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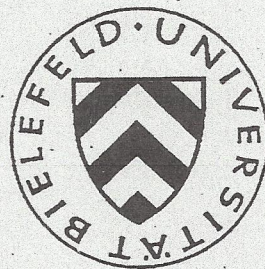
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Connection Between Ultimatum Behavior and Reciprocity in a Combined Ultimatum-Reciprocity Game

by

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Abstract

In a combined ultimatum-reciprocity game the relation between negative and positive reciprocity has been examined. In the combined game first an ultimatum game was played. After accepting the proposal a reciprocity game was played: player 2 could select between the two alternatives with payoffs to player 1 and player 2. The connection between the proposal in the ultimatum game and the reciprocal behavior in a reciprocity game have been studied. The experimental results are that the minimal amount of money accepted in the ultimatum (sub-)game does not differ significantly from the minimal amount accepted in the ultimatum game (without reciprocity game) and that the division of the total amount in the combined game is the sum of the division in the ultimatum game and the division in the pure reciprocity game.

Introduction

Reciprocity is characterized (K.A. McCabe, S.J. Rasenti and V.L. Smith, 1996) as "a specialized mental algorithm (L. Cosmides 1985; L. Cosmides, J. Tooby, 1992) in which long term self interest is best served by promoting an image both to others and yourself that cheating on cooperative social exchange (either explicit or implicit) is punished (negative reciprocity), and initiation of cooperative social exchange is rewarded (positive reciprocity)." This behavior is also observed in single games. The number of players that initiate cooperation increases if it is possible to punish and their own cost of punishment is not too high.

Negative reciprocity has been observed in ultimatum games (for a review of ultimatum bargaining and experiments on ultimatum bargaining see W. Güth, R. Tietz 1990; C. Camerer, R.H. Thaler 1995; A.E. Roth 1995).

Positive reciprocity has been examined in a lot of studies, for example in the gift exchange experiment (J. Berg, J. Dickhaut, K.A. McCabe, 1995) or similar games (W. Güth, P. Ockenfels, M. Wendel, 1994; F. Bolle 1995; M. Dufwenberg, U. Gneezy, 1996; E. Jacobsen, A. Sadrieh, 1996, B. Vogt 1998), comparable games in the labor market context (E. Fehr, G. Kirchsteiger, A. Riedl, 1993) or games in extensive form (K.A. McCabe, S.J. Rasenti and V.L. Smith, 1996).

The question addressed in this paper concerns the relation between negative and positive reciprocity. If a subject decides not to show negative reciprocal behavior does this imply that he will show positive reciprocal behavior? In an ultimatum game the responder can react by rejecting a too low offer which is interpreted as showing negative reciprocal behavior. Does accepting this offer mean that the subject will show positive reciprocal behavior in an additional decision after accepting the offer or has an additional initiation of cooperation to be performed by the proposer? Does being fair in one situation imply fairness in other situations? The cost of the punishment (the rejection) is also considered. To examine these questions the game DUR described in the next section has been examined experimentally.

The paper is organized as follows. First the game is described. Then the hypotheses tested in the combined ultimatum-reciprocity game are given. In the next part the experiment is described. Finally the results are shown and discussed.

Games

The combined ultimatum-reciprocity game consists of several parts. One part is an ultimatum game in which player 1 could make a proposal how to divide 100. This game was played to compare these results with the results of the combined game. The reciprocity game of the combined game (analyzed in B. Vogt 1998) is shown in figure 1 and figure 2.

In figure 1 a reciprocity game called an SR (side-payment - reciprocity) game is shown. In this game player 1 can give a side-payment S ($0 \leq S$) to player 2. Player 2 decides afterwards between two alternatives with payoffs to player 1 and player 2[1]. In this game the total payoff pairs are (-S+0,+S+20) or (-S+50,+S+10) depending on the selection of player 2.

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[1] In all games the payoff of the players is the sum of all payoffs given by the vectors in the rectangles along the path determined by their decisions different to the extensive form of a game.

Figure 1: The game SR (side-payment - reciprocity)

Game SR
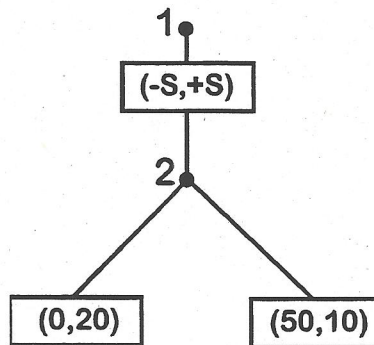
Player 1 prefers the alternative with the payoffs (50,10), because his payoff is higher than in the alternative with the payoffs (0,20). (50,10) is called the cooperative alternative (c_1,c_2) and (0,20) is called the egoistic alternative $(0,e_2)$. In the subgame perfect equilibrium player 2 selects the egoistic alternative with payoffs (0,20) independently of the side-payment of player 1, because he receives the side-payment independently of the alternative he selects and his payoff is higher if he selects the egoistic alternative. Therefore player 1 selects S=0 in the subgame perfect equilibrium. Selecting the cooperative alternative (50,10) with a higher payoff sum might be possible if player 1 induces reciprocity by giving the "right side-payment S" and player 2 reacts reciprocally. Neglecting the side-payment this kind of cooperation causes an improvement in the payoff of player 1 from 0 to 50 and a deterioration in payoff of player 2 from 20 to 10 (which is also the incentive to deviate from the reciprocal behavior). The side-payment has to account for these differences.

The inclusion of a destruction move as the first move of player 1 results in the game DSR (destruction move - side-payment - reciprocity) shown in figure 2. Player 1 can decide to modify the payoffs of player 2 in the egoistic alternative from 20 to 0. The cost k of this modification is k=-2. Player 2 does not know whether player 1 has

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modified the game when receiving the side-payment and when deciding between the two alternatives. Selecting the egoistic alternative which is non reciprocal in game SR and game DSR might have negative consequences (might result in a lower payoff).

Figure 2: The game DSR (destruction move - side-payment - reciprocity)

Game DSR
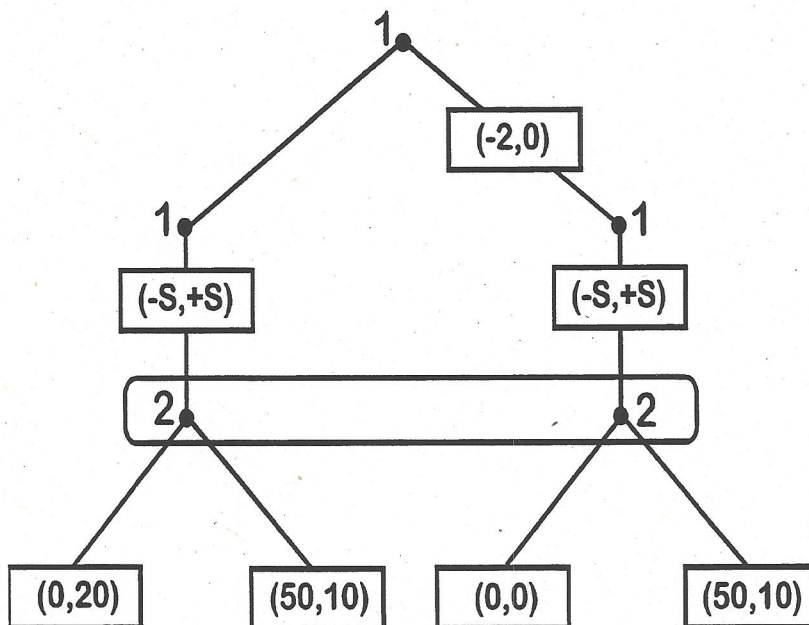
The subgame perfect equilibrium of this game is that player 1 selects k=0 and S=0 and that player 2 selects the egoistic alternative $(0, e_2)$. Player 1 can always improve his payoff by not modifying, because modifying effects only the payoff of player 2. If player 1 does not modify the side-payment is S=0 and player 2 selects the alternative $(0, e_2)$. The cooperative choice is (c_1, c_2).

In a reciprocity game high side-payments might induce cooperation and player 2 might show positive reciprocity. A somehow reversed situation is the ultimatum game. In this game the responder can react to small proposals by rejecting them. This behavior is interpreted as negative reciprocity (although the cost of rejecting a small proposal is lower than the cost of rejecting a higher proposal). In both cases reactions on proposed fair divisions of money occur. To examine the connection between these two situations a combined ultimatum-reciprocity game was played. The game is shown in figure 3. It can be explained by a comparison with figure 2. The side-payment in the game DSR (in figure 2) is replaced by an ultimatum game in the game DUR (destruction move - ultimatum - reciprocity) in figure 3. Player 1 makes a proposal $(p, 100-p)$ (with $0 \leq p \leq 100$) which is a division of 100. If player 2 rejects this proposal both receive 0. If player 2 accepts the proposal the payoff is $(p, 100-p)$ and player 2 decides between two payoff pairs $(0, 20)$ or $(50, 10)$. Player 1 can only transfer money to player 2 by the ultimatum proposal. After accepting the proposal player 2 can decide between two alternatives.

The subgame perfect equilibrium is given by $k=0$ and $p=100$ as strategy selections of player 1 and accepting the proposal and selecting the egoistic alternative as strategy selections of player 2.

The questions connected with this game are: How is a fair division of the total amount of money obtained and how does the possible additional payoff of player 2 (of 20) after accepting the proposal influence the minimal amount accepted? The cost of rejecting a proposal is increased. Does this lower the minimal amount accepted?

Figure 3: The game DUR (<u>d</u>estruction move - <u>u</u>ltimatum - <u>r</u>eciprocity)

Game DUR
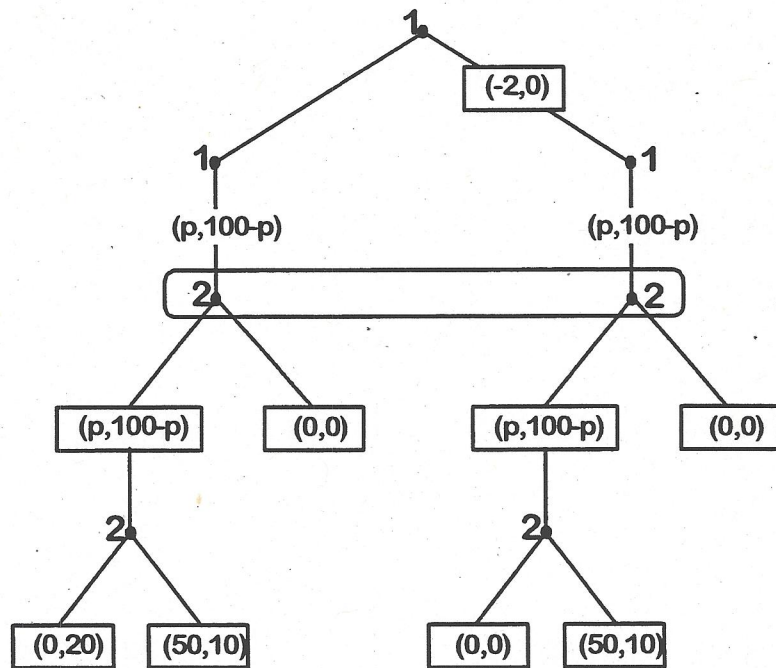
Possible divisions in the combined ultimatum-reciprocity game

In this part the hypotheses which will be tested by the experiment are derived. The first main point concerns the minimal amount (of money) accepted by player 2 in the ultimatum (sub-)game (hypothesis 1a and hypothesis 1b). The second main point concerns the minimal amount necessary to select the cooperate alternative (c_1, c_2) (hypothesis 2a and hypothesis 2b) after accepting the proposal.

The following questions are examined concerning the minimal amount accepted. Is the behavior different in the ultimatum game if a reciprocity game is played afterwards? The possibility of player 2 to get an additional payoff after accepting the proposal (he can select between $(0, e_2)$ and (c_1, c_2)) might influence the minimal amount accepted. It should lower the minimal amount accepted because player 2 receives money in addition. A second possibility is that nothing changes. The division in the ultimatum game is independent from the reciprocity game. The hypotheses are:

Hypothesis 1a:

A division is fair or unfair independent of the context, i.e. the minimal amount accepted in the ultimatum-reciprocity game $(100-p)_{DUR}$ is the same as in an ultimatum game $(100-p)_U$: $(100-p)_U = (100-p)_{DUR}$.

Hypothesis 1b:

The rejection level is given by the cost of rejection, i.e. the minimal amount accepted is 20 (the payoff for the egoistic alternative in the reciprocity game) lower than in an ultimatum game without the possibility to select between two alternatives afterwards: $(100-p)_U - 20 = (100-p)_{DUR}$.

Concerning the minimal amount necessary to select the cooperate alternative (c_1, c_2) the following questions are studied. Does being fair in the ultimatum game as player 1 not only cause an acceptance of the proposal, but also result in a positive reciprocal

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behavior of player 2 in the reciprocity game? Or has the proposal to reflect the payoffs necessary to avoid negative reciprocal behavior in the ultimatum game and to obtain a positive reciprocal behavior of player 2 in the reciprocity game? An answer to this question should be obtained by looking at the division of the total amount that can be obtained. The division of the total amount might be the sum of the divisions in the ultimatum game and in the reciprocity game. The division might also be determined by the fair division in the ultimatum game, because player 2 might show reciprocal behavior if he accepts the proposal in the ultimatum game. The hypotheses are:

Hypothesis 2a:

The minimal amount $(100-p)_U$ accepted by player 2 in the ultimatum game and minimal side-payment S_{DSR} necessary to select the cooperative alternative (c_1, c_2) in the reciprocity game are added in the combined ultimatum-reciprocity game to the minimal amount $(100-p)_{DUR}^C$ necessary to accept the proposal and to select (c_1, c_2):

$$(100-p)_{DUR}^C = (100-p)_U + S_{DSR}$$

Hypothesis 2b:

A high proposal in the ultimatum game itself induces reciprocity. An additional side-payment is not necessary, i.e. the minimal amount necessary to select the cooperative alternative (c_1, c_2) is the same as the minimal amount accepted in the standard ultimatum game: $(100-p)_{DUR}^C = (100-p)_U$

Experiment

In the experiment the game DUR and an ultimatum game were played to test the hypotheses.

The payoffs

The players received points as their payoffs. The worth of 1 point was 0.5 DM (~$.33). Losses up to 100 DM (~$66) had to be paid by the subjects.

The subjects

The subjects were 32 students. They were divided in 4 groups of 8 subjects.

Communication

Free preplay communication via terminals was possible.

Experimental performance

In part 1 of the experiment single games were played in 4 groups of 8 subjects with free preplay communication between 2 players[2].

In part 2 a strategy game was played. All subjects selected their strategies for all games and all roles (player 1 and player 2). One game was paid per type of game and per person. Subjects were assigned to each other randomly.

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[2] In the single games the payoff of one subject was the difference of his payoff to the mean payoff of the other subjects not in his group and playing the same role.

The strategies for the games were given as:

Ultimatum game: as **player 1**: a proposal p_U.

as **player 2**: a minimal amount **(100-p)$_U$** accepted.

Game DUR: as **player 1**: a proposal p_{DUR}.

as **player 2**: a minimal amount **(100-p)** $_{DUR}$ accepted.

as **player 2**: a minimal amount $(100-p)^c_{DUR}$

necessary to select (c_1, c_2).

Results of the strategy game

The results concerning the questions whether the minimal amount accepted in the game DUR is the same as in the standard ultimatum game are shown in figure 4. The medians of the minimal amounts accepted in the combined game $((100-p)_{DUR})$ and in the ultimatum game $((100-p)_U)$ are presented in the figure.

Figure 4: Medians of the minimal amounts accepted by player 2

	$(100-p)_U$	$(100-p)_{DUR}$
group 1	32.5	30
group 2	40	40
group 3	47.5	45
group 4	40	45

Hypotheses 1b ($(100-p)_U-20=(100-p)_{DUR}$) is rejected by a binomial test. For every subject and the minimal amount accepted it holds $(100-p)_U-20<(100-p)_{DUR}$. Assuming independence of all subjects this result holds on the 1% level.

Hypotheses 1a ($(100-p)_U=(100-p)_{DUR}$) is not rejected.

In a binomial test with $\alpha=30\%$ the hypotheses is not rejected. This is certainly not a test, but gives hints for the validity of the result.

Hypotheses 1a seems to be the best predictor for the data. The minimal amount accepted in the combined game is the same as in the standard ultimatum game and seems to be influenced by fairness considerations for this situation only.

The results concerning the question whether the division in the combined game is given by the added divisions of the single games are shown in figure 5. $(100-p)_{DUR}^C$ denotes the minimal amount necessary to select (c_1,c_2), $(100-p)_U$ is the minimal amount accepted in the ultimatum game and S_{DSR} denotes the side-payment in the corresponding reciprocity game DSR (with k=-2) (from B. Vogt 1998).

Figure 5: Medians of minimal amount necessary to select (c_1,c_2)

	$(100-p)_U$	$(100-p)_{DUR}^C$	Difference
group 1	32.5	45	12.5
group 2	40	65	25
group 3	47.5	60	12.5
group 4	40	68.5	28.5

side-payment S_{DSR}[3]:   20

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[3] The value of side-payment is taken from (B. Vogt, 1998). This value is the best predictor for the side-payment in game DSR.

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Hypotheses 2b ($(100-p)_{DUR}^{C} = (100-p)_U$) is rejected by a binomial test. For every subject it holds $(100-p)_{DUR}^{C} > (100-p)_U$. Assuming independence of all subjects this result holds on the 1% level.

Hypotheses 2a ($(100-p)_{DUR}^{C} = (100-p)_U + S_{DSR}$) is not rejected and is the best predictor for the data. The difference between the minimal amount accepted and the minimal amount necessary to select (c_1, c_2) varies around 20 which is the side-payment in the reciprocity game.

A comparison of the minimal amount $(100-p)_{DUR}$ accepted in game DUR (in figure 4) and the minimal amount necessary to cooperate $(100-p)_{DUR}^{C}$ in game DUR shows that the differences are between 15 and 23.5 which are even nearer to 20 than the differences in figure 5. This gives further support to the interpretation that an additional amount of 20 is needed to select the cooperative alternative.

What amount did the subjects propose as player 1? All subjects proposed an amount that was higher or equal to their minimal amount necessary to select the cooperative solution as player 2. As player 1 the subjects intended to establish the cooperative solution.

It seems that the fair division in the combined game is the sum of the divisions in the single games and that most subjects intend to establish this division. Being fair in one game does not cause a reciprocal behavior in the other game.

Conclusions

In this paper a combined ultimatum-reciprocity game has been analyzed. In the combined ultimatum-reciprocity game one question concerned the minimal amount of money accepted in the ultimatum (sub-)game and in the ultimatum game (without reciprocity game). Does the possibility of the responder to obtain an additional payment in the reciprocity game influence the minimal amount accepted? In the experiment the minimal amount accepted in the ultimatum (sub-)game does not differ significantly from the minimal amount accepted in the ultimatum game (without reciprocity game).

Another question was whether the division of the total amount in the combined game is the sum of the division in the ultimatum game and the division in the reciprocity game. The experimental data support that the division in the combined game is the sum of the divisions in the single games. As player 1 the subjects try to establish this cooperative solution.

The result of this experiment is that the amount of money which is necessary to obtain positive reciprocal behavior in the reciprocity game and to avoid negative reciprocal behavior in the ultimatum game are added up in a combined game to determine its outcome.

References

K. Abbink, G.E. Bolton, A. Sadrieh, Fang-Fang Tang (1996): Adaptive learning versus punishment in ultimatum bargaining, SFB 303 Dicussion paper B-381, University of Bonn

J. Berg, J. Dickhaut, K.A. McCabe (1995): Trust, reciprocity and social history; Games and economic behavior 10, 122-142

F. Bolle (1995): Rewarding trust, An Experimental study, Diskussionspapier 15/95 Europa-Universität Viadrina, Frankfurt (Oder)

G. Bolton, R. Zwick (1995): Anonymity versus punishment in ultimatum bargaining, Games and economic behavior 10, 95-121

C. Camerer, R.H. Thaler (1995): Anomalies - ultimatums, dictators and manners, Journal of economic perspectives 9, 209-219

L. Cosmides (1985): The logic of social exchange: Has natural selection shaped how humans reason? Studies with the Wason selection task, Cognition 31, 187-276

L. Cosmides, J. Tooby (1992): The Adapted Mind

M. Dufwenberg, U. Gneezy (1996): Efficiency, reciprocity and expectations in an experimental game, mimeo

E. Fehr, G. Kirchsteiger, A. Riedl (1993): Does fairness prevent market clearing? An experimental investigation, Quarterly journal of economics 108, 437-460

W. Güth, R. Tietz (1990): Ultimatum bargaining behavior - a survey and comparison of experimental results, Journal of economic psychology 11, 417-449

W. Güth, P. Ockenfels, M. Wendel (1994): Cooperation based on trust. An experimental investigation. Discussion paper, University of Frankfurt/Main

E. Jacobsen, A. Sadrieh (1996): Experimental proof for the motivational importance of reciprocity, SFB 303 Dicussion paper B-386, University of Bonn

K.A. McCabe, S.J. Rasenti, V.L. Smith (1996): Game theory and reciprocity in some extensive form games, Tucson

A.E. Roth (1995): Bargaining experiments, in The Handbook of Experimental Economics, J.H. Kagel and A.E. Roth (eds.), Princeton University Press, 253-348

B. Vogt (1998): The strength of reciprocity in a reciprocity game, IMW-working paper 279, Bielefeld