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# Simultaneous but independent ultimatum game: strategic elasticity or social motive dependency?

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## Abstract

Ultimata bargaining experimentally investigates the responder behavior for multiple proposers, that is, the responder's decision to accept or reject an offer conditional on another parallel offer. Responders' strategies combine the two formally independent but parallel games as if inducing competition among proposers by more frequently rejecting an offer when it is the lower one of the two offers received simultaneously. Furthermore, proposers' public offers strongly correlate, due to adapting over repetitions to the parallel offer or because of only slightly outbidding the other proposer's offer if known before their own announcement. Social preferences of inequity aversion or of pure altruism for income distributions resulting from simultaneous ultimata cannot explain a positive dependency of own offers on other parallel offers, and *joint responsibility* is proposed as a reference-dependent social motive.

**Keywords** Multiple ultimatum game · Context dependency · Responder rejection rate · Joint responsibility · Comparative dependency

**JEL Classification** C78 · C90 · C91

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## 1 Introduction

Ultimatum bargaining behavior[1] is mostly explained by social comparison and corresponding norm enforcement through costly punishment. The maximum offer in ultimatum games is usually half the cake, which in most studies coincides with the mode. An equal split of profits is generally the most prominent point of agreement in bargaining games (for the ultimatum game see Güth et al. 2001). Deviations from this solution point occur in ultimatum games mostly in line with maximizing own profits up to a degree where average rejection rates pose a risk. For most responders the threshold is around 40% of the cake beyond which zero payment for both is preferred. One main question of interest here is if people do follow social concerns (i.e., Rabin 1993; Fehr and Schmidt 1999; Bolton and Ockenfels 2000) or exhibit reciprocity (i.e., Dufwenberg and Kirchsteiger 2004; Falk and Fischbacher 2006). Diverse variations of the standard ultimatum game exist and experimentally support one or the other view. For distinguishing the influence of social norms from procedural influences in the form of reciprocity or rivalry, the expansion to a three player game with two different roles appears promising. For example, assume a seller is a single responder with at least two units of a good to sell, and who is simultaneously negotiating with two buyers demanding one unit each. Without competition, buyers (proposers) should simply offer the seller's (responder's) reservation value for obtaining the good. However, the literature on ultimatum bargaining shows that responders frequently reject offers simply above zero. This behavior could not only be due to relative concerns regarding income differences, but could result from the informational variety and perception of social norm violations or could reflect longer term strategic advantages.

Our experimental results suggest that responders can behaviorally induce competition among proposers. Although in a non-competitive setting, a given offer is more likely to be rejected when the offer of the other proposer exceeds it. Thus, simultaneous ultimata can increase offers toward or even above half the pie. Rejection rates are higher for the lower of the two simultaneous offers, which is anticipated by the proposers who increase their offers depending on the (expected) size of the parallel offer: while some proposers adjust their offers only minimally, a substantial fraction aims to consistently outbid the other proposer. Thus, responders seem to induce a relationship between independent offers, and this even for higher offer levels. Comparisons between offers, and proposers avoiding being the lower (and potentially rejected) offer, appear to dominate social concerns in simultaneous ultimata bargaining.

[1] In the standard ultimatum game two players divide an amount of money between them in the following sequence. The first player (the proposer) offers a part of the total amount and the second player (the responder) decides whether to accept or reject this offer. If the second player accepts, the amount is divided as suggested by the proposer. If the offer is rejected both players receive nothing. In the subgame perfect Nash equilibrium the responder accepts any positive amount and the proposer offers the smallest amount possible. Experimental or field investigations of the ultimatum game show that actual players of the game make non-negligible offers and responders reject low offers (i.e., Güth et al. 1982; Thaler 1988; Roth 1995; Camerer 2003). The various behavioral investigations of the ultimatum game also include high stakes or repeated interaction. High stakes slightly decrease rejection rates which in return leads to lower offers (Slonim and Roth 1998; Cameron 1999). Repeated interaction with fixed matching partners fosters higher rejection rates, presumably for building up the reputation of a tough player and thus increase future offers (Slembeck 1999). Furthermore, subjects prefer to reject only part of the offer when this is possible, instead of choosing zero payoffs for both players (Andreoni et al. 2003).

### 1.1 Background literature

Simultaneous ultimata games compare social expectations and self-interests in a multi player bargaining experiment. Expanding the standard ultimatum game from two to more players has been done for the receiving side. The core bargaining relation between proposer and responder does not change fundamentally when a passive dummy player is added as an additional receiver who has no option to reject the overall allocation. Dummy players mostly receive comparably small amounts (Güth and van Damme 1998; Kagel and Wolfe 2001), and responders frequently reject extreme offers (i.e., above 50% of the pie) to the dummy player when the responder's payoff does not depend on this decision and is independent of the proposer's allocation (Bosch-Rosa 2015). Generally, differentiating roles and information in three-player bargaining can lead to systematic variations of inequity aversion (i.e. Bolton and Ockenfels 1998). Furthermore, when responders in the ultimatum game compete for the offer of one proposer, lower offers are less often rejected (Halko and Seppälä 2006). Grosskopf (2003) experiments with one proposer bargaining at the same time with three responders, who have to individually agree to their division (or not), and where only one proposer-responder pie division out of the accepted proposals is randomly selected. The overall decreasing offers over repetitions are explained by reinforcement or directional learning. Güth et al. (1997) implement stronger competition with five responders with only the one with the lowest acceptance threshold (in a strategy method experiment) receiving their division. A trade-off between fairness and responder competition is proposed to account for overall lower (and further decreasing) offers.

An example of expanding the ultimatum game without inducing direct competition between the responders is provided by Knez and Camerer (1995). Here a proposer simultaneously sends offers to two formally independent responders. Expectations of half of the responders change with an increasing offer made to the other responder: some expect a larger and others a lower share of the total amount available. The authors assume that subjects dislike lower payoffs compared to the other players, however, responders were ambiguous with whom to compare, i.e. some compare with the other responder (decreasing willingness to accept a given offer depending on the size of the other responder's offer) and some compare with the proposer (increasing willingness to accept a given offer depending on the size of the other responder's offer). Thus, inequity aversion can be directed toward a person in the same role or toward a person in the opposing role. Also expanding the number of proposers appears to be a useful experimental expansion of the standard two-player ultimatum game, as often several offers are received in parallel in the real world. Roth et al. (1991) provide a study of ultimatum bargaining with multiple proposers, but here direct competition is induced as the responder is forced by the experimental design to accept only the highest offer. Under this specific bargaining structure results converge to the subgame perfect equilibrium of maximum offers. Responders with multiple ultimata might follow strategic concerns of how to increase the (future) offers they (will) receive, or they might have social considerations regarding social norms, for example in the form of inequity aversion or pure altruism. Social considerations can also take place in the form of rivalry, where happiness results from the relative advantage over another player

(Hopkins 2008). On the one hand, this could be understood in evolutionary terms as a relative strategic advantage for obtaining resources (in evolutionary terms offspring). On the other hand, perception of relative success or failure can serve self-regulatory purposes and can provide help with setting reasonable goals (i.e. aspiration levels).

Especially in a behaviorally new domain, where information about the execution of a social norm is not readily available, offers could be evaluated in reference to each other. Many studies document influences of social comparisons on individual behavior. For example Cason and Mui (1998) study a sequential dictator game where dictators observe the offers made by other dictators and find that dictators maintain other regarding preferences when information about the behavior of another dictator is provided, which is usually not the case when this kind of information is lacking. Responders in the ultimatum game feel treated worse when another responder is treated more kindly, as more offers are rejected when a responder observes the average offers made to other responders (Bohnet and Zeckhauser 2004)—possibly enforcing a social norm, and outcomes generally further deviate from the subgame perfect equilibrium when providing the information about others' behavior in the same situation (Duffy and Feltovich 1999). When structural information is not directly available, players could be more prone to a variety of social heuristics, while uncertainty could influence offer levels in the ultimatum game positively as well as negatively. If there is information asymmetry concerning the available pie to divide, this proposer's advantage is usually exploited by offering the equal split division of the minimum pie possible (Güth et al. 1996). With role uncertainty, when it is randomly decided who the receiving and who the providing side in a three-player dictator game is (i.e. "solidarity game" Selten and Ockenfels 1998), overall increased givings are observed.

Adding players to the standard two player game could not only increase uncertainty, but provide additional behavioral information. In an adaptation of three-player dictator games by Bolle et al. (2012) gifts are made conditional on the giving of another dictator (while keeping the relation of dictators to beneficiaries fixed at two to one). The evaluation of social norms is strongly guided here by the comparison to the behavior of the other dictator—seemingly as a kind of joint responsibility. If something is given at all to the beneficiary, this amount positively correlates with the other dictator's giving, at least up to a certain threshold, which simply contradicts social preferences of warm glow (Andreoni 1990) or inequity aversion (Fehr and Schmidt 1999). Similar observations of imitating the behavior of others have been made in public good games, termed conditional cooperation (Croson et al. 2005; Fischbacher et al. 2001; Keser and Van Winden 2000).

In the ultimatum game, contributions might similarly depend on the behavior of another player in the same role. Alternatively this behavioral information of contribution levels (i.e. gifts) can be learned from repeated interaction, when the behavioral information about other players is available, but repeated ultimatum games can as well imply reciprocity or reputation concerning rejection behavior (compare Duffy and Feltovich 1999; Slembeck 1999; Cooper and Dutcher 2011). An alternative explanation to strategic or social concerns could be that subjects do not have common knowledge of rationality, beliefs, or motives (Harrison and McCabe 1996), which would simply suggest reference-dependency to their own previous behavior or the observed behavior of other people in a similar situation.

### 1.2 Hypotheses

Without proposer competition (i.e. conflicting offers), inequity aversion as the main social motive for the division of the pie is the nil hypothesis, but information about social behavior could have a crucial impact as a reference point for own behaviors. Social information can result from observing behavior and their consequences in previous rounds as well as when making offers sequentially and knowing what the other player proposed. Are proposers' offers and responders' evaluations made independently or conditional on the parallel offer observed previously, made sequentially, or received simultaneously? Can rejection rates be explained by maximizing overall results or by specific social motives of altruism, inequity aversion, rivalry, or joint responsibility? Expanding the number of proposers as well as repeated interaction could help to better understand the social motive for offering larger than minimum amounts in the ultimatum game. Thus, not only one shot games including two proposers (with and without knowing the other proposer's offer) and one responder, but also repeated three-player ultimata can inform the behavior concerning the execution of specific social norms.

**Hypothesis 1**: *Social comparisons harmonize behavior by (a) adjusting to observed parallel offers in repeated ultimata games and (b) mimicry of previous offers in sequential ultimata games.*

When the behavioral information about other people in the same situation is available, this formally does not change your incentive structure, but can change your perception of the social situation. Hypothesis 1 postulates this form of perceptual dependency of own behavior on other people's behavior as a continuous adaptation under repetition. Higher offers in the ultimatum game, as behavioral deviations from profit maximization, might stabilize over time due to reciprocal observational confirmation. Furthermore, high offer levels can result from a direct social comparison before making one's choice. When the offer of another proposer (a person in the same situation) is observed before the own offer is announced, this might lead to a behavioral imitation. This form of reference dependency might be interpreted as a kind of joint responsibility. Social norm contingent behavior is further investigated in relation to strategic considerations in a second basic hypothesis.

**Hypothesis 2**: *Social comparisons enable norm enforcement through (a) building reputation of high rejection rates in repeated ultimata games and (b) inducing competition by conditional rejection rates in simultaneous ultimata games.*

Providing information about your own future behavior before others make their choice can take various forms. In the ultimatum game non-binding information, like cheap talk, should not effect the proposer's behavior. Nonetheless observations as an information about social behavior can take the form of a commitment device. Hypothesis 2 assumes that this opportunity is taken by the responder in the ultimatum game for fostering social interests. First, over repetitions a reputation of high rejection likelihoods can be built up to establish a social norm of higher offers. Second, when selectively rejecting between simultaneous offers this can pose a meaningful threat to boost offers. Behavior investigated under Hypothesis 1 directly influences the behavior under Hypothesis 2 in repeated games and might be anticipated by the proposer in

one-shot games. Social information can lead here to conformity or can serve an aim like building a specific bargaining reputation. Therefore, responder rejection behavior can always serve a strategic component in regard with social norm compliance as well as own interests. This difference needs to be taken into account when evaluating influences of social comparisons in simultaneous ultimata games.

## 2 Ultimata bargaining experiment

We investigate an ultimatum game in which each proposer divides the same amount $\varepsilon$ (50 eurocents in the repeated game and 500 eurocents in the one-shot game) between himself and a responder. If the responder accepts this division of the proposer, the amount is allocated accordingly between the two of them. However, if the responder rejects a proposer's division, both the responder and the proposer receive nothing. Moreover, responders can receive offers from two proposers making simultaneous offers. The first part of the experiment is a repeated three-player ultimata game with always two proposers and one responder in fixed roles and a partner matching design. The second part of the experiment compares the standard one-shot single proposer ultimatum game with a two proposer setting, which is also presented sequentially for the two proposers. The player's whole strategy set in the position of the proposer as well as the responder is captured for the standard ultimatum game, simultaneous ultimata, as well as sequential ultimata by the strategy method (Selten 1967; for further discussion of this approach see Oxoby and McLeish 2004; Brandts and Charness 2011). The sequence of the two parts with respective information and choices is illustrated in Table 1.

Eighty-four undergraduate students of the Viadrina University took part in the study. Participants received written instructions and detailed on-screen descriptions before each subpart of the experiment (compare Online Appendix). The experiment took place in the viaLab applying z-Tree (Fischbacher 2007). Each of the eight sessions in total lasted approximately 50 min. Six of the sessions were run with twelve subjects, while two were with six subjects. Final payments fully depended on participants' behavior, as no show-up fee was implemented. Average total payment for participating in the two parts of the experiment was €8.55 (SD 2.51).

### 2.1 Repeated three-player ultimata games

The existence of multiple proposers allows the responder to directly assess an offer based on another offer received simultaneously and investigates the interdependence of simultaneous ultimata and corresponding behavioral dependencies. In contrast to Bohnet and Zeckhauser (2004) or Knez and Camerer (1995), responders do not evaluate whether they are treated less or more kindly compared to another player in the same position. With two simultaneous ultimata, responders can evaluate which of the two offers is in line with their social expectations and which is not. Furthermore, the information about the existence of other proposers is also provided for the proposer

**Table 1** Items and variations for the two parts of the ultimata experiment

| | | Design | Role sequence | Choice | Information | Variants | Iterations |
|---|---|---|---|---|---|---|---|
| Part 1 | Repeated ultimata game under stable partner matching | Fixed roles with two proposers and one responder | Proposer | Offer 0–50 | Previous behaviors | – | 20 repetitions |
| | | | Responder | Reject or not (2x) | Two offers | | |
| Part 2 | One-shot ultimata game as strategy method for all roles | Standard | Proposer | 0–500 | No | – | 1 Answer |
| | | | Responder | Reject or not | One offer | (25, 75, 125, 175, 225, 275, 325, 375, 425, 475) | 10 Choices |
| | | Simultaneous | Proposer | 0–500 | No | – | 1 Answer |
| | | Sequential | Proposer | 0–500 | Parallel offer | (50, 150, 250, 350, 450) | 5 Answers |
| | | Simultaneous | Responder | Reject or not (2x) | Two offers | (50, 150, 250, 350, 450) | 25 Choices |

position, for measuring dependencies between the offered amounts and the strategic behavior based on the responder's social information.

The social information about the other proposer is implemented for the proposers as a treatment variable, where half the groups forming a three-player ultimatum game received full behavioral information after every period while in the other half proposers only knew about the existence of the other proposer's behavior. Thus, the first part of the experiment is a repeated three-player simultaneous ultimata game which expands the standard ultimatum game by the number of games the responder is playing from one to two parallel games, and both proposers know of the existence of this parallel game to their own game. This three-player ultimata game is repeated 20 times and only in half of the sessions proposers are informed after each period about all information in the parallel game: the other proposer's offer and if it was rejected or not. This results in 28 repeated three-player ultimata games with 14 games for each information treatment. The responder always receives the information about both offers at the same time and simultaneously (on one screen) decides for each if to accept or reject it.

Formally the two parallel ultimatum games are independent from each other and various behavioral information is provided: once as partial information as of the existence of the parallel game and once as full information with in addition the behavior in the parallel game after each period. Naturally the responder always has full behavioral information, but which is never repeated.

### 2.2 Simultaneous and sequential ultimata games

The second part of the experiment applies the strategy method to cover the whole strategy space for the standard ultimatum game together with its expansion of two simultaneous ultimata where the proposers are making their offers also sequentially. It is a one-shot game covering the behavior of one responder with one or two proposers. Each participant provides answers for all cases in both roles.

The one-shot game divides into two blocks: first the standard ultimatum game and second its simultaneous as well as sequential expansions (compare Table 1). In the first block, the standard ultimatum game, all participants made their offers as proposers and then decided in the role of the responder which offers to reject and which to accept (for offers from 25 to 475 in steps of 50 eurocents). The second block consists of the ultimata game with two proposers and one responder. Before this second block with simultaneous ultimata started, all participants were informed that receivers would now face two proposers in parallel. This information needed to be confirmed on the screen and only then everyone decided in the role of one of two proposers how much out of 500 eurocents to offer the responder. After this, all participants made their offers in a sequential way, i.e. conditional on the information that the other proposer's offer was either 50, 150, 250, 350, or 450 eurocents (randomly ordered each on a separate screen). Thus, in total six offers needed to be made in the second question block. Afterward, everyone decided in the role of the responder for the pairs of parallel offers. Possible offers again were 50, 150, 250, 350, or 450 eurocents and appeared on the left and the right side of the screen, representing the simultaneous offers of two proposers. The resulting 25 possible offer pairs were shown in random order on

separate screens. For each pair subjects had to decide whether to reject none, one (left or right side), or both offers.

All participants were matched with random players of their session for obtaining their individual payoffs for the second part of the experiment. This was done twice, once for the first block of questions and once for the second block of questions, resulting in two individual payments in addition to the sum obtained from the first part of the experiment. In the matching for the first block of questions, one person was randomly assigned proposer and one responder and their corresponding answers determined their payments. For the second block of questions, there was an equal chance of whether the simultaneous or the sequential game was chosen. Then one responder and two proposer roles were assigned randomly with their corresponding choices determining the payoffs. Thus, each answer generated by the strategy method was potentially payoff relevant. The resulting payoffs for the two question blocks of the second part of the experiment ranged between zero and €7.10 (with an average of €3.51 per participant). The experiment concluded with a demographic questionnaire.

## 3 Experimental results

Overall results in the simultaneous ultimata games are in line with the standard ultimatum game,[2] but also dependencies between the two parallel offers become evident. Behavioral information about the parallel ultimatum game is investigated in the repeated ultimata game as a possible updating process over periods. In the one-shot game the information about the other proposer's offer directly varies over the experimental treatments. In the sequential ultimata game the other parallel offer is known, before making the own offer as a proposer. In the simultaneous ultimata game it is only known that a parallel offer exists, and with no parallel offer in the standard ultimatum game. This allows to directly measure the effect of the information in the simultaneous and sequential ultimata game compared to the standard ultimatum game. Both parts of the experiment are analyzed together, but separately for offer levels and rejection rates.

### 3.1 Offer levels

In the repeated ultimata game the offers are on average slightly above 20 eurocents (40% of the pie) similar to the standard ultimatum game. Figure 1 shows the average offer over periods for the information treatments. After an initial learning phase of approximately five periods, the offers are consistently higher in the full information treatment where the behavioral information about the other proposer was provided. This difference between the information treatments becomes significant over repetitions, with periods having a negative effect ($p < 0.0056$) and the interaction information times period ($p < 0.0006$) having a positive effect on offer levels (in

[2] Through backward induction, rational responders should accept all positive offers, and proposers should offer the smallest amount possible (one eurocent here). Usually, in ultimatum experiments, responders reject small positive offers, and proposers offer between 30 and 50% of the pie.

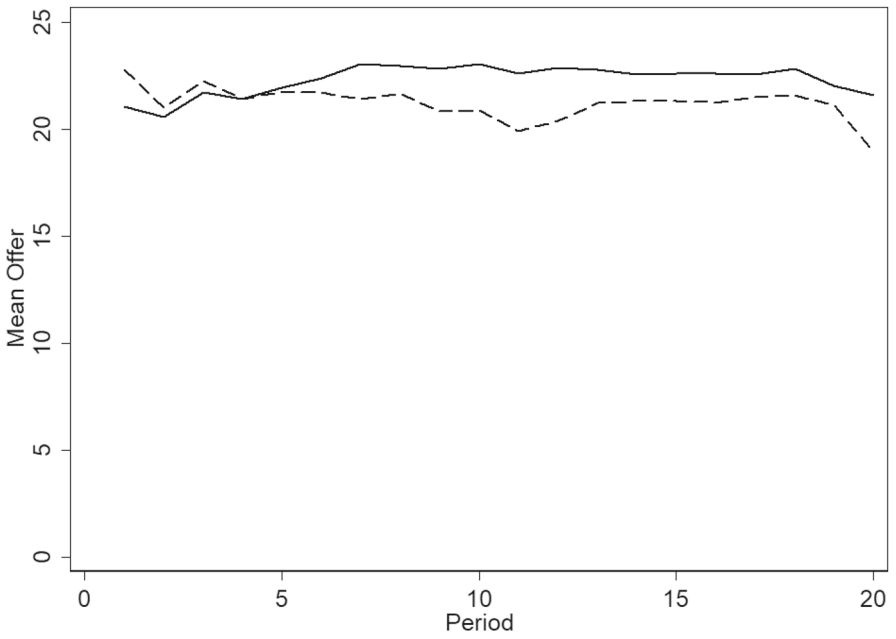


**Fig. 1** Average offers in repeated ultimata games with full information treatment in solid line and partial information treatment in dotted line

a linear mixed model with random effects of group and subject). With two simultaneous ultimatum games for the responser and without full information for the proposers, the average offer levels decline over periods. This result strongly confirms Hypothesis 1a of (over-)adjusting to the parallel offers when these are directly observed. Note that this confirms Duffy and Feltovich (1999) of behavioral information fostering deviations from equilibrium play and expands their reported influence of average observed other behavior to the observation of behavioral information in a parallel game with fixed roles and stable partner matching. Also the observed difference between the simultaneous offers received by the responder in one period points in the direction of overall mimicry. The difference between offers reduces significantly over periods (with $p < 0.0002$ in a linear mixed model with the group variable as random effects), but with no significant influence of the information treatment. The observation of rejections in previous periods already leads to converging simultaneous offers.

The expansions of the ultimatum game in a one-shot game yield similar results. Average offers in the standard ultimatum game with one proposer and one responder are only slightly lower (with 216 eurocents) than in the three-player ultimata game (with 225 eurocents). This difference when simply being informed about another parallel ultimatum game is not significant according to a paired t-test ($p = 0.302$ or Wilcoxon signed-rank test with $p = 0.2639$). Additional behavioral information is provided for the proposers when the offers are made sequentially. Then offers seem to depend on the other proposer's offer in the parallel game. Figure 2 shows the offer sizes conditional on the offers made by another proposer. Here a positive correlation exists,

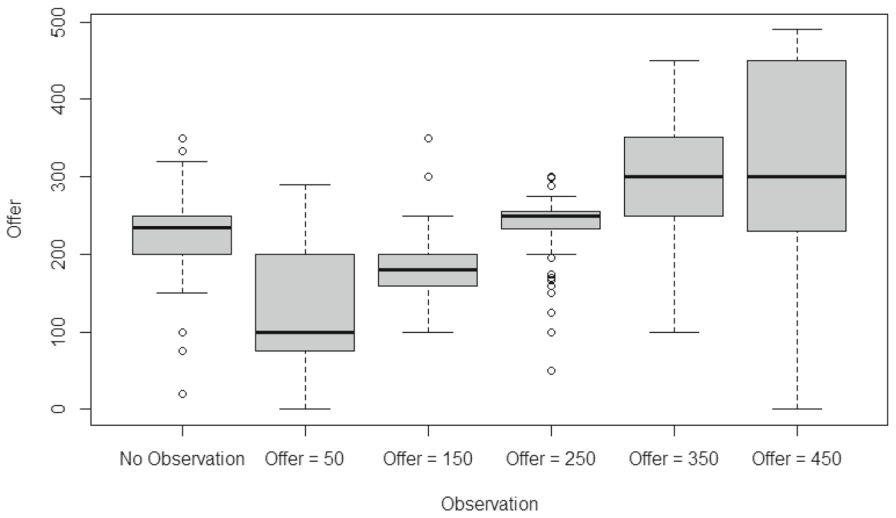


**Fig. 2** Offers made conditional on observing different offers by the other proposer

with offers increasing with the other proposer's offer. The dependency of the offer on the other parallel offer is strongly confirmed in a regression analysis (corrected for individuals as random effects) with a coefficient of 0.468 ($p < 0.001$).

Furthermore, according to a paired t-test offers differ for all neighboring pairs of simultaneous offers: 50 versus 150 ($p < 0.001$), 150 versus 250 ($p < 0.001$), 250 versus 350 ($p < 0.001$), and 350 versus 450 ($p = 0.039$) (all significance levels are confirmed in a Wilcoxon signed-rank test with the comparison between simultaneous offers of 350 versus 450 resulting in $p = 0.019$). The distribution of offers in Fig. 3 shows a large proportion of proposers who maximize their expected payoff, but many others adjust their offers to simply outbid the observed offer. The second peak in Fig. 3 captures this kind of behavior, which is strongly deviating from the profit maximizing offer (nearly 1/4 still outbid the other proposer when observing a parallel offer of 450 which is 90when the parallel offer is close to the profit maximizing offer (150 or 250), though offers vary strongly when observing parallel offers outside this range. Some seem to simply outbid the other proposer's offer, while others stick to the optimal response. Consistent outbidding of the parallel offer can be seen as a strategy to avoid zero payoffs, and perceiving any parallel offer as a competing offer.

Perhaps most surprising is that proposers' decisions are strongly influenced by the other proposers' offers when deciding sequentially. When a proposer observes the offer of another proposer (which the same seller receives) before making their own offer, thus, proposers are presumed to act sequentially, the second mover's offer depends positively on the observed offer of the first mover, in particular, the second mover is likely to choose an offer which exceeds the first mover's offer. This clearly supports Hypothesis 1b that behavioral information of another person in the same role guides one's own behavior. The pure existence of a parallel game without the information about proposer's behavior does not have this strong influence. Together these results contradict what social preference models would predict. Inequity averse

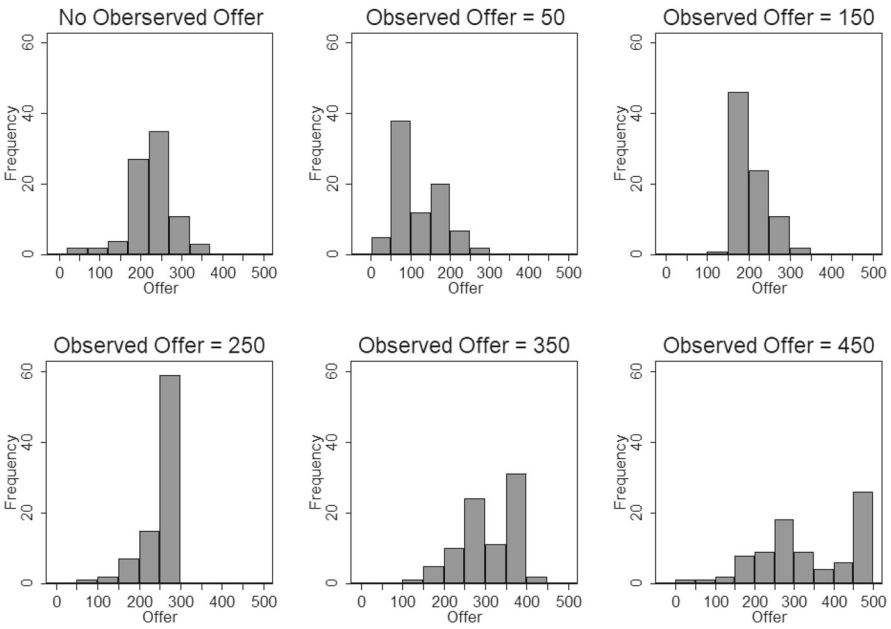


**Fig. 3** Distribution of offers conditional on observed simultaneous offers in the sequential ultimata game

preference would need, for an expansion of the two-player ultimatum game to a three-player ultimata game, to account for differences between all the three players as simultaneous inequity aversion. This is simply not reflected in the offered amounts. When the comparison toward the responder matters, who also receives an offer from another proposer, this would imply lower offer levels. A direct dependency on the other proposer's offer would only hold, if inequity aversion only counts for the other proposer who is in the same role. This can be understood as *joint responsibility*: if the other gives, I will give as well. Note that all standard theories of social preferences cannot account for a positive dependency between the offers. Pure altruism predicts a dependency between the offers, but this relation would then need to be negative rather than positive.[3]

### 3.2 Rejection rates

A possible strategy for responders in the repeated ultimata game could be to build up a reputation of high rejection rates at the beginning of the game to enforce higher offer levels later. Social information is always provided for the responder from the proposer's behavior in the simultaneous ultimatum game. This information can be a strategic advantage in the repeated game especially under full information. In the

[3] Giving by the other proposer would reduce my givings to the responder due to diminishing utility. Warm glow would remain constant and, thus, independent of the other proposer's givings. For rivalry to hold, the unreasonable responder behavior of consistently rejecting the lower offer must be fully anticipated.

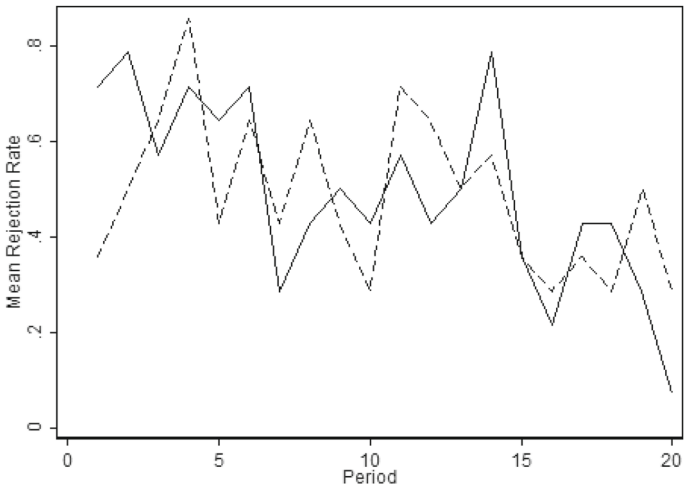


**Fig. 4** Rejection rates over periods for full information treatment in solid and partial information treatment in dotted line

one-shot game the exploitation of such a socially informational advantage must be anticipated by the proposers making parallel offers.

Rejection rates seem to decrease over the repetitions of the game (Fig. 4). This does not differ for the information treatments and is a weakly significant decrease only when comparing overall rejection rates of the last five periods with all earlier periods in a paired t-test ($p = 0.041$). Hypothesis 2a of a stronger change in rejection rates under increased social information is, thus, not supported. Decreasing rejections is the same in both treatments and might as well be explained by an end-game effect. In the repeated ultimata game the social information could be transmitted over periods. A regression analysis provides more detailed results. The information treatment (also in interaction with period) is never significant for the rejection rate, while the offer, the parallel offer, and period is (all with $p < 0.0001$). Interestingly, if the dummy of being the lower offer is added, this variable replaces the significance of the parallel offer. Social information seems to play a role in the form of a direct comparison to the simultaneous parallel offer and expectations might adjust over periods. The latter is further supported by including offers from the previous period significantly ($p < 0.01$) influencing the rejection rates in the current period. Increased expectations seem to result for previously higher offers. Further details on these influences on the rejection rate are provided in Appendix.

Also for the various offer levels no significant differences exist (in two-sample t-test as well as Mann–Whitney U test) between the two information treatments of the repeated ultimata games. This further confirms the lack of support for the hypothesis of higher rejection rates under increased social information. However, rejection rates in the critical region of 41–60% are significantly higher overall in the repeated when compared to the one-shot ultimata game. Table 2 shows the rejection rates grouped

**Table 2** Average rejection rates for different offer classes with the number of observations equal the number of participants (n = 84) in the one-shot game. For the repeated ultimata game the number of cases with existent offers in this range is shown in parenthesis (when offer existed the rejection rates were aggregated on the individual level before analysis). Significantly higher rejection rates compared to the game a line above in a paired t-test are indicated with ** for $p < 0.01$ and * for $p < 0.05$

| Offer in percent | < 20 | 20–40 | 41–60 | > 60 |
|---|---|---|---|---|
| Standard ultimatum game | 0.911 | 0.762 | 0.161 | 0.042 |
| Simultaneous ultimata game | 0.826* | 0.417** | 0.037** | 0.023 |
| Repeated ultimata game | 1 (5) | 0.478 (27) | 0.141* (24) | 0.067 (9) |

by offer ranges for the repeated and one-shot games.[4] This supports the assumption of reputation building under Hypothesis 2a when comparing the repeated ultimata game with the one-shot ultimata game. Surprisingly, rejection rates are also consistently higher in the one-shot standard ultimatum game when compared to the one-shot simultaneous ultimata game.[5] Over the whole spectrum of offers this difference in rejection rates is 11.8 (38.3% versus 26.5%) and highly significant ($p < 0.001$ in paired t-test as well as Wilcoxon signed rank test). Possibly rejection rates, as an eminent threat, could be lower with simultaneous ultimata as offers are not statistically different in the two games.

Under simultaneous ultimata the rejection rate of an offer can also depend on the size of the parallel offer. This is clearly the case in the one-shot simultaneous ultimata game, where the propensity to reject a given offer increases when the offer under consideration is exceeded by another offer the responder received simultaneously. Figure 5 shows the average rejection rate for offers of 50, 150, 250, 350, and 450 separately for the other simultaneous offer (50, 150, 250, 350, or 450). The rejection rate of an offer of 50 is higher when the parallel offer exceeds it. For an offer of 150, a similar picture results. The rejection rate increases when the parallel offer exceeds it (>150) and remains at this higher level for all simultaneous offers of 250, 350, and 450. Again, similar observations result for offers of 250 and 350. Consistent with this overall finding is the low rejection rate for the offer of 450. Here the possible parallel offers are always equal or lower and the rejection rate remains constant at 0.03. Thus, the rejection rate for an offer is smaller when it is not exceeded by another simultaneous offer, but increases once it is. This influence of parallel offers on the rejection rate is significant in a t-test with $p < 0.001$ for 50, with $p = 0.052$ for 150, with $p < 0.001$ for 250, and with $p < 0.001$ for 350 (all significance levels are confirmed in a Wilcoxon signed-rank test with the only difference for 150 resulting

[4] The ranges are formed around the provided options under the one-shot strategy method. The appearance of the offer on the left side versus the right side of the screen did not affect general rejection rates. Only for the same amount for both proposers the rejection rates for the right side offer increases by 3.6%. Order effects of the offers as in Galinsky and Mussweiler (2001) are not further considered, and in the analysis rejection rates were averaged for all the same offers.

[5] Significance levels are confirmed in a Wilcoxon signed rank test, with the only difference for comparing the standard ultimatum game with the simultaneous ultimata game for offers < 20% being significant with $p < 0.01$.

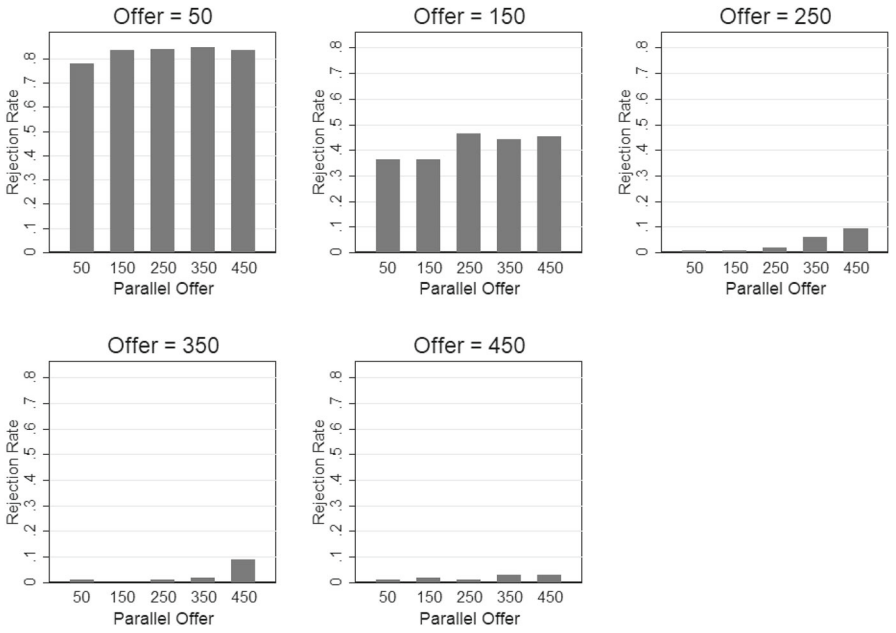


**Fig. 5** Rejection rates for offers of 50, 150, 250 and 350 eurocents, conditional on another offer received simultaneously

in $p = 0.047$). These conditional rejection rates clearly support Hypothesis 2b of simultaneous ultimata inducing competition.

A regression analysis (see Appendix) further confirms this dependency between simultaneous ultimata. The offer and the parallel offer significantly (both with $p > 0.001$) influence the rejection rate. Again, if the dummy of being the lower offer is added, this replaces the parallel offer as a significant influence for rejections. Social information clearly plays a role in relation to the parallel offer received simultaneously.

Conditional rejection rates induces a qualitative difference between the offers besides the actual offer levels. Similar to previous investigations of social preferences in the ultimatum game, the results show that responders feel treated unkindly from one proposer when treated more kindly from another proposer simultaneously. Surprisingly, this is also the case for fairly generous offers, but which is in line with Falk et al. (2003) arguing that responders' reactions to offers depend more on the presumed underlying intention than on the resulting payoffs. As the differences between the conditional rejection rates are small, so are their influences on expected payoffs. Maximum results are achieved for the proposer at around 250 eurocents (half the pie) with considerably low rejection rates. The two ultimatum games are formally independent decisions and conditional behavior on the parallel offer seems to link most to social information as *joint responsibility*. Strategic advantages are too inconsistent over players or repetitions to explain the dependency between parallel offers for the proposer or the responder.

## 4 Summary and discussion

Our investigation shows that rejection rates decrease with multiple proposers, but offers do not. Furthermore, offers of two simultaneous proposers are not significantly higher than offers of single proposers. Coats et al. (2013) derive a different conclusion for three simultaneous proposers, with higher offers of multiple proposers in a repeated stranger matching design. The authors similarly stress that this contradicts inequity aversion models and they assume "reciprocal behavior" in their experimental setting. Increasing offers could not result in the same way in a one-shot game, but appears also unlikely since lower rejection rates resulted in our simultaneous ultimata game and higher rejection rates would be needed for higher offers. That responders increase their incomes substantially, by for example rejection offers conditional on the parallel offer received simultaneously, might only be feasible in a repeated design with at least fixed roles (if not fixed partners) and a resulting strategic component (compare Slembeck 1999). In the one-shot as well as repeated ultimata game, offer levels are sustained by a psychological heuristic of rejecting conditionally on the size of the parallel offer.

These ultimata game results contradict social preference models as the responder and the proposer behavior is not in line with inequity aversion or pure altruism. Standard inequity aversion fails to explain these kinds of conditional rejection rates. Inequity aversion assumes rejection rates to be either independent of parallel offers or should decrease for increasing parallel offers (when given offers are small). Both is clearly rejected by the data. Rivalry between the proposers might be a motive induced by the responder. This partially creates an efficient threat for proposers. High offers could be the result then under strong risk aversion. Usually the most secure strategy in ultimatum bargaining is to offer the equal split of the pie. Under simultaneous ultimata it appears to be even more secure when being higher than the parallel offer, but this is of interest or realized only by some of the proposers. Other competition scenarios for getting away with more than the equal split appear difficult to adopt. One possibility is to assume the parallel offer being an outside option for the responder. With this additional asymmetry different amounts would be divided fairly (see Hennig-Schmidt et al. 2017). Other strategies for inequality in terms of Hopkins (2008) appear difficult to implement and especially to distinguish from profit maximization. *Joint responsibility* describes the reference dependency of offers more generally with positive dependencies even beyond the equal split of the share. However, joint responsibility is here not distinguishable from inequity aversion toward the person in the same role, simple behavioral imitation, or general norm formation. Possibly a multifaceted concept is required (compare Engelmann and Strobel 2004), as various social motives might be needed to explain behavior over game variants: relative concerns (i.e. inequity aversion, rivalry, or joint responsibility), social uncertainty (i.e. maximin), and reciprocity between unequal partners.

Dependencies between the two parts of the experiment do hint at another interesting issue. As offers and rejection decisions are made repeatedly in fixed roles, the role allocation in the first part could have influenced the behavior measured under the strategy method for both roles. This seems not to be the case for overall offers and rejection rates. Only for the sequential offer there is a tendency for responders showing a stronger influence of the other parallel offer on the own offer. This could be interpreted

in the following way: having been in the role of the responder previously lets one better imagine the psychological heuristic of always rejecting the lower of the two offers, but this comparison of roles in the first part and offers in the second part is only significant in one out of seven two sample t-tests (for the parallel offer of 450 with $p = 0.0053$). Different results from taking one or the other position in the ultimatum game might influence the observed social behavior. In the experimental ultimata game here, the other player's perspective appears to be in most cases fully acknowledged. Thus, perspective taking (Batson et al. 2003; Galinsky et al. 2008) or false consensus effects (Engelmann and Strobel 2012) seem not to play a substantial role.

It is rather informative that responders' as well as proposers' behavior is systematically affected by the behavioral information about the other person in the same social role. This conclusion is supported by the strong (and increasing) positive correlation between simultaneous offers. Observing the offers of other proposers provides information about the appropriateness of an offer, which may let proposers adjust their own offers. The strong relation to previous or parallel offers of other proposers indicates reference-dependent preferences (Tversky and Kahneman 1991), whereby the size of another offer might serve as a reference point for evaluating a given offer. Under this premise, the lower offer can be perceived as a loss and, therefore, is more likely to be rejected by the responder. Similarly, decisions could be influenced by anchoring (Tversky and Kahneman 1974), decoys (Simonson 1989), sampling (Stewart et al. 2006), or other reference-dependent models which enforce positive correlation. To systematically disentangle such context effects demands further relational studies over different kinds of games. There seems to be no stable solution as repeated ultimatum games have shown, and some form of adaptive learning or informational updating processes take place. Cognitive approaches concerning automatic imitation learning or mimicry might provide further insights (i.e., Van Baaren et al. 2004; Heyes 2011) to understand the processes involved when determining the social value of an offer.

## Appendix

### Regression Analysis

The rejection rates are influenced not only by the current offer, but also by the parallel offer received simultaneously. The restricted maximum likelihood regression analysis for the repeated (1120 observations for 28 responders) and the one-shot (4200 observations of 84 responders) ultimata games clearly illustrates this dependency. Note that the relative comparison, as being the lower offer of the two, has a stronger influence on the rejection rate than the absolute amount of the parallel offer. The absolute amount is important as of the previous offer in the repeated ultimata game. Here also the period (with 20 repetitions) remains influential, while the information treatment does not have any significant effect. In both the repeated and the one-shot ultimata game the best model, according to the Akaike information criterion (AIC), results when the amount of the parallel offer is replaced by its relative differences (i.e., the current offer being the lower offer) capturing a kind of "comparative dependency".

**Table 3** Liner mixed effects regression model with the rejection rate as the dependent variable. Estimated regression coefficients of the fixed effects are shown with random effects for subjects (28 in the repeated and 84 in the one-shot ultimatum game) and p-values in brackets. Akaike information criterion (AIC) provided for model comparison.

| | **repeated ultimata game** | | | | | | **one-shot ultimata game** | | |
|---|---|---|---|---|---|---|---|---|---|
| Intercept | 0.9009 | 0.9274 | 0.7488 | 0.7517 | 0.7137 | 0.5962 | 0.72446 | 0.69804 | 0.69887 |
| | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) |
| offer | -0.0448 | -0.0448 | -0.0246 | -0.0246 | -0.0333 | -0.0322 | -0.00200 | -0.00187 | -0.00185 |
| | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) |
| parallel offer | 0.0177 | 0.0178 | 0.0002 | | | | 0.00017 | 0.00003 | |
| | (<0.0001) | (<0.0001) | (0.9504) | | | | (<0.0001) | (0.4979) | |
| lower offer | | | 0.3183 | 0.3192 | 0.3118 | 0.3195 | | 0.06607 | 0.07440 |
| | | | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | | (0.0001) | (<0.0001) |
| period | -0.0079 | -0.0090 | -0.0078 | -0.0078 | -0.0091 | | | | |
| | (0.0045) | (<0.0001) | (<0.0001) | (<0.0001) | (<0.0001) | | | | |
| information | 0.0558 | | | | | | | | |
| | (0.5151) | | | | | | | | |
| period X information | -0.0022 | | | | | | | | |
| | (0.5808) | | | | | | | | |
| previous offer | | | | | 0.0114 | 0.0109 | | | |
| | | | | | (0.0012) | (0.0020) | | | |
| AIC | 1120.8 | 1104.7 | 1000.9 | 989.4 | 946.2 | 953.9 | 2542.4 | 2536.2 | 2516.7 |

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