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Measuring Beliefs in an Experimental Lost Wallet Game*

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We measure beliefs in an experimental game. Player 1 may take $x < 20$ Dutch guilders, or leave it and let player 2 split 20 guilders between the players. We find that the higher is x (our treatment variable), the more likely is player 1 to take the x. Out of those who leave the x, many expect to get back less than x. There is no positive correlation between x and the amount y that 2 allocates to 1. However, there is positive correlation between y and 2's expectation of 1's expectation of y. *Journal of Economic Literature* Classification Numbers: C72, C92.

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, or bring it to a

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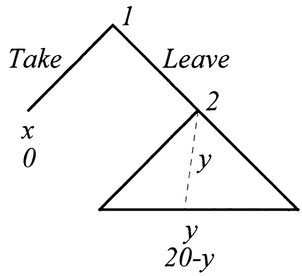

FIG. 1. The game $\Gamma(x)$.

nearby police station for the owner to pick up. The police routinely register your name, and subsequently ask the wallet owner to reimburse you in the amount she 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 does not reimburse the finder if she picks her 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.

A special instance of this situation is modeled in the game $\Gamma(x)$ in Fig. 1, where payoffs are in Dutch guilders (f), x is an exogenously given parameter such that $0 < x < 20$, and y is chosen by player 2 such that $0 \le y \le 20$.

If the players are motivated solely by personal monetary gain, the unique subgame perfect equilibrium in $\Gamma(x)$ is (*Take*, $y = 0$), corresponding to the dismal outcome with the lost wallet. This outcome is inefficient since if 1 chooses *Leave* and 2 chooses y such that $x < y < 20$, then a payoff vector is realized which is better for both players.

However, much experimental evidence suggests that when humans interact they may be motivated by various nonmaterial considerations and not only personal monetary gain. In some cases this may eliminate inefficiency. We address related issues by investigating the nature of strategic behavior in an experimental game which resembles $\Gamma(x)$. However, for methodological reasons, we ask player 2 to report a *strategy*—a choice of y—without informing her about 1's choice.[1] We still refer to the experimental game as $\Gamma(x)$.

[1] The strategy approach, which goes back to Selten (1967), has the advantage that we can record 2's behavior irrespective of whether her information set is reached. See Roth (1995, pp. 322–323) for a discussion of the strategy method. We discuss this aspect of our design further in Section IV B.

We use x as a treatment variable taking values of $f4$, 7, 10, 13, and 16.[2] As in $\Gamma(x)$, the money pie to be split by player 2 is held fixed at $f20$ in all treatments. We let participants engage in anonymous, one-shot plays of this experimental game. Our objective is to record regularities in the participants decision making and to draw conclusions about the motivations behind their behavior. To shed some additional light on this, we explicitly measure some of the players' beliefs about one another's actions and beliefs by asking the participants to make certain guesses about other participants' choices or guesses, rewarding them for accuracy.

We investigate the following issues which relate to the treatment variable x:

- An efficient outcome obtains if and only if player 1 chooses *Leave*. However, if 1 chooses *Leave* his potential loss is increasing in x. Is the propensity for 1 to choose *Leave* negatively correlated with x?
- By choosing *Leave*, player 1 places a trust in 2. To what extent does 2 reciprocate and keep this trust by choosing $y \geq x$?[3]
- One might argue that the higher is x, the kinder is 1 by choosing *Leave* since the potential loss he may incur by doing so is higher. Player 2 may want to be kind in return by correspondingly choosing a higher y. Is y positively correlated with x?

Furthermore, we investigate the following issues which relate to the players' beliefs:

- Is there a connection between 1's expectation of y and 1's propensity to choose *Leave*? In particular, does 1 choose *Leave* only if he expects to get back at least x?
- Is player 2's choice of y positively correlated with her expectation of 1's expectation of y (conditional on 1 choosing *Leave*)? This could happen if 2 were averse to "letting 1 down," in the sense of not wanting to choose y below 1's expectation of y. Of course, player 2 cannot know 1's expectation of y. Yet, the higher is her *expectation* of 1's expectation of y the higher she may be inclined to choose y.

$\Gamma(x)$ is related to the *Dictator game* in which one player decides how to divide $f20$ between herself and another (dummy) player. The subgame of

[2] At the time of the experiment $f20$ were worth approximately 12 U.S. dollars.

[3] The usage of the terminology "place a trust," "keep the trust," and "reciprocate" here is in line with that of Berg *et al*. (1995, p. 126) who study a game (further discussed below) which is related to ours.

$\Gamma(x)$ where 2 moves, considered in isolation, has precisely such a structure.[4] When the Dictator game is tested experimentally, 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 and Holt 1993, pp. 263–269 for a discussion). We suspect that 2's behavior in $\Gamma(x)$ will be affected by similar concerns, but that in addition it may matter that whether 2's choice affects payoffs is at 1's discretion. To check this, we also run an experimental Dictator game in which the procedures, including the belief elicitation, were analogous to those discussed above. Letting $y \in [0, 20]$ denote the dictator's choice of how much to allocate to the dummy player, we investigate the following issues:

- Is the choice of y lower in the Dictator game than in $\Gamma(x)$?
- Is the dictator's choice of y in the Dictator game positively correlated with her expectation of the dummy player's expectation of y?

We conclude this introduction by discussing some other related literature: Berg *et al.* (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."[5] Bolle (1995) reports experimental results involving a game which resembles $\Gamma(x)$, 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 participants acting in these games were rewarded according to their decisions.[6] Bolle set x equal to half the value of the pie split by player 2 and he did not consider the effect of changing x. In both of these studies, most

[4] We investigate the potential importance of some nonpecuniary concerns that arise due to a choice that *precedes* a dictator subgame. One can compare this to the Ultimatum game, in which an action is added that *succeeds* a proposed dictator division: a responder gets to accept or reject the proposed split, and in the latter case, each player gets a zero payoff. See Camerer and Thaler (1995) and Güth (1995) for detailed discussions of results in experimental Ultimatum games. See Güth and van Damme (1998) for a report on an experiment on a game which incorporates essential elements of both the Dictator and the Ultimatum game.

[5] $\Gamma(x)$ can be related to the game of Berg *et al.* as follows: In $\Gamma(x)$ player 1 is given a certain amount of money ($x > 0$). He chooses to send all or nothing to player 2. The amount sent is multiplied by a factor inversely related to x, and given to player 2 who makes a choice on how much money to "send back" to player 1. $\Gamma(x)$ may be viewed as more general than the game of Berg *et al.* in allowing other exogenously given multiplication factors than 3, and more restrictive in not allowing player 1 to send intermediate amounts.

[6] See Bolle (1990) for a discussion of whether such a setup skews incentives relative to the case where all participants are paid.

participants did not behave according to the subgame perfect equilibrium with only self-interested material considerations affecting payoffs.[7]

The paper is organized as follows: Section II explains the experimental procedure. Section III presents the hypotheses we test, and the experimental results. Section IV contains a discussion of our main findings. Appendices 1–3 contain the experimental instructions.

II. EXPERIMENTAL PROCEDURE

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

In total we had five sessions of experimental $\Gamma(x)$ games and two sessions of experimental Dictator games. Twelve different pairs of students interacted in each session. In the $\Gamma(x)$ games, x was fixed within a session and was changed between sessions to f4, 7, 10, 13, 16. For each session we had invited 13 participants to Room A, 13 participants to Room B, and 4 extra participants to a third room to cover for no-shows. After filling Rooms A and B with 13 participants (using participants 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 did not cheat. That person was paid the average of all other participants 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 the game would be played only once.

Participants in Room A read the instruction for this part (see Appendix 2). In the $\Gamma(x)$ sessions, they were then asked to go to the experimenter, one at a time. They got an envelope with x in it, and then had to go behind a curtain. Over there they had to decide whether to take the money

[7] Several other authors have conducted experimental studies in which aspects of trust, reciprocity, and efficiency are key features. See, e.g., Fehr *et al*. (1993), Fehr *et al*. (1997), Güth *et al*. (1994), van der Heijden *et al*. (1997), and McKelvey and 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.)

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.

Participants 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 x in the envelope in the $\Gamma(x)$ treatments. The participants' choices, sealed in envelopes, were put in a box near the experimenter.

Then part 2 started. The participants in Room A received new instructions. They were asked to guess the average y chosen by participants in Room B in part 1, and were rewarded according to accuracy (see Appendix 3). Our intention was to provide incentives for them to state their expectation of their co-player's choice of y.[8]

The participants in Room B also received new instructions (see Appendix 3). In the $\Gamma(x)$ sessions they were asked to guess the average guess of the participants in Room A who chose to leave the money in the envelope in part 1. In the Dictator game sessions they were asked to guess the average guess of the participants in Room A. 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 parts 1 and 2 were calculated and the participants were privately paid.[9]

III. HYPOTHESES AND RESULTS

We now present the hypotheses we test and report on our experimental findings. We first discuss the experimental game $\Gamma(x)$ and then the experimental Dictator game.

[8] 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 participant believes that the co-player chooses $y = f0$ with probability $\frac{1}{2}$ and otherwise chooses $y = f10$. Such a participant has an expectation of $f5$. With the incentive scheme we use he should indeed guess $f5$. Had we asked him to guess his co-players choice he should guess either $f0$ or $f10$, however.

[9] Note that while the participants were anonymous to each other, the experimenter could learn each one's decision. The study of Hoffman *et al.* (1996) shows that it is then likely that dictators give away more than with subject–experimenter anonymity. Probably a similar remark applies to $\Gamma(x)$, but the importance of "social distance" concerns in general games is a matter of some controversy. See Hoffman *et al.* (1994) and Bolton and Zwick (1995) for some partly conflicting evidence, and Roth (1995, pp. 298–302) for further discussion.

A. $\Gamma(x)$

The experimental raw data concerning $\Gamma(x)$ is given in Tables I and II.

The following two hypotheses should find support if participants 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*.

H_1: All players 2 choose $y = 0$.

Recall that 12 different pairs of participants interacted in each treatment. Table III summarizes for each treatment how many participants behaved according to the classical solution (e.g., in the $f4$ treatment, none out of the 12 players 1 chose *Take*. In the $f16$ treatment, 3 players 2 chose $y = 0$).

It is clear by inspection of the table that the hypotheses H_0 and H_1 do not find much support.

We now move toward investigating what other patterns of behavioral regularities show up in the data. We first focus on player 1, and then on player 2.

An efficient outcome results if and only if 1 chooses *Leave*. Is the propensity for player 1 to choose *Leave* related to the size of x? By

TABLE I

Raw Data on Player 1 in $\Gamma(x)$[a]

	$x = 4$		$x = 7$		$x = 10$		$x = 13$		$x = 16$	
Participant	Choice	Guess	Choice	Guess	Choice	Guess	Choice	Guess	Choice	Guess
1	*L*	4	*T*	2.5	*T*	1.25	*T*	0	*T*	0
2	*L*	5	*T*	3	*T*	5	*T*	0	*T*	1
3	*L*	8	*T*	4.5	*T*	5	*T*	0	*T*	1.65
4	*L*	8	*T*	6	*T*	10	*T*	3.5	*T*	2
5	*L*	8	*T*	7.5	*L*	6	*T*	4	*T*	2.5
6	*L*	8	*T*	8	*L*	7	*T*	5.5	*T*	3
7	*L*	8	*L*	0.75	*L*	8	*T*	6.25	*T*	4
8	*L*	8.45	*L*	4	*L*	8	*T*	9	*T*	4
9	*L*	8.5	*L*	4.75	*L*	10	*L*	4	*T*	5.5
10	*L*	8.5	*L*	6	*L*	10	*L*	6	*T*	7
11	*L*	10	*L*	8	*L*	10	*L*	9	*T*	10
12	*L*	10	*L*	9	*L*	10	*L*	9	*L*	16.05
Average	$12L/12$	7.87	$6L/12$	5.33	$8L/12$	7.52	$4L/12$	4.69	$1L/12$	4.73

[a] For each treatment, the first column indicates strategy choice (T = *Take*, L = *Leave*), and the second column indicates the guess of the average y.

TABLE II
Raw Data on Player 2 in $\Gamma(x)$[a]

	$x = 4$		$x = 7$		$x = 10$		$x = 13$		$x = 16$	
Participant	y	Guess	y	Guess	y	Guess	y	Guess	y	Guess
1	0	6.5	0	4.5	0	4	0	0	0	4.5
2	4	5	0	8	0	4.5	0	7	0	5
3	4	6	0	8	1	10	0	13	0	11
4	4	8	0	9.5	5	6	1	6	2	2
5	6	7	2	7	10	7	5	5	3	5
6	10	5	2	9	10	8	7	8	4	10
7	10	8.5	7	5	10	8.5	8	3	8	8
8	10	10	8	7	10	10	8	8	10	7.5
9	10	10	9	7.5	10	10	8	8.45	10	9
10	10	10	10	8	10	10	10	7.5	10	10
11	10	10	10	8	12	5	10	8.5	10	10
12	10	10	10	9	12.5	9	16.5	7.5	12	12
Average	7.33	8.00	4.83	7.54	7.54	7.67	6.12	6.83	5.75	7.83

[a] For each treatment, the first column indicates the strategy choice, and the second column indicates the guess of the average guess of y made by the players 1 who chose *Leave*.

TABLE III
Number of Choices Made According to the Classical Solution in Each Treatment in $\Gamma(x)$

	$x = 4$	$x = 7$	$x = 10$	$x = 13$	$x = 16$
# of *Take*	0	6	4	8	11
# of $y = 0$	1	4	2	2	3

inspection of Table III one immediately sees that the number of cases where 1 chooses *Leave* is (apart from the $f7$ treatment) decreasing in x. A logistic regression supports this observation. As can be seen from Table IV, this effect is highly significant.

Next we investigate whether monetary efficiency is achieved only when player 1 expects to earn at least x. In that case the following hypothesis should find support:

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

The procedure for measuring expectations is described in Section II and Appendix 3. The relevant data are summarized in Table V:

TABLE IV
Leave Choices and the Size of x[a]

Variable	DF	Parameter Estimate	Error	Wald Chi-Square	Pr > Chi-Square
Intercept	1	−3.1405	0.8613	13.2933	0.0003
Value of x	1	1.0140	0.2623	14.9440	0.0001

[a] Results of a logistic regression.

TABLE V
Efficiency and H_2 for Each Treatment in $\Gamma(x)$

	$x = 4$	$x = 7$	$x = 10$	$x = 13$	$x = 16$
# of *Leave* choices (efficent outcomes)	12	6	8	4	1
# of *Leave* choices by players who expect to get back at least x	12	2	4	0	1
Proportion of violations of H_2	0/12	4/6	4/8	4/4	0/1

In the $f4$ treatment every player 1 chose *Leave* and in all cases the player expected to get back more than x, so H_2 was never violated. In the $f16$ treatment we have only one observation, which is in line with H_2. However, in each of the $f7$, 10, and 13 treatments H_2 is violated on four occasions.

In the remainder of this section we focus on player 2. Her choice has bearing on monetary payoffs if and only if 1 chooses *Leave*. Thereby 1 risks losing the x he could have for sure, and he gives 2 a shot at a positive payoff. To what extent does player 2 reciprocate in the sense of choosing $y \geq x$? By inspection of Table III, one sees that this happens quite often in the $f4$, 7, and 10 treatments, but only happens once in the other treatments.

A related aspect is that, arguably, the higher is x, the kinder is 1 by choosing *Leave* since the potential loss he may incur by doing so is higher. Player 2 may want be kind in return by correspondingly choosing a higher y. We expect an effect of this kind to motivate participants in making their choices, and therefore test the following hypothesis which we expect to be able to reject:

H_3: y and x are uncorrelated.

We use the Wilcoxon test to investigate whether the samples of y come from populations with the same distribution. We do a pairwise comparison by treatments. The nonparametric Wilcoxon test 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 0.0007). In Table VI 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. (The last row refers to the results in the Dictator game sessions to be discussed in the next subsection.) Table VI conveys a result we find surprising. At the 5% level, H_3 is not rejected for any of the pairs of treatments.

Finally, we ask whether there is a positive correlation between y and 2's expectation of 1's expectation of y (conditional on 1 choosing *Leave*; we henceforth suppress this qualification). This would be in line with the idea that 2 might be "averse to letting 1 down" in the sense that she does not want to give 1 less than 1 expects to get. Of course, 2 does not know 1's expectation, which is why we focus on 2's expectation of this.

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

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 cannot be rejected. We find that $r_S = 0.40$, and that H_4 cannot be rejected at the 5% level. We interpret this as support for H_4. After ensuring the existence of correlation, we measure the *degree* of correlation: There is a positive correlation of 0.35 between y and 2's expectation of 1's expectation of y.

The connection between y and 2's expectation of 1's expectation of y is illustrated in the diagrams of Fig. 2. For each treatment (including the

TABLE VI

Wilcoxon Tests with Pairwise Comparisons of y by Treatments in $\Gamma(x)$ (Prob > $|z|$, Where z Is the Test Statistic)

	$x = 4$	$x = 7$	$x = 10$	$x = 13$	$x = 16$
$x = 4$	—	0.1124	0.6033	0.3408	0.3865
$x = 7$		—	0.0941	0.7290	0.4705
$x = 10$			—	0.2253	0.3123
$x = 13$				—	0.3123
$x = 16$					—
Dictator	0.2821	0.4423	0.1523	1.0000	0.9455

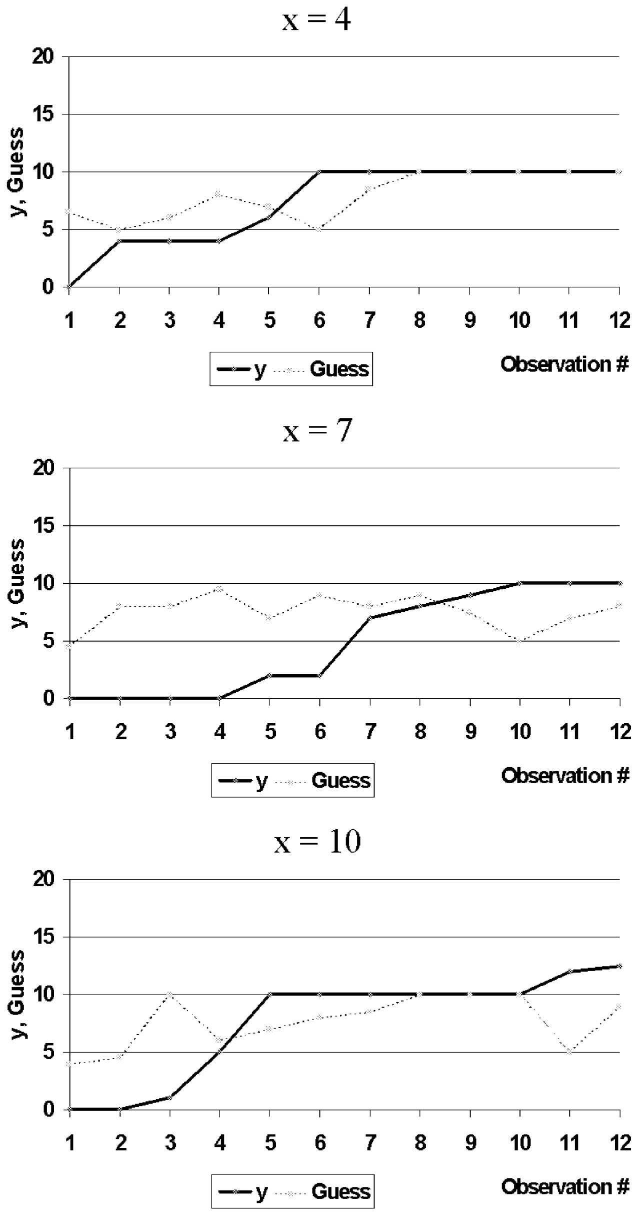

FIG. 2. Player 2's choice of *y* and 2's guess of 1's guess of *y*.

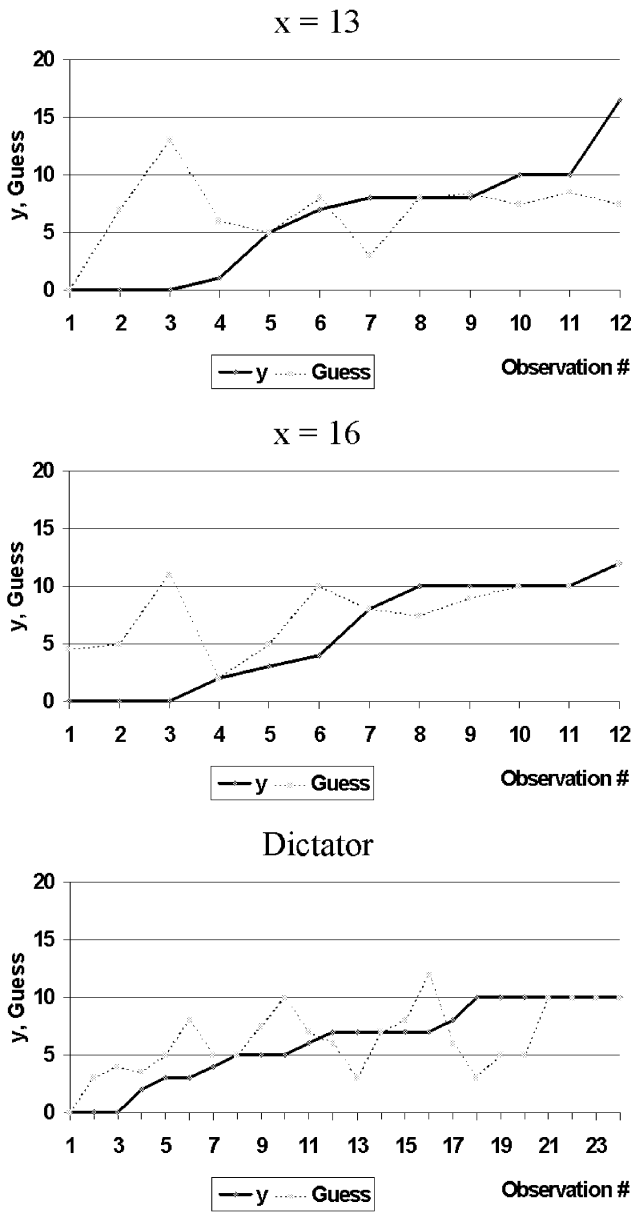

FIG. 2—*Continued*

Dictator game to be discussed in the next subsection) the choices of the participants in the player 2 position are plotted in increasing order, with the relevant second-order expectation of y plotted alongside.

B. The Dictator Game

The experimental raw data concerning the Dictator game is given in Tables VII and VIII.

In $\Gamma(x)$ 2's subgame is reached only if 1 chooses *Leave*. If 2 is motivated by reciprocity considerations, she might choose y higher than she would as a dictator in a Dictator game (where the choice of y has payoff consequences independently of 1's behavior). Then the following hypothesis should be rejected:

H_5: The same y is chosen in the Dictator game and in $\Gamma(x)$.

Refer back to Table VI. H_5 is not rejected for any value of x. We find this surprising (although perhaps less so given that H_3 was not rejected).

Finally we test the following hypothesis (motivated along the same lines as H_4):

H_6: In the Dictator game, y is positively correlated with 2's expectation of 1's expectation of y.

Again, 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

TABLE VII
Raw Data on the Dictator in the Dictator Game[a]

Participant	y	Guess	Participant	y	Guess
1	0	0	13	7	3
2	0	3	14	7	7
3	0	4	15	7	8
4	2	3.5	16	7	12
5	3	5	17	8	6
6	3	8	18	10	3
7	4	5	19	10	5
8	5	5	20	10	5
9	5	7.5	21	10	10
10	5	10	22	10	10
11	6	7	23	10	10
12	7	6	24	10	10
Average				6.08	6.38

[a] For each participant, the first column indicates the strategy choice, and the second column indicates the guess of the dummy players' average guess of y.

TABLE VIII
Raw Data on the Dummy Player in the Dictator Game[a]

Participant	Guess	Participant	Guess
1	0	13	8
2	0	14	8
3	2	15	8
4	2	16	8.3
5	2	17	10
6	3	18	10
7	3	19	10
8	3.15	20	10
9	5	21	10
10	5	22	10
11	7	23	10
12	7.5	24	15
Average			6.54

[a] For each participant, the numbers indicate the guess of the average y.

expectation of y. We find that $r_S = 0.44$, and that H_6 can not be rejected at the 5% level. 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 0.51 between y and 2's expectation of 1's expectation of y.

In the last diagram of Fig. 2 the dictator choices of y are plotted in increasing order, with the relevant second-order expectation of y plotted alongside.

IV. DISCUSSION

In this section we discuss our results, focusing on players 1 and 2 in turn.

A. Results on Player 1

The higher is x, the fewer players 1 choose *Leave* (apart from in the $f7$ treatment). We find this result quite intuitive, since the potential loss that 1 may experience by choosing *Leave* is increasing in x.

It is perhaps more surprising that several players 1 choose *Leave* even when (our estimate of) their expectation of y was lower than x. Experiments in which participants chose to give up money to other participants are not new in the literature—see the discussion in the Introduction about the Dictator game literature, or witness many participants' 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 situations where they expect a co-player to treat them unfavorably.[10]

B. Results on Player 2

We have reported that player 2 quite often reciprocates in the sense of choosing $y \geq x$ in the f4, 7, and 10 treatments, while this almost never happens in the f13 and 16 treatments. This result seems consistent with the findings by Berg *et al.* (1995) that in their experimental game (cf. footnote 5 above) many players 2 send back no less than their counterpart sent them.[11] One possible explanation of our results could be that player 2 is reluctant to give 1 more than one-half of the f20 that may be split. For $x \leq f10$, reciprocity in the sense that $y \geq x$ can then be achieved while maintaining the no-more-than-one-half constraint. Since reciprocity is mutual, players 2 are more likely to reciprocate at x less than or equal to f10, since 2 assumes that 1 understands the constraint. This explains the bifurcation of the data at $x = f10$.

We find no correlation between x and y in the experimental data. Indeed, the behavior of player 2 looks much like in a Dictator game. This result may be compared to the finding of Berg *et al.* (1995) that there appears to be no correlation between the amount sent and the amount sent back.[12] Van der Heijden *et al.* (1997) also report similar results. Arguably, the more money is sent, the kinder is player 1. Our setup is different in that player 1 can only be kind in one way (by choosing *Leave*), but, in a sense, we control for how kind 1 is by using x as a treatment variable. This difference between the designs turns out to be unimportant. We note, however, one issue that may have bearing on this result. In our experiment player 2 never faces the *fait accompli* of 1 choosing *Leave*, since we use the strategy method to record 2's behavior. This setup may

[10] A caveat to this result is that, with the belief elicitation method used, a risk avert player 1 may have an incentive to understate his expectation of y in order to cover himself in case 2 gives back less than he expects. Note, however, that this cannot account for the positive correlation between beliefs and actions we find when testing H_4.

[11] Lack of reciprocity when $x \in \{13, 16\}$ cannot be taken as evidence against this similarity, because in the game of Berg *et al.* the "multiplication factor" (cf. footnote 5) is always 3 and hence never as low as 20/13 or 20/16.

[12] In the "social history" treatment of Berg *et al.* (in which participants were informed about the choices made in earlier sessions before making choices) they find "an increase in the correlation between amounts sent and payback decisions" (p. 135), which suggests that this result is sensitive to the social setting.

affect behavior, and we take the experimental evidence reported by Schotter *et al*. (1994) to be indicative that the concern is real.[13]

We find that y is positively correlated with 2's expectation of 1's expectation of y. Such correlation is in line with the idea that 2 may be averse to letting 1 down in the sense that 2 wishes not to give 1 less than 1 expects to get. Since 2 does not know 1's expectation of y she must judge this by her expectation of 1's expectation of y, which then is correlated with her choice of y. We close by noting that effects of this nature can be modeled by incorporating beliefs directly into a player's utility function along the lines suggested by Geanakoplos *et al*. (1989). Geanakoplos *et al*. provide several examples of how their theory can be used to incorporate "emotions" in strategic analysis. These effects are qualitatively different from many other ideas that have been advanced to rationalize experimental data, like warm glow of giving in Andreoni (1990), altruism in Andreoni and Miller (1994), empathy and gratitude in Stark and Falk (1996), and aversion to unfair treatment in Bolton (1991), Kirchsteiger (1994), Bolton and Ockenfels (1997), and Fehr and Schmidt (1997). All these approaches are, from a game theoretic point of view, "standard" in that the relevant utilities can be defined on the domain of strategy profiles. By contrast, in the theory of Geanakoplos *et al*. each player's utility is defined on a richer domain, which includes the player's beliefs. Rabin's (1993) model of reciprocity for normal form games, and Dufwenberg and Kirchsteiger's (1998) related extensive game model, are examples of applications of the theory of Geanakoplos *et al*.

APPENDIX 1

{*When the participants arrived they were directed to their seats. The participants 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

[13] Confer their findings for the games 1M, 1S, and 1H, which have similarities with $\Gamma(x)$. It is hard to draw definite conclusions though, because Schotter *et al*. use matrices or graphs to describe their experimental games to participants while we use words only.

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 $f8$ 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 participants 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 "f7, 10, 13, 16" for "f4" to get the instruction participants received in the other* $\Gamma(x)$ *sessions. In the two Dictator game sessions subjects received instructions which described that game, but were otherwise analogously formulated.*}

THE PROCEDURE

The decision procedure will be as follows: Each person in Room A will get an additional $f4$ and have two options:

(a) to take the $f4$. 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 $f4$ in the envelope. In that case the person in Room B with whom he/she is matched with will get to split $f20$ between the two of them. That is, the person in Room B decides how much of $f20$ 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 $f4$ 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 f4 and give back the envelope without the money, or to ‘‘leave’’ the f4 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 f20 to split between the two of them.

If the person in Room A leaves the f4, then f20 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 f20 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 f4.

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 f4, then the note in the envelope from Room B will determine how to split the f20 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 participants' choices had been collected, in each treatment they received instructions as follows*.}

QUESTION

{*To participants 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 participants 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 f5 regardless of your choice. Otherwise, your reward will depend on your accuracy.

{*For all participants 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.

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