
S2_13	A(+)*	A(+)	A(+)
S1_14	A(+)	A(400)	A(+)*
S1_9	A(400)	A(+)	A(500)
S2_18	A(400)	A(300)	W
S1_15	A(400)	A(400)	A(+)
S2_3	A(400)	A(400)	A(400)
S1_13	A(500)	A(400)	A(400)
S1_17	A(600)	A(600)	RS
S1_19	A(750)	A(850)	A(900)
S1_21	A(750)	A(400)	A(+)*
S1_16	A(800)	A(750)	A(700)
S2_10	A(800)	A(1000)	A(600)
S2_12	A(800)	A(800)	A(800)
S1_8	A(850)	A(700)	A(800)
S2_22	A(900)	A(800)	RA
S2_11	A(1000)	A(1000)	A(1000)
S2_1	A(1000)	RA	RS
S2_7	RA	A(100)	A(+)
S2_17	RA	A(500)	A(500)
S2_20	RA	A(600)	RS
S1_7	RA	RA	A(+)
S1_5	RA	RA	A(500)
S1_10	RA	RA	RA
S1_11	RA	RA	RA
S2_6	RA	RS	RA
S1_4	RA	RS	W
S1_1	RA	W	other
S1_12	RS	A(+)	A(700)
S1_22	RS	RS	RS
S2_9	RS	RS	RS
S2_21	RS	RS	RS
S1_3	RS	RS	V
S1_20	V	V	RS
S2_2	F	F	F
S2_14	F	F	F
S2_19	F	F	F
S1_6	F	F	W
S1_2	other	W	V
S2_5	other	other	RS

\* Accepts all offers except (3000,0,0).

$T3$  the use of  $A(+)$ -type strategies (i.e. accepting any offer that gives a strictly positive amount to the responder) slightly increases at the cost of  $A(a)$  strategy types.

Investigating the use of these threshold-type strategies ( $A(a)$  or  $A(+)$ ) more closely reveals that a relative majority of 41 percent (18 out of 44) of the responders use this strategy type in each treatment. Interestingly, the aspiration levels of these responders do not stay constant across treatments. Applying the Page test for ordered alternatives on this subset of subjects reveals statistically marginally significantly ( $N = 18$ ,  $L = 224.5$ ) *decreasing* aspiration levels across treatments. A pair-wise comparison with the

Table 6 – Summary of strategy types by treatment

Strategy type	Treatment T1	Treatment T2	Treatment T3
A(+)	7	8	11
A(a)	15	17	12
RA	10	5	4
RS	5	6	8
V	1	1	2
W	0	2	3
F	4	4	3
else	2	1	1

help of the Wilcoxon signed rank test reveals a marginally significantly decrease of the aspiration level from  $T2$  to  $T3$  ( $p = 0.056$ , one-sided). When comparing behavior in  $T1$  with behavior in  $T3$  this decrease is significant at the 5 percent level ( $p = 0.023$ ). Hence, the acceptance rates of responders using a simple aspiration level strategy in all treatments significantly increase from  $T1$  to  $T3$ .

**Observation 5.** ASPIRATION LEVEL STRATEGIES

*A relative majority of responders (41 percent) submit in each treatment an A-type strategy, i.e. A(a) or A(+). Additionally, on average, the aspiration levels decrease and consequently acceptance rates increase from T1 to T3.*

These treatment effects indicate that responders have concerns about relative standings with respect to the other responder. Another interesting question is to what extent the distributional concerns extend over individual group members and to what extent this concerns are targeted towards the group as a whole. To explore this question we take another close look at the submitted strategies in treatment  $T1$ .

**Observation 6.** DISTRIBUTIONAL CONCERNS IN  $T1$

*(i) 37 out of 44 responders (84 percent) submitted a strategy monotonous in own payoff. (ii) 7 out of 44 responders (16 percent) submitted the individually rational purely money maximizing strategy A(+), and 34 percent (15 out of 44) submitted an A(a) type strategy showing no sensitivity for the distribution of the rest of the pie, i.e. no spite or altruism attitudes.*

*(iii) Another 34 percent of responders (15/44) submitted strategies sensitive to the payoff distribution. 10 of them (23 percent) chose strategy type RA, and another 5 responders (11 percent) chose strategy type RS.<sup>15</sup>*

*(iv) Only a surprisingly small minority of 4 responders (less than 10 percent) showed a concern for equal treatment of all three players, by submitting an F-type strategy.*

It is striking that for responders who take the material payoff of others somehow into account the payoff comparison seems to be targeted towards the players' roles in the game (e.g. spite against the proposer or against the other responder) rather than towards the entire payoff distribution. This shows up in the fact that only a very small minority refer to the equal division among all players when choosing their strategy. It is also interesting that no individual responder resorts to the strategy of only accepting

<sup>15</sup>In the experimental study closest to ours Knez and Camerer, 1995 observe in another three-person game strategies that can be categorized in a similar way. In their study 19 out of 40 responders submit an A-type strategy, 13 an RS-type strategy and 8 an RA-type strategy.

offers where both responders earn the same material payoff, but that *on average* the acceptance rates are highest along this distribution line.

When applying the recently developed outcome based motivation theories to our simple three-person ultimatum game we have to state that none of them can capture the pronounced behavioral heterogeneity existing in our data. In this sense it seems that the correct question to ask is not *which* theory describes behavior best but *how* these theories can be combined and/or adjusted such that they can capture this heterogeneity.

## 5 Summary and conclusions

In this paper we investigate experimentally a three-person ultimatum game. In this game a proposer chooses a three-way proposal while two responders decide simultaneously and independently which proposals to accept or reject. Any responder can unilaterally reject a proposal, thereby reducing the proposer's material payoff to zero. Such a rejection is costly for the responder since she loses all the material payoff offered to her. As the treatment variable the consequence of a rejection for the *other* responder is varied. In treatment *T1* the rejecting responder reduces the material payoff of the other responder to zero as well. In treatment *T2* the rejection by one responder leaves the material payoff of the other responder unaffected. In treatment *T3* the rejection by a responder leaves the material payoff offered to the other responder unaffected and in addition the material payoff offered to the rejecting responder is transferred to the other responder.

We use the strategy method, which allows us to collect complete strategies of responders. That is, we collect information about the acceptance or rejection for each feasible three-way proposal potentially made by the proposer under varying payoff consequences for the responder. This provides us with the possibility to categorize the decisions of responders generating a set of intuitively plausible strategy types. These strategy types, in turn, deliver unique information about the distributional concerns of responders in the three-person ultimatum game. With the help of the different treatments we are able to elicit whether the material standing of a responder relative to the other responder matters.

An outstanding result is that we observe quite some heterogeneity in the behavior of responders, which at the same time also shows lots of structure. Only less than four percent do not fall into one of the six plausible strategy types. About half of the responders showed no concern for the distribution of the material payoffs relative to the other responder. They submitted a strategy with a fixed acceptance threshold (aspiration level) in all treatments. This aspiration level shows quite some variance across subjects and varies between 0 points (accept all feasible proposals) and one third of the pie. Only 14 percent of all responders submitted a strategy consistent with purely selfish money maximizing behavior, i.e. a strategy indicating that all proposals that give a strictly positive amount are accepted.

The other half of responders chose strategies that are sensitive to the absolute and relative standing with respect to the proposer *and* the other responder. Many of these strategies can be categorized either as exhibiting altruism towards the other responder or as exhibiting spite against the other responder. In the first case responders reject proposals that give the other responder too little, whereas in the second case they reject

proposals that give the other responder too much. Only a few strategies exhibit the egalitarian norm of accepting only offers in a close neighborhood of the equal split.

Across treatments we observe two interesting patterns. Firstly, the submitted strategies seem to become more spiteful when the payoff consequences of rejection change from influencing the other responder negatively (as in  $T1$ ) to influencing the other responder positively (as in  $T3$ ). Secondly, the individual aggregated acceptance rates significantly increase from  $T1$  and  $T2$  to  $T3$ , on average. That is, the number of accepted feasible proposals is significantly higher in the treatment where a rejection affects the other responder positively than in the treatments where the other responder is affected negatively or not affected at all. Both observations indicate that a considerable subset of responders is sensitive concerning their relative standing with respect to the other responder.

Though our experiment is not explicitly designed to test recently developed behavioral models of social preferences (Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002) we are able to formulate a fairly general hypothesis based on these models for the basic treatment  $T1$  of the three-person ultimatum game. Our finding is that none of the proposed models is able to organize the obtained data in a satisfying way. This not too strong performance of the mentioned behavioral models - in particular, when applied to three-person problems - is in line with findings of other studies designed to test (some of) these models (Kagel and Wolfe, 2001; Bereby-Meyer and Niederle, 2001; Deck, 2001; Engelmann and Strobel, 2002).<sup>16</sup> However, we do not conclude from this that these models - which can organize quite some regularities observed in other earlier experiments - have to be considered as useless. Rather, we are convinced that the above cited studies and our empirical results show that these models are not complete, yet. Based on the results obtained in our experiment it seems to be necessary to develop theoretical models that capture the heterogeneity of people, in particular, with respect to their reference group and player position in a better way than the existing models do.

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<sup>16</sup>Actually not all these studies test all three theoretical models in a satisfactory way and the performance of the different models differs in the different studies.

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## A Proofs

Hereafter we assume that responder's preferences are monotone in the own material payoff and that the subjective probability of a proposal to be accepted by the other responder is strictly larger than zero. We make assumptions concerning the properties of the motivation function corresponding to the assumption of inequality aversion as in the models of Fehr and Schmidt (FS), and Bolton and Ockenfels (BO). Additionally, we assume that the marginal utility of the proposer's payoff does not exceed the marginal utility of responder  $i$ 's material payoff, that is  $\left| \frac{\partial u_i(\cdot)}{\partial \pi_i} \right| \geq \left| \frac{\partial u_i(\cdot)}{\partial \pi_P} \right|$ .

We focus on the most interesting subset of proposals feasible in the experiment, satisfying  $x_i \leq x_P$ ,  $x_j \leq x_P$  and  $x_i \leq 1000$ .

We define a general motivation function  $u_i = u_i(\pi_i; \pi_j, \pi_P; d_{ij}, d_{iP}, \sigma_i)$  where  $\pi_i$ ,  $\pi_j$ , and  $\pi_P$  are the material payoffs received by responder  $i$ , responder  $j$  and the proposer, respectively.  $d_{ij} = \pi_i - \pi_j$ ,  $d_{iP} = \pi_i - \pi_P$  are the inequality terms, and  $\sigma_i = \frac{\pi_i}{\pi_i + \pi_j + \pi_P}$  is the share of the pie received by responder  $i$ .

### A.1 Proof (Monotonicity in own payoff in T1)

Responder  $i$  chooses 'accept' in game T1 if  $v_i(x_i; x_j, x_P) > v_i(0, 0, 0)$ . Here,  $v_i(0, 0, 0)$  is a constant referring to the situation where none of the players receives a positive share of the pie. We now evaluate the effect of increasing the offer to responder  $i$ , that is we evaluate  $\frac{\partial v_i(\cdot)}{\partial x_i}$ .

$$\frac{\partial v_i(\cdot)}{\partial x_i} = \frac{\partial u_i(\cdot)}{\partial \pi_i} \frac{\partial \pi_i}{\partial x_i} + \frac{\partial u_i(\cdot)}{\partial \pi_j} \frac{\partial \pi_j}{\partial x_i} + \frac{\partial u_i(\cdot)}{\partial \pi_P} \frac{\partial \pi_P}{\partial x_i} + \frac{\partial u_i(\cdot)}{\partial d_{ij}} \frac{\partial d_{ij}}{\partial x_i} + \frac{\partial u_i(\cdot)}{\partial d_{iP}} \frac{\partial d_{iP}}{\partial x_i} + \frac{\partial u_i(\cdot)}{\partial \sigma_i} \frac{\partial \sigma_i}{\partial x_i}.$$

Consider now that the payoff of responder  $j$  is fixed and that redistribution takes places only between responder  $i$  and the proposer, i.e.  $\frac{\partial \pi_j}{\partial x_i} = 0$ . (This corresponds to changes in acceptance along a vertical line in the table responders used in the experiment.) Given the strategy 'accept' is adopted by both responders  $i$  and  $j$ , the redistribution between responder  $i$  and the proposer translates into the payoffs as follows:

$\frac{\partial \pi_i}{\partial x_i} > 0$ ,  $\frac{\partial \pi_P}{\partial x_i} < 0$ ,  $\frac{\partial d_{ij}}{\partial x_i} < 0$  because  $x_i < x_P$ . Additionally,  $\frac{\partial d_{ij}}{\partial x_i} < 0$  if  $x_i < x_j$ ,  $\frac{\partial d_{ij}}{\partial x_i} > 0$  if  $x_i > x_j$ , and  $\frac{\partial \sigma_i}{\partial x_i} = 1$ . Hence, if both responders accept it is the case that:  $\frac{\partial v_i(\cdot)}{\partial x_i} \Big|_{x_j = \text{const.}} =$

$\frac{\partial u_i(\cdot)}{\partial \pi_i} - \frac{\partial u_i(\cdot)}{\partial \pi_P} + \frac{\partial u_i(\cdot)}{\partial \sigma_i} \pm \frac{\partial u_i(\cdot)}{\partial d_{ij}} - \frac{\partial u_i(\cdot)}{\partial d_{iP}} > 0$ . This inequality holds because: (i)  $\frac{\partial u_i(\cdot)}{\partial \pi_i} \geq 0$ , due to monotonicity in own payoff; (ii)  $\frac{\partial u_i(\cdot)}{\partial \sigma_i} > 0$  for  $\sigma_i \leq \frac{1}{3}$  under the assumptions of Bolton and Ockenfels model; (iii)  $\frac{\partial u_i(\cdot)}{\partial d_{ij}} < 0$ ,  $\frac{\partial u_i(\cdot)}{\partial d_{iP}} < 0$  and under the assumptions of FS that disadvantageous inequality aversion is stronger than the advantageous inequality aversion; (iv) and  $\frac{\partial u_i(\cdot)}{\partial \pi_i} - \frac{\partial u_i(\cdot)}{\partial \pi_P} \geq 0$  due to our additional assumption. Hence, we can conclude that if  $v_i(x_i, x_j, x_P) > v_i(0, 0, 0)$  for some  $(x_i, x_j, x_P)$ , then also for any  $x'$  such that  $x'_i > x_i$  and  $x'_j = x_j$ .  $\square$

### A.2 Proof (Distributional effects in T1)

Consider that the payoff of responder  $i$  is fixed and redistribution takes places only between responder  $j$  and the proposer, i.e.  $\frac{\partial \pi_i}{\partial x_j} = 0$ . (This corresponds to changes in acceptance along a horizontal line in the table responders used in the experiment.) Given the strategy 'accept' is adopted by both responders  $i$  and  $j$ , the redistribution between responder  $i$  and the proposer translates into the payoffs as follows:

$\frac{\partial \pi_i}{\partial x_j} > 0$ ,  $\frac{\partial \pi_P}{\partial x_j} < 0$ . Now,  $\frac{\partial d_{ij}}{\partial x_j} < 0$  and  $\frac{\partial d_{iP}}{\partial x_j} > 0$  if  $x_i < x_j$ ,  $\frac{\partial d_{ij}}{\partial x_j} > 0$  and  $\frac{\partial d_{iP}}{\partial x_j} < 0$  if  $x_i > x_j$ , and  $\frac{\partial \sigma_i}{\partial x_j} = 0$ . Hence, if both responders accept it is the case that:

$$\frac{\partial v_i(\cdot)}{\partial x_j} \Big|_{x_i = \text{const.}} = \frac{\partial u_i(\cdot)}{\partial \pi_j} - \frac{\partial u_i(\cdot)}{\partial \pi_P} + \frac{\partial u_i(\cdot)}{\partial d_{iP}} - \frac{\partial u_i(\cdot)}{\partial d_{ij}}.$$

First, consider the terms entering from the model of FS, i.e.  $\frac{\partial u_i(\cdot)}{\partial d_{iP}}$  and  $\frac{\partial u_i(\cdot)}{\partial d_{ij}}$ . All proposals in



the analyzed range satisfy either  $x_P > x_j > x_i$  or  $x_P > x_i > x_j$ . In the first case,  $\frac{\partial u_i}{\partial d_{iP}} = \frac{\partial u_i}{\partial d_{ij}}$  as players' roles do not affect the evaluation of inequality under the assumptions of FS. In the second case,  $\left| \frac{\partial u_i(\cdot)}{\partial d_{ij}} \right| < \left| \frac{\partial u_i(\cdot)}{\partial d_{iP}} \right|$  due to assumption made by FS that disadvantageous inequality is disliked more than advantageous inequality. Both types of inequality, however, decrease players' utility, i.e.  $\frac{\partial u_i(\cdot)}{\partial d_{ij}} < 0$  and  $\frac{\partial u_i(\cdot)}{\partial d_{iP}} < 0$ . It follows that  $\frac{\partial u_i(\cdot)}{\partial d_{iP}} - \frac{\partial u_i(\cdot)}{\partial d_{ij}} > 0$  for all proposals satisfying  $x_P > x_i > x_j$ .

Now, consider the spite/altruism terms  $\frac{\partial u_i(\cdot)}{\partial \pi_j}$  and  $\frac{\partial u_i(\cdot)}{\partial \pi_P}$ . Due to the fixed-pie splitting character of the treatment  $T1$ , holding different attitudes towards responder  $j$  and the proposer is complementary and they reinforce each other: either  $\frac{\partial u_i(\cdot)}{\partial \pi_j} - \frac{\partial u_i(\cdot)}{\partial \pi_P} < 0$  (spite against responder  $j$  and altruism towards the proposer) or  $\frac{\partial u_i(\cdot)}{\partial \pi_j} - \frac{\partial u_i(\cdot)}{\partial \pi_P} > 0$  (altruism towards responder  $j$  and spite against the proposer).

In case responder  $i$  holds the same attitudes towards both players, they substitute each other, and their relative weight becomes important: if the altruism (spite) towards the proposer is stronger (weaker) than altruism towards responder  $j$ , then  $\frac{\partial u_i(\cdot)}{\partial \pi_j} - \frac{\partial u_i(\cdot)}{\partial \pi_P} < 0$ , otherwise  $\frac{\partial u_i(\cdot)}{\partial \pi_j} - \frac{\partial u_i(\cdot)}{\partial \pi_P} > 0$ .

Responder  $i$  submits strategy  $RS$  in treatment  $T1$  if  $\left. \frac{\partial v_i(\cdot)}{\partial x_j} \right|_{x_i=const.} < 0$ , and strategy  $RA$  if  $\left. \frac{\partial v_i(\cdot)}{\partial x_j} \right|_{x_i=const.} > 0$ . Table 7 contains information on the strategy type chosen by responder  $i$  in the absence and presence of inequality aversion in the sense of FS for all possible motivations towards the proposer and responder  $j$ .

Table 7 – Predicted strategies under different behavioral assumptions

Attitude of responder $i$ to		It holds that		Implied strategy type if	
responder $j$	proposer	$\frac{\partial u_i}{\partial d_{iP}} = \frac{\partial u_i}{\partial d_{ij}}$	$\frac{\partial u_i}{\partial d_{iP}} < \frac{\partial u_i}{\partial d_{ij}}$	$(1 \wedge 2) \wedge (3 \vee 4)$	$(1 \wedge 2) \wedge \neg(3 \vee 4)$
(1)	(2)	(3)	(4)		
altruistic	altruistic	$\frac{\partial u_i}{\partial \pi_j} > \frac{\partial u_i}{\partial \pi_P}$	$\frac{\partial u_i}{\partial \pi_j} > \frac{\partial u_i}{\partial \pi_P} \wedge C1$	$RA$	$RS$
spiteful	spiteful	$\frac{\partial u_i}{\partial \pi_j} > \frac{\partial u_i}{\partial \pi_P}$	$\frac{\partial u_i}{\partial \pi_j} > \frac{\partial u_i}{\partial \pi_P} \wedge C1$	$RA$	$RS$
altruistic	spiteful	TRUE	C1	$RA$	$RS$
spiteful	altruistic	TRUE	TRUE	$RS$	$RS$

Note: 'altruistic' means  $\frac{\partial u_i(\cdot)}{\partial \pi_j} > 0$ , 'spiteful' means  $\frac{\partial u_i(\cdot)}{\partial \pi_j} < 0$ , C1 means  $\frac{\partial u_i}{\partial \pi_j} - \frac{\partial u_i}{\partial \pi_P} > \frac{\partial u_i}{\partial d_{ij}} - \frac{\partial u_i}{\partial d_{iP}}$ .

Generally, we can conclude that the  $RA$ -type strategy is predicted if the responder puts more weight on the well-being of the other responder than on the well-being of the proposer or is even spiteful towards the proposer, and inequality aversion in the sense of FS is not too strong.  $RS$ -type strategies are predicted when the spite towards the other responder outweighs any spite towards the proposer. This type of strategy is also predicted when the responder is inequality averse in the sense of FS.  $\square$

### A.3 Proof (Aspiration level hypothesis)

Ochs and Roth, 1989 suggested in the context of two-person ultimatum games that a responder bases her acceptance decision on a fixed material share she desires to receive, the aspiration level. We model the aspiration level as a strictly positive utility  $\bar{u}_i$  (the value when everybody receives no material payoff) responder  $i$  foregoes when receiving the offered material share.

It is easily seen that responder  $i$  chooses to accept a proposal  $x$  in treatment  $T1, T2, T3$  if for a treatment the following conditions are satisfied: (al1)  $x_i - \bar{u}_i > 0$ , (al2)  $x_i - \bar{u}_i > 0$ , and (al3)

$x_i - p_i(x_j)\bar{u}_i > 0$ , respectively. Such a responder, therefore, submits an aspiration level type strategy  $A(a)$  in treatments  $T1$  and  $T2$  with the same aspiration level  $a = \bar{u}_i$ . In  $T3$ , assuming  $p_i(x_j)$  is increasing in  $x_j$ , a strategy of the  $RS$ -type is submitted. The assumption on  $p_i(x_j)$  is consistent with the acceptance rates observed in the experiment, which are nondecreasing in the own monetary payoff. It can be therefore be seen as a reasonable belief, being ex post consistent with the average responder's behavior.  $\square$

## B Instructions for the experiment

*These are the instructions for subjects who had drawn the letter A {B (C)}, respectively. The instructions are translated from German.*

**Instructions** You will now participate in an experiment on economic decision making that is used to study human behavior in bargaining situations. This experiment is financed by several scientific institutions. If you read the following explanations carefully, you can (besides a fixed amount of 70 Schilling) earn money with the decisions you will make in the experiment. Therefore, it is very important that you read the instructions carefully.

The experiment consists of three rounds. After the third round, the experiment is over. You will then be paid out the amount you earn in two out of the three rounds. The two rounds determining your earning will be chosen at random after the third round.

During the experiment we speak of points instead of Schillings. Your total earnings will therefore be calculated in points. Your earnings in Schillings will be calculated with the exchange rate 10 points = 1 Schilling.

The instructions handed out to you are for your private information only. It is prohibited to talk during the experiment. If you have questions, please raise your hand. We will then come to you and answer your question. If you do not obey this rule you will earn nothing in the respective round. On the following pages we describe how the experiment proceeds.

### General instructions

In this experiment, you are either a person A, a person B, or a person C. What person you are is shown on the upper right corner of this sheet. One person A, one person B and one person C form a group. The group composition stays the same for all three rounds. You will, however, receive no information about the identity of the persons with whom you form a group.

In all rounds, you are person A {B (C)}.

### Round 1: Instructions

Person A has to make a proposal how to divide 3000 points between person A, person B and person C. Persons B and C decide simultaneously and independently of each other, if they accept or reject the proposal.

If both person B and person C, reject the proposal nobody earns anything in this round. If only person B rejects the proposal (that is, person C accepts the proposal), nobody earns anything in this round. If only person C rejects the proposal (that is, person B accepts the proposal), nobody earns anything in this round. If neither person B nor person C rejects the proposal (that is, both, person B and person C, accept), then everybody in the group earns points according to the proposal of person A.

Please note: a unilateral rejection by person B as well as a unilateral rejection by person C leads to a situation where everybody in your group earns nothing in this round.

Person A has a decision sheet (Decision sheet A - round 1) where he/she chooses which division of the 3000 points he/she proposes. Person A indicates his/her decision on this decision sheet. (The precise way how to do this is described in the specific instructions for person A.)

While person A is making her/his decision, persons B and C are filling in their decision sheets anonymously and independently from each other. Person B and C each has one decision sheet (Decision sheet B/C - round 1). On this sheet person B and C indicate for each feasible proposal whether they accept or reject the proposal. (The precise way how to do this is described in the specific instructions for person B and C.)

After all persons have filled in their decisions on the decision sheets all decision sheets will be collected. The experimenters record the decision of person A in your group and put it together with the decisions of person B and C in your group. All three decisions together determine your earnings in this round according to the above described rules. How much you have earned in this round you will learn only after the third round. All decisions are anonymous and you have to keep them for yourself.

### **Specific instructions for person A**

We describe here how you have to fill in your decision on the decision sheet. On the Decision sheet - round 1 you indicate what your proposal for the division of 3000 points between yourself, person B and person C is.

You will make your proposal by filling in the relevant number of points in the grey fields after the words "I propose for myself:", "I propose for person B:", "I propose for person C:".

Please, note that you can make only one of the proposals shown in the table on your decision sheet. In this table, you can find the possible offers to person C in the first row and the possible offers to person B in the first column. The numbers in the grey field show how much you demand for yourself, for a given combination of offers to person B and C. For instance, if you make an offer of  $x$  points to persons B and an offer of  $y$  points to person C, then you demand  $3000-x-y$  points for yourself.

After you have filled in your decision, please indicate it also by circling the corresponding numbers in the first row (offer to person C) and the first column (offer to person B) in the table.

### **{Specific instructions for person B (C)}**

Here we explain how you fill in your decisions on the decision sheet.

You have received an Information sheet B (C) - round 1 and a Decision sheet B (C) - round 1. The grey table on the decision sheet shows you all possible combinations of offers person A can make to you - given an offer to person C (B). In the first (white) row of this table you find all possible offers to person C (B). In each column below an offer to C (B) you find all possible offers to you given the offer to C (B). Please note that each combination of an offer to you and an offer to person C (B) automatically determines how much person A demands for him/herself. How much person A demands for him/herself for a combination of offers to you and person C (B) you can easily read off the Information sheet B (C). Please, have a look at this sheet. In the first column (next to the words "offer to me") you find all possible offers of person A to you. The columns left to the first column of the table shows you the amount person A demands for himself/herself given an offer to you and an offer to person C (B). The possible offers to person C (B) you can find in the first row of the table under the heading "offer to person C (B)".

The formula for the calculation of the demand of person A is: Person A's demand = 3000 points - offer to me - offer to person C (B).

You make your decision which of the feasible proposals you want to accept by circling them on the decision sheet B (C) - round 1. Note that all proposals that you do NOT circle will be regarded as rejected.}

### **General instructions (continued)**

As already mentioned, this experiment consists of three rounds. In the second and third round, the same amounts of money as in round 1 are at stake. The rules, however, will be slightly different in each round. You will be person A {B (C)} again. You will learn about the details of the new rules at the beginning of each round.

Person A will learn only after the end of round 3 whether the proposal made by person A was accepted or rejected. Similarly, person B and C will learn only after round 3 which offer was actually made to them.

At the end of round 3 we will publicly and transparently for you randomly determine which two out of the three rounds you will be paid out. The determination of your earnings in all rounds will be monitored by the 'observer' who was chosen from among you. The observer will acknowledge the correct determination of your earnings with his/her signature on the payoff-forms. The money you earn during this experiment will be paid out to you privately and anonymously. Your earnings are your private information.

It is important that you understood the consequences of your decisions and the decisions of the other persons in your group. Your decisions have a substantial effect on the amount of money you earn. If you have any questions, please raise your hand. We then come to you and answer your question. Before you make your decisions, please answer the following questions.

Suppose person A makes the following proposal: X points for person B and Y points for person C

1. How much does person A demand for himself?
2. Suppose person B and C reject the proposal. How much does person A, person B and person C earn in this case?
3. Suppose person B rejects the proposal but person C accepts the proposal. How much does person A, person B and person C earn in this case?
4. Suppose person B accepts the proposal but person C rejects the proposal. How much does person A, person B and person C earn in this case?
5. Suppose person B accepts the proposal and person C accepts the proposal. How much does person A, person B and person C earn in this case?

After you have answered all questions and the answers were controlled by the experimenters, please take your decision sheet A {B (C)} - round 1.

Now you have to decide which proposal you make. Fill in your proposal in the corresponding fields on your decision sheet A - round 1 (left upper corner). Thereafter, please also circle the corresponding numbers in the first row ("offer to person C") and first column ("offer to person B").

{Now you have to decide which of the possible proposals you accept (and which you reject). This you do by circling in the table all offers you accept in a clear and distinct way. Please note that all offers you do not circle are regarded as being rejected.}

You do not have to hurry. Take your time and think well about your decision before you indicate it on the decision sheet. After you filled in your decision, you can change it only with the approval of the experimenter. When you are ready, please control whether you indicated your participant number on the decisions sheet (in the upper right corner). Then, turn the decision sheet face down so that we can collect it.

*The instructions for rounds 2 and 3 have been the same as for round 1, except that the explanations concerning the payoff consequences of a rejection differed. They were described in the same way as for round 1. Subjects also had to answer questions about the calculation of payoffs again.*