Efficiency, Reciprocity and Expectations in an Experimental Game

Dufwenberg, M.; Gneezy, U.

Publication date:
1996

Citation for published version (APA):
Dufwenberg, M., & Gneezy, U. (1996). *Efficiency, Reciprocity and Expectations in an Experimental Game*. (CentER Discussion Paper; Vol. 1996-79). Microeconomics.

Efficiency, Reciprocity, and Expectations in an Experimental Game[*]

Martin Dufwenberg & Uri Gneezy[**]

September 1996

ABSTRACT:

We experimentally investigate the nature of strategic interaction in a 2-player game. Player 1 may take x Dutch guilders (ƒ x) and end the game (player 2 then gets ƒ 0), or let player 2 split ƒ 20 between the players. x is a treatment variable taking values of ƒ 4, 7, 10, 13, and 16.

We find that most players 2 "give away" positive amounts (ƒ6 on average), but their choices are independent of x. We explicitly measure the players' beliefs and find that many players 1 expect to get back no more than ƒ x but nevertheless let player 2 split the ƒ 20, and that the behavior by the players 2 is consistent with a theory of a guilt based on psychological game theory.

---

[*] We thank Eric van Damme for his advice, Gary Bolton, Doug DeJong, Werner Güth, Jos Jansen, Jan Potters, Ariel Rubinstein, and Oded Stark for helpful suggestions, seminar participants in Oslo for a stimulating discussion, and Jos Jansen and Wim Koevoets for assistance during the experimental sessions. Dufwenberg gratefully acknowledges financial support from the European Union's HCM-Network project "Games and Markets", organized by Helmut Bester.

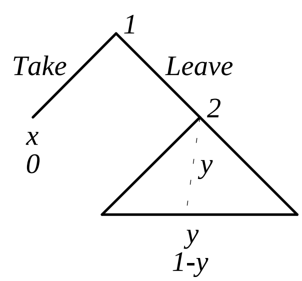
[**] CentER for Economic Research, Tilburg University, P.O. Box 90153, 5000 LE Tilburg. +31-13-4663262 (MD), +31-13-4662718 (UG), +31-13-4663066 (fax), martin.dufwenberg@kub.nl, gneezy@kub.nl (e-mails).

I. INTRODUCTION

Suppose you find a wallet in the street. No one sees you. The wallet contains money, and some other stuff which is of apparent value to the owner but of no use to you. You can either keep the wallet for yourself, or bring it to a nearby police station for the owner to pick up. The police will routinely register your name, and subsequently ask the wallet owner to reimburse you in the amount he considers appropriate. What would you do?

It is commonly assumed in economics that people are motivated only by material, self-centered concerns. In the above situation such an assumption leads to an inefficient outcome. The owner will not reimburse the finder if he picks his wallet up at the police station. The finder figures this out and simply keeps the wallet. *Both* these persons would prefer that the owner gets back the wallet and reimburses the finder sufficiently.

By contrast, experimental evidence suggests that, when humans interact, various non-material considerations often become relevant. In some cases these may eliminate inefficiency. To address related issues, we experimentally investigate the nature of strategic behavior in a sequential game which may be thought of as a "lost wallet game" because in a sense it models the above situation.[1] Formally, we refer to the game as $\Gamma(x)$, and in the benchmark version *only* monetary payoffs are indicated:



$\Gamma(x)$

In $\Gamma(x)$, $x \in (0,1)$ is exogenously given and $y \in [0,1]$ is an object of choice for player 2. The game starts with player 1 choosing *Take* or *Leave*. If he chooses *Take* the game ends and the

[1] The monetary payoffs of $\Gamma(x)$ qualitatively match the payoff related to the wallet's contents. Of course, if additional non-material concerns are payoff relevant these need not be identical in the two cases. Nevertheless we find the comparison intriguing, and we thank Tone Ognedal for suggesting it.

payoffs are x and 0 to player 1 and player 2 respectively. If 1 chooses *Leave*, then 2 is called upon to move. 2 chooses $y\in[0,1]$ and the subsequent payoffs are y and $1-y$. If the monetary payoffs coincide with the players' real payoffs, then clearly if 2 is called upon to move she should choose $y=0$. If 1 figures this out he should choose *Take* at the root. This outcome is inefficient since if 1 chooses *Leave* and 2 chooses y such that $x<y<1$, then a payoff vector will be realized which is better for both players.

We let subjects engage in anonymous, one-shot plays of an experimental game corresponding to $\Gamma(x)$. The monetary value of the unit pie to be split by player 2 is held fixed at 20 Dutch guilders (*f* 20).[2] We use x as the (only) treatment variable taking values of *f* 4, 7, 10, 13, and 16. We want to draw conclusions about the *motivations* behind the subjects behavior and therefore explicitly measure some of the players' beliefs about one another's actions and beliefs. We do this by asking the subjects to make certain guesses about other subject choices or guesses, rewarding them for accuracy (see Appendix 3).

The hypotheses we test relate to issues of *efficiency* (in monetary values), *reciprocity*, and *guilt*. We now discuss these issues in turn. An efficient outcome obtains if and only if 1 chooses *Leave*. We investigate whether 1's propensity to choose *Leave* depends on x, and test the hypothesis that efficiency is achieved only when player 1 expects to earn more than x.

We say that player 2 is affected by reciprocity considerations if she chooses $y>0$ *because* she feels that 1 is "nice" by choosing *Leave* and she then has a preference for being "nice in return". One might argue that the higher is x, the nicer is 1 by choosing *Leave* since the potential loss he may incur by doing so is higher. We expect an effect of this kind to motivate the subjects in their decision making and that therefore y is positively correlated with x. We test, and expect to reject, the alternative hypothesis of no correlation between x and y.

Player 2 may choose $y>0$ also for reasons not related to reciprocity. We investigate specifically whether 2 has some preference for "not letting 1 down", in the sense that she feels *guilty* if she chooses y "too low" relative to what she believes that 1 expects to get back. Player 2 does not know 1's expectation of y, but we measure her expectation of 1's

[2] At the time of the experiment (March 1996) 20 Dutch guilder was worth approximately 12 US dollars.

expectation of y (conditional on 1 choosing *Leave*) and test the hypothesis that this second-order expectation is positively correlated with y.

Note that if such an effect is relevant this indicates that 2's subjectively perceived payoff depends not only on what strategy profile is implemented (as in standard game theory) but also on her beliefs. Psychological game theory (Geanakoplos, Pearce & Stacchetti, 1989) offers a framework for formalizing such effects. We devote some attention below (Section IV.C) to discussing whether our results can be interpreted from that perspective, and if so how.

We now compare our approach to some related literature: $\Gamma(x)$ is related to the *Dictator game* in which one player decides how to divide a unit of payoff between himself and another (dummy) player. The subgame of $\Gamma(x)$ where 2 moves, considered in isolation, has precisely such a structure. One perspective one might have on our study is that we investigate the potential importance of some non-pecuniary concerns that arise due to a choice that *precedes* a dictator subgame.[3] When the Dictator game is tested in experiments, with monetary payoffs controlled, "the dictator" quite often gives away more than zero, which is typically explained with reference to altruism or fairness considerations (see Davis & Holt 1993, pp 263–9 for a discussion). We suspect that 2's behavior will be affected by similar concerns in $\Gamma(x)$, but that in addition it may matter that whether 2's subgame is reached or not is at 1's discretion.

Berg, Dickhaut, & McCabe (1995) analyze a "trust game" which shares many features with $\Gamma(x)$: Player 1 is given a sum of money. He chooses how much to keep and "sends" the rest to player 2. The amount sent is tripled and given to player 2 who chooses how much to "send back".[4] Bolle (1995) reports from an experiment involving a game which resembles

[3] This is in contrast to the *Ultimatum game*, in which an action is added that *succeeds* a proposed dictator division. In the Ultimatum game the "other" player gets to accept or reject the proposed split, and in the latter case, each player gets a zero payoff. The Ultimatum game invokes a feature of *potential revenge*; the responder may punish the divider if he feels he is being treated unfair. See Camerer & Thaler (1995) and Güth (1995) for detailed discussions. See Güth & van Damme (1994) for a report on an experiment on a game which incorporates essential elements of *both* the Dictator and the Ultimatum game.

[4] $\Gamma(x)$ can be related to Berg *et al*'s game as follows: In $\Gamma(x)$ player 1 is given a certain amount (x) of money. He then chooses to send all or nothing to player 2. For any $x>0$, the amount sent is then multiplied by the factor $1/x$ and given to player 2 who then makes a choice on how much money to "send back" to player 1. $\Gamma(x)$

$\Gamma(x)$, except that an element of chance was added. A lottery was conducted to select four out of the 64 experimental games that were played, and *only* the subjects acting in these games were rewarded according to their decisions.[5] Bolle set x=½ and did not consider the effect of changing x. In both of these studies, most subjects did not behave according to the subgame perfect equilibrium with only self-interested material considerations affecting payoffs.[6]

In closing this introduction we emphasize that perhaps the most crucial feature of our study is that we measure some of the players' expectations. This allows us to draw some inferences regarding the players motivations, and to tie our findings explicitly to ideas from psychological game theory.[7] Psychological game theory enriches the scope of the strategic analysis by allowing emotional considerations (in our case guilt) to affect strategic decision making. Berg *et al* (1995, p139) stress the importance of using ideas of this type to explain experimental findings.

Section II explains the experimental procedure. Section III presents the hypothesis we test, and the experimental results. Section IV contains a discussion of our main findings. Appendices 1-3 contain the subjects' instructions.

II. Experimental Procedure

The subjects were recruited via an ad in the weekly students' newspaper at Tilburg University and via posters on campus. These announcements invited subjects to come to our offices and "sign up" for an economic experiment on decision making. We indicated that the subjects' earnings would depend on these decisions, and approximately how much money was at stake.

---

may be viewed as more general than Berg *et al*'s game in allowing not only x=1/3, and more special in not allowing player 1 to send intermediate amounts.

[5] See Bolle (1990) for a discussion of whether such a set-up skews incentives relative to the case where all subjects are paid.

[6] Several other authors have conducted experimental studies in which aspects of efficiency and reciprocity are key features. See e.g. Fehr, Kirchsteiger, & Riedl (1993), Fehr, Gächter & Kirchsteiger (1995), Güth, Ockenfels & Wendel (1994), van der Heijden, Nelissen, Potters, & Verbon (1996), and McKelvey & Palfrey (1992). However, these experiments are relatively less closely related to ours (various real world market institutions are mimicked, there is no "Dictator subgame", or there are more stages).

[7] Bolle (1995) measures something similar to *1's expectation of y*, but not *2's expectation of 1's expectation of y* which turns out to be the crucial expectation from a psychological games perspective.

In total we had 5 sessions, with 12 different pairs of students in each. *x* was fixed within a session and was changed between sessions to Dutch guilders (*f*) 4, 7, 10, 13, 16. For each session we had invited 13 subjects to Room A, 13 subjects to Room B, and 4 extra subjects to a third room to cover for no-shows. After filling Rooms A and B with 13 subjects (using subjects from the third room room if necessary) these where given an "Introduction" (see Appendix 1). Then, they took an envelope at random. In each room, 12 envelopes contained 12 different numbers (A1,..,A12 in Room A and B1,..,B12 in Room B). These numbers were called "registration numbers". One envelope was labeled "Monitor", and determined who was the person who checked that we do not cheat. That person was paid the average of all other subjects participating in that session. After opening the envelopes the second part of the instruction was distributed (see Appendix 2). At this point it was stressed by the experimenter that this game will be played only once.

Subjects in Room A read the instruction for this part (see Appendix 2.). They were then asked to go to the experimenter, one at a time. They got an envelope with *fx* in it, and then had to go behind a curtain. Over there they had to decide whether to take the money out of the envelope or not. Then to write their registration number on a note, to put this note in the envelope, and to put the envelope in a box near the experimenter.

Subjects in Room B also read the instructions for this part (see Appendix 2). They were asked to write down how much they would give to their anonymous counterpart in Room A (i.e. to choose *y*), conditional on him/her choosing to leave the *fx* in the envelope.[8] The subjects' choices, sealed in envelopes, were put in a box near the experimenter.

---

[8] Note that we ask the players to report *strategies*; each player makes one choice for each information set he possesses. The advantage of this approach is that the experimenter can record behavior at all information sets, whether these are being reached or not. However, we note that since a player is not faced with the *fait accompli* of reaching a certain information set, and this may affect his behavior. See Roth (1995, pp322-3) for a discussion. The idea of asking for strategies in experiments goes back to Selten (1967). It has recently been used for example by Mitzkewitz & Nagel (1993). Investigating to what extent behavior is affected by the strategy method may be an interesting topic for future research.

Then part 2 started. The subjects in Room A received new instructions (see Appendix 3, also for the incentive scheme used) in which they were asked to guess the average *y* chosen by subjects in Room B at part 1.[9]

The participants in Room B also received new instructions (see Appendix 3), in which they were asked to guess the average guess of the subjects in Room A who chose to leave the money in the envelope in part 1. Meanwhile, an experimenter and the two monitors checked and recorded the envelopes of Room A, and matched them each with an envelope from Room B (as described in the instructions). In the end, all the payoffs from part 1 and 2 were calculated and the subjects were paid.[10]

III. HYPOTHESES AND RESULTS

We now present the hypotheses we test and report on our experimental findings. The raw data is given in Tables 1 and 2.

[Insert Tables 1 and 2 here]

The following two hypotheses should find support if subjects behave according to the "classical solution" (subgame perfect equilibrium when each player's payoff depends only on his monetary reward):

H_0: All players 1 choose *Take*

---

[9] We want to measure 1's expectation of the *y* chosen by his *co-player*, but nevertheless ask 1 to guess the *average* choice of *y* in the whole session. We believe this creates a superior measure. Say, for example, that a subject believes that the co-player will choose *y*=0 with probability ½ and otherwise choose *y*=*f*10. Such a subject has an expectation of *f*5. With the incentive scheme we use he should indeed guess *f*5. Had we asked him to guess his co-players choice he should guess either *f*0 or *f*10, however.

[10] Note that while the interacting subjects were anonymous to each other, they were not anonymous vis-à-vis the experimenter. Hoffman, McCabe, Shachat, & Smith (1994) report experimental evidence to the effect that if subjects are anonymous also vis-à-vis the experimenter non-monetary concerns will become less important than otherwise. However, a subsequent study by Bolton & Zwick (1995) suggests that while there is some truth to this claim, the differences are rather small and qualitatively results do not differ so much. See Roth (1995, pp 298-302) for further discussion.

H_1: All players 2 choose y=0

Recall that twelve different pairs of subjects interacted in each treatment. Table 3 summarizes for each treatment how many subjects behaved according to the classical solution, and in how many games the classical solution was played (e.g: in the *f*4 treatment, none out of the twelve players 1 chose *Take*. In the *f*16 treatment, the classical profile (*Take, y*=0) was played in two out of twelve games).

	f **4**	***f*** **7**	***f*** **10**	***f*** **13**	***f*** **16**
# of *Take*	0	6	4	8	11
# of *y*=0	1	4	2	2	3
# of (*Take, y*=0)	0	3	0	2	2

TABLE 3: Number of choices made according to the classical solution in each treatment.

It is clear by inspection of the table that the hypotheses H_0 and H_1 do not find much support. Note also that the classical solution was implemented in only 7 (=0+3+0+2+2) out of the 60 games that were played.

An interesting additional observation is that the proportion of efficient outcomes (1 chooses *Leave*) is (apart from the *f*7 treatment) decreasing in *x*. We find this result quite intuitive, since the potential loss that 1 may experience by choosing *Leave* is increasing in *x*.

Next we investigate whether monetary efficiency is achieved only when player 1 expects to earn more than *x*. We use "more than" rather then "no less than" because the slightest degree of risk aversion would make a player choose *Take* when his expectation of *y* equals *x*. The procedure for measuring the subjects expectations is described in Section II.

H_2: 1 chooses *Leave* only if 1's expectation of *y* is higher than *x*.

The relevant data are summarized in Table 4:

	*f*4	*f*7	*f*10	*f*13	*f*16
# of *Leave* choices (efficent outcomes)	12	6	8	4	1
# of *Leave* choices by players who expect to get back more than *x*	11	2	0	0	1

TABLE 4: Efficiency and H_2.

In the *f*4 treatment every player 1 chose *Leave* and in all except one case the player expected to get back more than *x*, so H_2 was violated in only one out of twelve cases. In the *f*16 treatment we have only one observation, which is in line with H_2. However, in the *f*7, 10, and 13 treatments H_2 finds little support. It seems that not only material self-interest motivates many players 1 in their decison making. We comment further on this finding in section IV.A.

The next hypothesis concerns an aspect of reciprocal behavior by player 2. If she considers 1 to be "nice" when he chooses *Leave*, then she may want to reward player 1 by an appropriate choice of $y>0$. We find it reasonable to argue that the higher is *x*, the "nicer" is player 1 by choosing *Leave*. If player 2 argues the same way, and if she has a preference for reciprocating or responding in kind, then 2's preferred choice of *y* may depend positively on the size of *x*. We expect an effect of this kind to motivate subjects in making their choices. Therefore we expect to find positive correlation between *x* and player 2's choice of *y*. That is, we test the following hypothesis which we expect to be able to reject:

H_3: *y* and *x* are uncorrelated.

We use the Mann-Whitney *U* test based on ranks to test whether the samples of *y* comes from populations with the same median. We do a pairwise comparison by treatments. The nonparametric Mann-Whitney *U* is appropriate because the distributions are clearly not normal (in fact, using the skewness and kurtosis test for normality we can reject the hypothesis that *y* is normally distributed at a significance level of .0007). In Table 5 we report test results. A number in the intersection of a row and a column indicates, for the corresponding pair of treatments, the probability of getting at least as extreme absolute values of the test statistic as we observe, given that H_3 is true.

	***f*4**	***f*7**	***f*10**	***f*13**	***f*16**
***f*4**	-	.1124	.6033	.3408	.3865
***f*7**		-	.0941	.7290	.4705
***f*10**			-	.2253	.3123
***f*13**				-	.3123
***f*16**					-

TABLE 5: Mann-Whitney *U* tests with pairwise comparisons of medians of *y* by treatments.
(Prob > $|z|$, where *z* is the test statistic)

Table 5 conveys a result we find surprising. At the five percent level, H_3 is not rejected for any of the pairs of treatments. We discuss this finding further in Section IV.B.

Why is player 2 choosing $y>0$ if she is not motivated by reciprocity considerations of the kind we discussed above? One explanation may be that she chooses $y>0$ because she is "averse to letting 1 down". This would be the case if she feels *guilty* if she chooses *y* "too low" relative to what she believes to be 1's expectation of *y*.[11] We therefore test for positive correlation between *y* and 2’s expectation of 1’s expectation of *y* (conditional on 1 choosing *Leave*; we henceforth suppress this qualification):

H_4: *y* is positively correlated with 2's expectation of 1's expectation of *y*

[11] An alternative but closely related explanation would be that player 2 has a preference for "meeting 1's expectations" because 2 then experiences a comfortable "warm glow". We do not distinguish between this explanation and the one involving guilt, although in what follows we choose to talk about guilt rather than a warm glow. This way we avoid confusion with the warm glow effects of Andreoni (1990), which are not related to expectations.

We first use the Spearman rank correlation coefficient (r_s) to test for the *existence* of correlation between *y* and 2's expectation of 1's expectation of *y*. We run the test for the entire 60 observations because, as shown above, the hypotheses that the choices of *y* in different treatments come from the same distribution can not be rejected. We find that r_s=.36, and that H_4 can not be rececected at the five percent level (in fact, H_4 can be rejected only at levels smaller than .0047). We interpret this as support for the hypothesis that *y* and 2's expectation of 1's expectation of *y* are correlated.

After ensuring the existence of correlation, we measure the *degree* of correlation: There is a positive correlation of .33 between *y* and 2's expectation of 1's expectation of *y*. This is consistent with a theory of *guilt* based on psychological game theory. In Section IV.C we elaborate a bit on this issue with reference to our experimental results.

IV. DISCUSSION

In this section we discuss the three main results of this paper: (i) Many players 1 choose *Leave* even when their expectation of *y* was no greater than *x*. (ii) There is no correlation between *x* and *y*. (iii) There is positive correlation between *y* and 2's expectation of 1's expectation of *y*.

A. *Trust?*

With reference to our finding about hypothesis H_2, note that in the treatments with *x* equal to *f*7, *f*10, and *f*13 it was *not* trust in the sense that player 1 expected 2 to give back more than *x* that induced 1 to choose *Leave*. It is not just material self-interest that makes player 1 choose *Leave*. Experiments in which subjects chose to give up money to other subjects are not new in the literature—see the discussion in the introduction about the dictator game literature, or witness many subjects behavior in the player 2 position of our game. However, as far as we know, there is little documented evidence indicating that players are willing to give up money in a way which increases monetary efficiency in situation where they expect a co-player to treat them unfavourably.[12]

[12] The findings of Bolle (1995) on an experimental game similar to ours is in line with this conclusion. He asks player 1 "What *will* Player 2 give back?", and 22 out of 41 subjects who chose the action similar to *Leave*

One may reasonably suspect that "trust" in the sense of "counting on others to give back what one risks to lose" may explain observations about efficient outcomes in cases were the classical theory predicts inefficient outcomes. Berg *et al* (1995, p137) discuss this issue. However, the observations we make about the players 1's behavior indicates that such an explanation is in need of qualification.

B. *Reciprocity?*

Player 2 may think that player 1 is being "nice" by choosing *Leave*, and she may want to reward 1 in proportion to how nice she considers him. We strongly suspected that a "the higher is x, the nicer is 1 by choosing *Leave*" effect would make 2's choice of y positively correlated with x across treatments. Therefore, we were much surprised to find no support for a connection between x and y in the experimental data.

This result may be compared with findings of Berg *et al* (1995) that there appears to be no connection between amount "sent" by player 1 and how much player 2 "sends back" in their experimental game. Also van der Heijden *et al* (1996) report a similar result. Arguably, the more money is sent, the nicer is player 1. In our set-up 1 cannot "choose how nice to be". He can only be nice in one way (by choosing *Leave*). However, to some extent, we control for how nice 1 is by using x as a treatment variable. This difference between the designs turns out to be unimportant.[13]

C. *Guilt?*

---

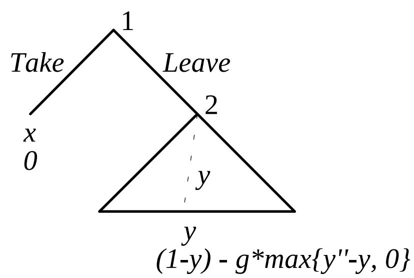
gave answers no higher than (what corresponds to) x. However, since Bolle's and our questions differ (cf Appendix 3), and since he did not reward subjects for accuracy, the analogy should be interpreted cautiously. We also note that our findings do not contradict the evidence that "trust is an economic primitive" of Berg *et al* (1995). They use a definition of trust that does not explicitly relate to expectations (see Berg *et al* p126).

[13] These findings do not contradict Berg *et al*'s (1995, p122) claim that "reciprocity exists as basic element of human behavior", because their main definition of "reciprocity" (see p126) is built on different ideas from those that motivate our hypothesis H_3 (and their hypothesis A_3). We note also that in Berg *et al*'s "social history" treatment (in which subject were informed about the choices made in earlier sessions before choosing their own actions) they find "an increase in the correlation between amounts sent and payback decisions" (p135). The issue of when and in what sense reciprocity is important is apparently a delicate one, and more research seem necessary in order to disentangle various aspects.

Our finding that y is positively correlated with 2's expectation of 1's expectation of y is in line with a theory of guilt based on psychological game theory. Suppose that if 2's subgame is reached, she will feel *guilty* if she gives 1 "too little" relative to what she expects that 1 expects to get. And for a given such second-order expectation, the less 2 gives the more guilty she feels unless she thinks she meets 1's expectation. To model a "guilt effect" of this kind we need the following notation:

$y' \in [0,1]$	is player 1's expectation of y
$y'' \in [0,1]$	is player 2's expectation of y'

$\Gamma(x)$ can now be transformed into the following psychological game $\Pi(x)$:



$\Pi(x)$

1's payoffs in $\Pi(x)$ depend only on what strategy profile is played, just as in $\Gamma(x)$. However, 2's payoffs are "belief-dependent". If a profile (*Leave, y*) is realized, her payoff is the sum of two terms. The first term reflects 2's monetary, just as in $\Gamma(x)$. The second term, in which g is a non-negative constant, is "psychological" and captures the guilt effect. g represents player 2's sensitivity to experiencing disutility by guilt. The effect of this second term is such that whenever g>1 player 2 has a unique optimum response if 1 chooses *Leave*. Player 2 will choose $y=y''$. This specification suggest that the correlation between y and y'' should be equal to 1.[14]

This model is obviously simplistic and we leave for future research the task of specifying a "realistic" model in which specific parameters can be reasonably estimated using experimental data. We emphasize, however, that psychological effects cannot be captured using standard game theoretic techniques. They are therefore qualitatively different from several existing explanations of experimental findings that make reference to utility functions that do not only depend on self-oriented, monetary arguments.[15] Psychological games distinguish themselves from standard games in that it is typically not possible to a priori associate *one* specific utility vector with each possible strategy profile. Multiplicity of possible equilibria may then be a much more frequent phenomenon than in standard games (see Geanakoplos, Pearce, & Stacchetti (1989) and also Rabin (1993) for more discussion and examples). Hopefully, experimental investigations can select which of these are relevant (we like to think that the results reported here indicate that this may be feasible).

References

Andreoni, J., 1990, "Impure Altruism and Donations to Public Goods: A Theory of Warm Glow Giving", *Economic Journal* 100, 464-77.

Andreoni, J. & J. Miller, 1994, "Giving According to GARP: An Experimental Study of Rationality and Altruism", Paper presented at the 4th Amsterdam Workshop on Experimental Economics.

[14] A psychological Nash equilibrium (see Geanakoplos, Pearce, and Stacchetti 1989 for details) requires that players optimize given their beliefs which furthermore must be correct. This entails that $y=y'=y''$. Moreover, both players optimize given one another's actions and beliefs. For example, say that x=1/5. Then the profile (*Leave*, y=½) and the beliefs $y'=y''$=½ are compatible with a psychological Nash equilibrium. (As a curiosity we note that this particular equilibrium is consistent with the choices and guesses made by the subjects A8 and B8 in the 4 guilder treatment; see Tables 1 and 2.)

[15] See, for example, Bolton (1991) who reports experimental evidence that subject are averse to being unfairly treated, Andreoni & Miller (1994) who rationalize experimental findings with reference to altruism, and Falk & Stark (1996) who present a theory in which altruism and reciprocity considerations are intertwined via effects of "empathy" and "gratitude". Ochs & Roth (1989, p 380) suggest that it may be a good research strategy to let utility functions include arguments that capture certain effects that are salient in experimental data. Güth & Tietz (1990, p 400) argue to the contrary. See Roth (1995, p 264-6) for further discussion.

Berg, J., J. Dickhaut & K. McCabe, 1995, "Trust, Reciprocity, and Social History", *Games and Economic Behavior* 10, 122-42.

Bolle, F., 1990, "High Reward Experiments without High Expenditure for the Experimenter?", *Journal of Economic Psychology* 11, 157-67.

Bolle, F., 1995, "Rewarding Trust: An Experimental Study", Diskussionspapier 15/95, Europa-Universität Viadrina.

Bolton, G. & R. Zwick, 1995, "Anonymity versus Punishment in Bargaining", *Games and Economic Behavior* 10, 95-121.

Bolton, G., 1991, "A Comparative Model of Bargaining: Theory and Evidence", *American Economic Review* 81:5, 1096-1136.

Camerer, C. & R. Thaler, 1995, "Ultimatums, Dictators, and Manners" *Journal of Economic Perspectives* 9:2, 209-219.

Davis, D. & C. Holt, 1993, *Experimental Economics*, Princeton University Press.

Fehr, E., S. Gächter & G. Kirchsteiger, 1995, "Reciprocity as a Contract Enforcement Device: Experimental Evidence", Paper presented at the 5th Amsterdam Workshop on Experimental Economics.

Fehr, E., G. Kirchsteiger, & E. Riedl, 1993, "Does Fairness Prevent Market Clearing? An Experimental Investigation", *Quarterly Journal of Economics* 108:2, 437–60.

Geanakoplos, J., D. Pearce, and E. Stacchetti, 1989, "Psychological Games and Sequential Rationality", *Games and Economic Behavior* 1, 60–79.

Güth, W., 1995, "On Ultimatum Bargaining Experiments: A Personal Review", *Journal of Economic Behavior and Organization* 27:3, 329-44.

Güth, W. & E. van Damme, 1994, "Information, Strategic Behavior and Fairness—An Experimental Study", CentER Discussion Paper #9465, Tilburg University.

Güth, W., P. Ockenfels & M. Wendel, 1994, Efficiency by Trust in Fairness? Multiperiod Ultimatum Bargaining Experiments with an Increasing Cake", *International Journal of Game Theory* 22, 51-73.

Güth, W. & R. Tietz, 1990, "Ultimatum Bargaining Behavior: A Survey and Comparison of Experimental Results", *Journal of Economic Psychology* 11, 417-49.

van der Heijden, E., J. Nelissen, J. Potters, & H. Verbon, 1996, "Gift Exchange Experiments: The role of Reciprocity and the Matching Structure", Mimeo, Tilburg University.

Hoffman, E., K. McCabe, K. Shachat, & V. Smith, 1994, "Preferences, Property Rights, and Anonymity in Bargaining", *Games and Economic Behavior* 7, 346-380.

McKelvey, R. & T. Palfrey, 1992, "An Experimental Study of the Centipede Game", *Econometrica* 60, 803-36.

Mitzkewitz, M. & R. Nagel, 1993, "Experimental Results on Ultimatum Games with Incomplete Information", *International journal of Game Theory* 22, 171-98.

Ochs, J. & A. Roth, 1989, "An Experimental Study of Sequential Bargaining", *American Economic Review* 79:3, 355-384.

Rabin, M., 1993, "Incorporating Fairness into Game Theory and Economics", *American Economic Review* 83:5, 1281–1302.

Roth, A., 1995, "Bargaining Experiments", in J. Kagel & A. Roth (eds.), *The Handbook of Experimental Economics*, Princeton University Press.

Selten, R., 1967, "Die Strategiemethode zur Erforschung des eingeschränkt rationalen Verhaltens im rahmen eines Oligopolexperiments", in H. Sauermann (ed.), *Beiträge zur experimentellen Wirtschaftsforschung*, Tübingen, 136-168.

Stark, O., & I. Falk, 1996, "On the Transfer Value of Gratitude", Mimeo, Department of Economics, University of Oslo.

APPENDIX 1

{*When the subjects arrived they were directed to their seats. The subjects in Room A received the following written instruction. The instruction in Room B was identical except that "Room A" was substituted for "Room B" everywhere in the text, and vice versa.*}

Instruction for persons in Room A

You are about to participate in an experimental study of decision making. The experiment will last about an hour. In the experiment, each of you will be paired with a different person who is in another room. You will not be told who this person is either during or after the experiment. This is Room A, the other person is in Room B. As you notice, there are other people in the same room with you who are also participating in this experiment. You will not be paired with any of these people.

After reading this instruction, we ask you to draw one envelope from this box. In the envelope you will find a note with your 'registration number', which will be used throughout the experiment. After observing this note, please put it back in the envelope so no one else will see it. You will be asked to show this note later on when you will be paid. One envelope is an exception to this rule. Instead of a number, this envelope contains the announcement 'Monitor A'. The monitor will watch us while we carry out the experiment and assist us from time to time. An analogous procedure to determine the 'registration number' and to select 'Monitor B' is used in Room B. Every student will get *f* 8 as a show up fee, and in addition you may earn money in the experiment. Some of the money will be given to you during the experiment, and the rest at the end of it. The monitor will receive a payment equal to the average payoff of all other students in the experiment. All the money will be payed in cash.

From the moment you have drawn an envelope you are no longer allowed to talk or communicate with the other participants. If you have a question, please raise your hand and one of us will come to your table. As soon as everyone has taken his/her envelope, we will distribute further instructions.

Are there any questions about what has been said up till now?

APPENDIX 2

{*After the subjects had read the instruction they received upon their arrival and clarifying questions had be answered (these were rare), we distributed the following instruction (identical in both rooms) in the session with the treatment in which x=f4 . Substitute "f 7, 10, 13, 16" for "f4" to get the instruction subjects received in the other sessions.*}

The Procedure

The decision procedure will be as follows: Each person in Room A will get an additional *f* 4 and have two options:

(a) to take the *f* 4. In this case (s)he gives back an empty envelope, and the person with whom he/she is matched in Room B does not get to split any money.

(b) to leave the *f* 4 in the envelope. In that case the person in Room B with whom he/she is matched with will get to split *f*20 between the two of them. That is, the person in Room B decides how much of *f*20 to give to the person in Room A, and how much of it to keep.

The remainder of these instructions will explain exactly how this experiment is run: Each person in Room A will get an envelope with *f* 4 and a note, and then, one at a time, will go behind a curtain. Over there (s)he will be asked to write his/her registration number on the note and put the note back into the envelope. Then, (s)he will have to decide whether to "take it or leave it". That is, whether to "take" (and keep) the *f* 4 and give back the envelope without the money, or to "leave" the *f* 4 in the envelope. The person in Room A will be asked to put the envelope in a box near the experimenter. If the person in Room A decides to take the money, then the person with whom (s)he is matched in Room B will not get any money to split. If the person in Room A decides to leave the money in the envelope, then the person with whom (s)he is matched in Room B will get *f*20 to split between the two of them.

If the person in Room A leaves the *f* 4, then *f*20 will be made available to split between the two paired players. The split will be determined by the person in Room B. Each person in Room B will be asked to decide how much money out of *f*20 to give to the person in Room A with whom he/she is matched. The persons in Room B are asked to write their decisions on a sheet of paper which is given to them, and then to put this sheet of paper in their envelope, and the envelope in a box near the experimenter. Note that this decision by the person in Room B will be relevant only if the person in Room A chose to leave the *f* 4.

Then, Monitor A will take the box from Room A, and Monitor B will take the box from Room B. Together with an experimenter, they will match each envelope of Room A with the envelope of the person in Room B that has the same registration number, i.e. A1 will be matched with B1, A2 with B2 etc. If the envelope of the person in Room A will be empty, then no additional money will be given. If the envelope of Room A will contain the *f*4, then the note in the envelope from Room B will determine how to split the *f*20 between the two persons. The experimenter (with the monitors observing) will record the payoff of each of you. You will be paid at the end of the experiment.

The experiment is structured so that, apart from the experimenter, no one will know the decisions of people in either Room A or Room B. Since your decision is private, we ask that you do not tell anyone your decision either during or after the experiment.

APPENDIX 3

{*After the subjects' choices had been collected, in each treatment they received instructions as follows.*}

Question

{*To subjects in Room A only:*}

Now we ask you to guess what was the average amount that persons in Room B chose to give back to the persons in Room A. Your reward will depend on your accuracy.

{*To subjects in Room B only:*}

We asked the persons in Room A to guess how much the person in Room B chose to give back to them. We now ask you to guess what was the average of the guesses of the persons in Room A, but we consider only the persons that also chose to leave the money in the envelope. In other words, we do not consider the the guesses of those who chose not to leave the money. If no one in Room A chose to leave the money, then you will be paid *f*5 regardless of your choice. Otherwise, your reward will depend on your accuracy.

{*For all subjects the instruction continued as follows:*}

In order to check whether your guess is accurate, one of the experimenters will calculate this average, from the envelopes of the persons in Room B. You will be rewarded in the following way: You will start with *f*5, and for every 1 cent of mistake, 1 cent will be deducted from this *f*5. The mistake is the absolute value of (your guess - the actual average). For example, if you will guess accurately, you will get *f*5. If you miss by, say *f*2, (i.e. your guess is either two guilders too high or two guilders too low), you will be paid *f*3. If your mistake will be larger than or equal to *f*5, then you will not be payed at all for this part.

Please write your guess and your registration number on this sheet, and wait for the experimenter to collect the sheets.

x=*f*4

Subject	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Average
T=0, *L*=1	1	1	1	1	1	1	1	1	1	1	1	1	12/12
Guess	8	8.5	4	8	8	10	8.5	10	8	5	8.45	8	7.87

x=*f*7

Subject	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Average
T=0, *L*=1	1	0	0	1	0	0	1	0	1	1	0	1	6/12
Guess	4.75	4.5	8	9	3	6	6	2.5	.75	8	7.5	4	5.33

x=*f*10

Subject	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Average
T=0, *L*=1	1	1	1	1	1	0	1	1	1	0	0	0	8/12
Guess	10	6	10	8	10	5	10	7	8	5	10	1.25	7.52

x=*f*13

Subject	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Average
T=0, *L*=1	1	0	1	0	0	0	0	1	0	1	0	0	4/12
Guess	9	3.5	6	6.25	9	0	5.5	4	0	9	4	0	4.69

x=*f*16

Subject	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12	Average
T=0, *L*=1	0	0	0	0	0	0	1	0	0	0	0	0	1/12
Guess	2	7	10	4	1.65	3	16.05	5.5	1	0	2.5	4	4.73

TABLE 1: Raw data on player 1. For each treatment, the first row indicates the registration number of the subject, the second indicates the strategy choice (*T*=*Take*, *L*=*Leave*), and the third row indicates the guess of the average y.

x=*f*4

Subject	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Average
y	4	4	10	10	10	0	10	10	10	6	4	10	7.33
Guess	5	8	10	10	10	6.5	10	10	8.5	7	6	5	8.00

x=*f*7

Subject	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Average
y	10	0	8	10	7	9	10	0	2	2	0	0	4.83
Guess	7	4.5	9	5	8	7.5	8	8	7	9	8	9.5	7.54

x=*f*10

Subject	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Average
y	10	0	12	10	0	5	10	10	1	10	12.5	10	7.54
Guess	10	4.5	5	10	4	6	8.5	7	10	10	9	8	7.67

x=*f*13

Subject	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Average
y	10	5	1	16.5	8	10	8	0	7	8	0	0	6.12
Guess	8.5	5	6	7.5	8	7.5	8.45	7	8	3	0	13	6.83

x=*f*16

Subject	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12	Average
y	4	0	2	3	10	12	0	8	10	10	0	10	5.75
Guess	10	4.5	2	5	7.5	12	11	8	10	10	5	9	7.83

TABLE A2: Raw data on player 2. For each treatment, the first row indicates the registration number of the subject, the second indicates the strategy choice, and the third row indicates the guess of the average guess of *y* made by the subjects in room A who chose *Leave*