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A three-person ultimatum game to investigate effects of differences in need, sharing rules and observability on bargaining behaviour *

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This paper describes an extension of the well-known simple two-person ultimatum game. The extended game includes differences between players in their need for the payoffs and it includes a third person who shares with the person who accepts an offer. In addition, this third person may receive information on the identity and decisions of the other players. The experimental procedure is designed to permit collection of multiple observations per participant while minimizing carry-over effects.

From a first, exploratory experiment with this game it is concluded that equity considerations do play a role in this three-person bargaining situation, as players offered 20.3% more than in the typical two-person situation. It further appeared that a receiving person with a higher need allows exploitation by the offering person. Effects were also found for share, need and observability. It is concluded that the experimental procedure employed is a very efficient tool for the study of ultimatum bargaining behaviour.

Ultimatum games typically consist of two persons of whom one, say person P1, receives a certain amount of money. This person P1 then

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has to make an offer of part of this money to the second person, call him or her P2. If the second person, P2, accepts the offer, both keep the money as agreed. If P2 rejects the offer, then the money has to be returned and both P1 and P2 receive nothing.

This simple bargaining situation has been studied extensively (for an overview, see e.g. Thaler 1988; Güth and Tietz 1990). One of the conclusions from these studies has been that players do not behave according to normative game theory. To explain the observed deviations from game theory, or in general, from economic assumptions about rational behaviour, researchers have referred to equity theory (Adams 1965; Berkowitz and Walster 1976). Equity theory states that behaviour in exchange situations is guided by fairness considerations. People compare what they receive out of a certain situation, for example their money payoffs, with other persons' outputs. They also compare their own input, for example the effort, status or money they put into the situation, with other persons' inputs. If inequity is perceived between their own output–input ratio and another person's output–input ratio, people tend to behave in ways that restore equity. In the ultimatum bargaining situation, the economic rational solution (person P1 keeping almost all of the money) would create much inequity. To avoid this inequity P1 is willing to keep less and P2 demands more.

Previous studies of ultimatum games, however, have been limited in several respects. First, to the authors' knowledge, previous studies always have assumed that players have an equal *need* for the payoffs. In contrast, in many real-world bargaining situations players differ in their need for the payoffs. If players know whether the other players have a high(er) or low(er) need for the money, their bargaining behaviour might be substantially different. Predictions for this situation derived from economic assumptions about rational behaviour differ from predictions that may be derived from equity theory. If a person P1, who has to make an offer, knows that P2, who has to decide whether to accept or reject, has a high need for the money, then rationally P1 could keep more for himself than in conditions where P2 has a lower need, because he knows P2 can less afford to reject. However, if fairness considerations, such as are assumed in equity theory, operate, then one would predict the opposite: P1 will keep less for himself if P2 has a higher need for the money because P2 deserves more, and P2 will be less willing to accept that P1 keeps a lot

for himself, because this would create too much inequity. Equally, if P1 has a high need for money, and P2 knows this, then if he behaves rationally, P1 will keep less for himself to reduce the risk of getting nothing. Equity considerations, however, would lead to the prediction that P1 will keep more for himself and that P2 will agree to this.

Another characteristic of the typical ultimatum experiment is that players are assumed to decide independently and only for themselves. In many interesting real-world situations, however, a player not only has to consider his own interests, but also the interests of some third person or group. For example, a person may be a representative of some group, such as a firm. The relationship of the player with this third person or group can vary in several respects. Members of the group may *share* more or less in the payoffs that the person receives from the bargaining situation. Also, the third person or group may more or less have the opportunity to *observe* the decisions that the representative makes. In addition, this third person too may have a high or low *need* for the payoffs. It should be noted that these variables are cornerstones in Principal-Agent theory, which, it has been suggested, explains why firms do not always behave so as to maximize their profits (Holström and Tirole 1987).

These variables may all affect bargaining behaviour in ultimatum situations. First, if P2 has to *share* his payoff with some third person, say P3, and both P1 and P2 know about this sharing, then according to equity theory P1 will keep less for himself and P2 will be more demanding to P1. Supposing all players had equal access or inputs to the situation, then if P2 and P3 have to share equally, that is 50/50, maximum equity can be achieved: P1 can make an offer that results in each of the three players receiving equal payoffs. If, however, the sharing rule is different, for example P2 receiving 10% and P3 90%, or vice versa, then there will always be some inequity. In that case P1 may be less motivated to be generous. P2's demands are also expected to vary: for example if P2 may keep only 10 percent of an accepted offer, then P2 might be more willing to reject offers. This is because then for P2 the opportunity costs of rejection are lower than if he may keep, say, 50 or 90 percent. On the other hand, if P2 has a low share, then P2 may be less involved and may be more tolerant of conditions of unfairness and P2 may therefore be more willing to accept offers. On this argument, if P2 may keep 90% of an accepted offer, then he or she is more involved and less willing to accept. It should be noted

that the situation where P2 may keep 90% comes closest to the simple two-person ultimatum game because the share of P3 is smallest.

Second, whether or not person P3 can *observe* the bargaining behaviour of P1 and P2 may change the behaviour of the players. It has been shown, for example in the study of social dilemma situations (Dawes 1980), that with decreasing anonymity cooperative behaviour increases. We therefore expect that P1 will keep less and that P2 will demand more in conditions where they both know that P3 will be told about their identity and decisions, compared with conditions where each person's identity and decision is kept secret. If, however, both players know that only person P2's identity and decision will be told to person P3, then it is possible for P1 to exploit this 'vulnerability' of P2 by keeping more for himself. If P2 recognizes this vulnerability, then he or she will be less demanding.

Third, the *need* of person P3 for the payoffs could also have its effects on the behaviour of P1 and P2. If equity considerations operate, then, other things equal, the higher the need of P3, the higher the offer of P1 and the higher the demands of P2. If persons behave according to game theory, however, then there should be no effect of the need of P3 on the behaviour of P1 and P2 because P3 has no power to influence outcomes.

A final question of interest is whether there is any difference in the behaviour of players P1 and P2 between situations with and without a third person present to observe and/or share in the accepted offer. Rationally, player P1 could interpret the bargaining situation as a game against some other party and not care whether this party consists of one or of more persons. Equity theory, however, predicts that P1 will keep less for him- or herself when the receiving party consists of more persons. This may be either because P1 cares about equity or because P1 anticipates fairness considerations to play a role in P2's decision.

To explore these research questions an extension of the typical ultimatum game was developed. This extended game includes differences in needs between players and includes a third person (P3), or principal, who shares with P2 (the agent) according to some fixed sharing rule. In this first exploration of this game, need was operationalized by having students from either a Western European or an Eastern European country participate in the experiment, and by telling these players whether they were playing with participants from

East or West. In addition to the need of each of the three players, we varied the amount of information that the third person, P3, received about the identities and decisions of the other players. To test the difference between the typical ultimatum game and the game developed here, the experiment also contained a control condition in which there was no third person.

For reasons of efficiency, multiple observations were collected from each participant. The three-person ultimatum game, however, was framed as much as possible as a set of independent economical transactions between individuals. In the experiment, the games a person played were called 'transaction opportunities'. Each game concerned a transaction with different other participants and each participant was only and always either P1 or P2. In this way, we hoped to minimize carry-over effects between games and to avoid anticipation of changes of roles, which has been shown to increase offers considerably (Güth et al. 1982). Because positions were assigned randomly and were fixed throughout the experiment, and because players were told that some participants had been assigned the role of player P3, all participants' inputs were assumed to be equal across conditions.

Method

Design

The ultimatum game that was developed consists of three persons, P1, P2 and P3, of whom P1 receives money. P1 is only allowed to keep this money if P2 accepts some offer that P1 makes. However, if P2 accepts the offer, then P3 receives a certain fixed share of this offer. For each game, players receive information about whether the other persons in the game are participants who typically have a high need for the money payoff from the experiment, or whether the other persons are participants who typically have a lower need for the money. In some conditions they are told that, after the experiment, P3 will receive information on the real identity, decision and money payoff of players P1 and P2; in other conditions P3 will receive this information only about player P2. For all players, stimuli consist of complete descriptions of each player's bargaining situation.

The experiment reported here was conducted in Linz, Austria, in August 1990. In each game the total sum, that P1 initially received, consisted of 300 Austrian shillings (Ös), which is approximately US$25. Using a $2 \times 2 \times 2 \times 3 \times 3$ factorial design, bargaining situations were varied with respect to P1's need for money (High, Low), P2's need for money (High, Low), P3's need for money (High, Low), the share that P2 gets of an accepted offer (10%, 50%, 90%), and the information that P3 will receive about P1 and P2 (None, Name and decision of P2 only, Names and decisions of both P1 and P2). In addition, three control conditions were created. In the control conditions there was no third person and the other person, whether P1 or P2, could be either someone with a High need for money, someone with a Low need for money, or just Any other participant.

The dependent variables were the amount of money that person P1 chose to keep for himself and for each possible offer of P1 (in discrete steps of Ös30), whether person P2 would accept this offer or not.

Participants and procedure

Twenty-four students from the IAREP summer school on economic psychology volunteered to participate in this study. Twelve of the participants were from various Eastern European (former Soviet bloc) countries. It was known to all participants that these students had little money available, and therefore had a much higher need for money than the other 12 participants, who were from various Western European countries. Therefore, the simple fact whether someone was from an Eastern or from a Western country could be used to operationalize the need factors in the design. Within each of these two groups of 12 participants, 6 were randomly allocated the role of P1 and another 6 were randomly allocated the role of P2. These roles were fixed for the whole of the experiment and participants were informed of this. Thus one factor in the design, either the need of P1 or the need of P2, was treated as a between-subjects factor. The remaining factors were treated as within-subjects factors, resulting in 36 different bargaining situations. These 36 treatments were randomly allocated to three blocks of twelve situations. So, each participant experienced twelve different three-person bargaining situations. In addition, each experienced one of the control conditions, in which

there was no third person. The order of presentation of these thirteen situations was randomized for each participant separately.

All 24 participants joined the experiment simultaneously, but could work individually and at their own speed. Participants first had to fill in their names on coded forms that were then sealed and collected. This allowed us to guarantee a player's anonymity in all conditions except in those where P3 was told the player's identity, decision and payoff after the experiment. It was stressed that the experiment involved real money, which really would be paid, and that anonymity really was guaranteed.

Next, participants had to read a four-page instruction booklet, explaining the rules of the game and containing a worked-out example of one 'transaction opportunity', as the individual games were called in this experiment. For these examples they also had to fill out some questions, that were to be used as manipulation checks. Then came 13 one-page stimuli, each describing a transaction opportunity and asking for the player's response. It was explained in the instructions that the experimenters did not have enough money for all these 13 transaction opportunities to be played for real money and that therefore, afterwards, for each participant one of the 13 would be selected randomly for real payment The instructions explained that persons P2 would give their decisions (accept or reject) for various potential offers of P1 (i.e., eleven equally spaced discrete levels that covered the full range of 0 to 300 Ös; cf. Kahneman al. 1986) and that after the experiment the decision most closely matching the offer of P1 would count as the real decision of P2. This procedure allowed us to have high stakes and should also minimize carry-over effects within participants. The procedure was carried out exactly as it had been described to the participants, except that there were no participants who were assigned to positions P3 only. After the experiment, participants were informed that they had been person P3 in games where other participants had been P1 and P2. Thus, they not only received the payoff from the randomly selected 'own' game, but also the payoff and identity information from a game in which they had been person P3.

Results

All 24 participants filled out their questionnaires completely, and they all answered the control questions correctly. All completed the

questionnaires within 40 minutes. Responses of participants taking the roles of P1 and P2 were analyzed separately. Analysis focused on the amount of money that P1 chose to keep (KEEP), and on the maximum number of shillings that P1 was allowed to keep for himself, according to P2's decisions to accept or reject his offer (MAXACCEPT).

The first step in the analysis tested whether there were any differences between the two-person (control) situations and the three-person bargaining situations. We calculated each participant's mean response across all experimental treatments in which the other player had the same level of need as in this participant's control situation. For participants who received the control condition in which the need level of the other player was unspecified, the mean was taken across all twelve experimental situations. In two-person situations, P1 tried to keep a mean of Ös187.50, while in three-person situations s/he tried to keep Ös155.90; this difference is significant ($t(11) = 2.10$, $p < 0.05$, 1-tailed). P2 allowed P1 to keep at most Ös222.50 in two-person situations and a mean of Ös208.50 across the various three-person situations; this difference is not significant ($t(11) = 1.42$).

An ANOVA was used to test whether there were any effects of the need of either person, but this analysis did not reveal any significant effects.

Next, the responses of P1 and P2 in the different three-person bargaining situations were analyzed with the SPSS MANOVA repeated measures procedure. No significant effects were found, which is not surprising, considering the small sample size.

However, as described in the previous section, the game was designed to minimize carry-over effects. Treating participants as blocks to remove personality and other constant differences between participants, and assuming that treatment-by-participant interactions are negligible, we were able to perform ANOVAs with only main effects.

This showed a significant effect of the share of P2 on the number of shillings that person P1 tried to KEEP ($F(2,125) = 3.98$, $p < 0.05$): P1 kept the least (Ös146.70, which is 48.9% of the total sum) when P2 and P3 had to share equally; P1 kept Ös152.10 (50. 7%) when P2 got 10%; and P1 kept the most (Ös165.60, 55. 2%), when P2 got 90% of an accepted offer. Also, it shows a highly significant effect of the information that P3 received ($F(2,125) = 16.81$, $p < 0.0001$): if P3 received information about P2 only, then P1 kept Ös177.50 (59.2%),

which is more than if the information was about both P1 and P2 (Ös139.40, 46.5%) or none (Ös147.50, 49.2%).

Both these factors also had significant effects on the maximum number of shillings that P1 was allowed to keep, MAXACCEPT. First, the smaller the share of P2, the less P1 was allowed to keep ($F(2,125) = 84.28$, $p < 0.0001$): when P2's share was 90%, then P1 was allowed to keep most (Ös225.60 or 75.2%), when the share was 50%, P1 was allowed to keep less (Ös217.50 or 72.5%), and when the share was 10%, P1 was allowed to keep least, Ös178.50 (59.6%). Secondly, the more information P3 had, the more P2 allowed P1 to keep ($F(2,125) = 63.45$, $p < 0.0001$). When P1 and P2 were both observable, then P2 allowed P1 to keep Ös231.90 (77.3%), which is more than the Ös199.40 (66.5%) allowed when only P2's behaviour was observable by P3, or the Ös190.60 (63.5%) that P1 was allowed to keep when P3 received no information. In addition, there was a significant effect of the need of P2 ($F(1,125) = 69.42$, $p < 0.0001$): when P2 had a high need for the payoff then P2 allowed P1 to keep more (Ös220.40, 74.7%) than when P2 had a lower need, in which case P1 was allowed to keep at most Ös194.20 (64.7%).

Discussion and conclusions

This study investigated an ultimatum bargaining situation where a third person would receive part of the accepted offer. The effects on offers and decisions to reject or accept were explored of the need of the players, the share of the offer that the third person would receive, and the anonymity of the players with respect to a third person, or principal.

The main empirical result from this study is that in conditions where person P2 has to share with some third person, person P1 offers 20.3% (10.5% of the total sum) more to P2 than in conditions where there is no third person. This confirms results from studies on simple ultimatum games that equity considerations do affect the behaviour of players and refutes the prediction from game theory that neither P1 nor P2 care about the presence of a third person if this third person has no power to influence the outcomes. The average offer to P2 in two-person conditions was 37.5% of the total sum, which is consistent with previous studies (Thaler 1988).

In this first, exploratory study, further statistically significant effects were obtained by assuming that the experimental procedure effectively prevented carry-over effects and that observations were independent after blocking for participant effects. The results of these analyses do not unequivocally support equity theory. First, it seems that, while neither the need of the offering person P1, nor the need of the sharing and/or observing person P3 had any effect, the need of the person who has to decide whether to accept (P2) did affect bargaining behaviour. With a higher need for the payoffs this person P2 allowed the offering person P1 to exploit him or her. Next, it can be concluded that the way the receiving persons had to share an accepted offer affected bargaining behaviour. Our prediction from equity theory for person P1 was confirmed: the offering person P1 kept least for him/herself when maximum equity could be achieved because P2 and P3 shared the offered sum equally. Demands of the receiving person P2 decreased with the share of P2. This confirms our hypothesis that lower opportunity costs of rejection lead to higher demands and not our alternative hypothesis that involvement increases with share. Finally, it can be tentatively concluded that the observability of players affected their behaviour. When only the receiving person P2 was observable, then the anonymous other player attempted to exploit this vulnerability by keeping more money. On the other hand, when the offering person P1 could be observed, too, then P2 allowed this person to keep more for him/herself. It is unclear why P2 would behave in this way.

One further observation that should be mentioned was that two participants (both from Western countries) who were person P2 rejected offers from P1 that were highly altruistic. If P1 gave all of the total sum to P2, then these persons P2 rejected the offer, which meant that both got nothing. This observation not only is against all predictions from game theory, but it also confirms our impression that participants were highly involved in the game and that they were really concerned about the differences in need between participants. In practice these responses had no effect because no person P1 made such high offers.

We conclude that the experimental method that was explored here proved to be highly efficient and easy to administer, while allowing a high level of experimental control and creating an involving situation in which participants played for real money. However, further re-

search is needed to investigate the effects that were observed in this study. Such research should focus first on the stability of the effects observed here, using larger samples of participants, preferably from a different population, and using designs that allow one to test for interaction effects. Perceptions of equity should also be measured in future experiments. A further interesting topic would be to study the difference between conditions with chance allocation of the roles P1 and P2, as in the current experiment, and conditions where people first earn the right to play as either P1 or P2. In a study by Hoffman and Spitzer (1985) this procedure has been found to change behaviour considerably. The positions for P1 and P2 could, for example, be auctioned, as suggested by Güth and Tietz (1986). But there are also many other factors that are of interest to the study of bargaining behaviour that easily could be investigated with this kind of extension of the simple ultimatum game.

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