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Crowding Out and Imitation Behavior in the Solidarity Game

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Abstract: In the Solidarity Game (Selten and Ockenfels, 1998), two "rich" persons can support a "poor" one. A strong positive correlation between one rich person's solidarity contribution and his expected contribution of the other is observed. This paper investigates the causality behind this correlation. Depending on the measure, we find that up to two thirds of our subjects behave strategically. More than one third of the subjects show a crowding-out effect, i.e. they want to give less if they expect others to give more. This is no contradiction to the positive correlation if these subjects assume the others to be like themselves. In addition to strategic motives we find, for a quarter of the subjects, the wish to imitate their co-benefactors, usually however only for low contributions.

Key words: Solidarity, Crowding out, Imitation
JEL No.: D 64, C 72, C92

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Willst du dich selbst erkennen, so sieh, wie die anderen es treiben; willst du die anderen verstehen, schau in dein eigenes Herz.[2]

Friedrich Schiller

I. The problem

In many experiments concerning game situations, i.e. situations where one's own well-being is also dependent on the decisions of others, experimenters ask their subjects to reveal, in addition to their own choices, their expectations about the choices of others. The method of expectation formation and its role in decision making may, however, vary a lot between coordination games, speculation, trust games, solidarity games, etc. If honestly reported, these expectations may shed light on the logic of decision making though the connection often cannot be interpreted without further hypotheses. The latter has been most clearly expressed by Selten and Ockenfels (1998), who formulate two alternative hypotheses on the relation of behavior and expectations. While Selten and Ockenfels (1998) analyse their data generally under the view of non-strategic decisions we think that this might be a crucial difference.

(i) *The strategic approach* (*behavior based on expectations)*: Expectations of others' decisions stem from the experience of the subjects and from their insight into the strategic situation. These expectations guide their own decision. In game theoretic terms: their decisions are best replies to their expectations.

(ii) *The non-strategic approach (expectations based on behavior)*: Behavior (at least in complicated situations) is guided by routine or social norms. The expectation of others' behavior is formed under the assumption that others decide on the *same basis*.

The latter does not necessarily imply the expectation of similar behavior. If someone expects, however, similar behavior he is said to underlie the (false) consensus effect.

Selten and Ockenfels (1998) explicitly state that there is no direct possibility to test the direction of the causality, i.e. to reject (i) or (ii). With our extended experiment,

[2] To know yourself, see how the others behave; to understand the others, look into your own heart.

however, we can paint a differentiated picture with elements of both. We will show in this paper that, in our environment, 1/2 to 2/3 of our subjects can be assumed to decide “game theoretically”, which implies that expectations and gifts are determined jointly as equilibrium values. These subjects seem to assume others to be like themselves, a (false) consensus effect (Dawes, 1977, Ross et al., 1977).

In the following, we want to concentrate on the Solidarity Game as defined by Selten and Ockenfels (1998). In this game, three persons are provided with a certain amount of money, each with a probability of 2/3. If there are one or two losers (persons who did not get DM 10), then the winner(s) can give the loser(s) as much as he (they) like(s). Subjects have to decide conditionally for the one winner and the two winners cases.

First, we simplified the structure of the basic game by informing our subjects not only about the fact whether they were winners or losers but also by restricting the Solidarity Game to the case of one loser and two winners. Thus we even went beyond the “partial play method” of Büchner et al (2003). We found, however, except for one group of subjects, the same strong positive correlations between expectations and decisions as Selten and Ockenfels (1998). The reason for our simplification was to avoid the interference of decisions in the cases of one and two winners. Of course, our procedure also diminished or even abandoned the “solidarity” effect[3] which is discussed in Bolle (2002) as a possible cause for the positive correlation.

The decision required in the normal Solidarity Game was supplemented by the question of how a winner subject would behave if she *knew* the decision of the other winner subjects, i.e. we wanted to find out the reaction curve with respect to the co-benefictor’s gift. With these reaction curves we could directly investigate whether (i) applied. In 64 of 96 cases (67 %), gifts turned out to be exactly best replies to expectations (deviations $\leq$ 0.5 were counted as hits).

The results were also used to categorize the reaction curves, the most frequent category (39 % of those with complete reaction curves) showing a negative slope.

[3] Solidarity has to be defined. In any case, it has an element of (intendend) reciprocity in it.

This “crowding out” or “free riding” is implied by theory if one’s utility is also influenced by the income or the well-being of others. Then the well-being of the loser is a public good for the winners. Also the average reaction curve is slightly decreasing which, at first glance, seems to be a contradiction to the positive correlation between expectations and choices. It is not, if higher expectations are connected with *higher level*, though often decreasing, reaction functions.

It would, however, be misleading if we disregarded other types of reaction curves. In addition to 15 % with constant reaction curves, 25 % of the subjects belong to a category of (partial) imitators, i.e. subjects whose reaction functions $gift_{own}=R(gift_{other})$ show values equal to $gift_{other}$ for small $gift_{other}$, for example a reaction 0, 1.5, 2.5, . , . or 0, 1, 2, . , . to $gift_{other}=0$, $gift_{other} \in (0,1]$, $gift_{other} \in (1,2]$, . , . Except for five subjects this imitation behavior breaks down when gifts are high, perhaps because it is too expensive or because of the resulting inequality to one’s own disadvantage. 19 % of the subjects could not be placed in one of these three categories. 4 % submitted only incomplete reaction curves.

As a last question, the subjects had to indicate what they would give if the other was informed about their gift in advance. In 42 of 100 cases the choices were different (deviation > 0.5), i.e. at least 42 % of the subjects seemed to follow strategic motives when deciding in advance.

So, about 2/3 consistency between the results of (a) the *Normal Solidarity Game* and (b) the *Reaction Curve Approach* as well as a 42 % difference between (a) and (c) the *choice in advance to others,* indicate that strategic behavior may play an important role. The correlation between one’s own gift and one’s expectation of the other’s gift is partly due to positively sloping reaction functions; the major reason, however, can be found in a joint determination of choices and expectations under the assumption that the other has the same reaction function as oneself.

In the next section, the experiment is described, in Section III the results are reported and discussed and Section IV concludes.

II. The experiment

The experimental sessions took place in June and October 2004 at the Viadrina University in Frankfurt (Oder), Germany. In classroom experiments, 150 first year students were randomly partitioned in groups of 3, one “loser” who got nothing and two “winners” who were both endowed with 10 euros. They were not called winners and losers but were only informed about the fact of whether or not they got the endowment. The subjects were positioned at a certain distance, i.e. at least one seat to the right and to the left was empty and they were instructed that it was strictly forbidden to communicate. Neither the subjects nor the two persons who executed the experiment knew which subjects belonged to a group.

After a short verbal instruction every subject got a sheet of paper with a code number (filled in by the experimenter) and space to fill in a pseudonym to be chosen by the subject. The front pages of the sheets of paper repeated the instructions and gave the information “you have got 10 (or 0) euros”. On the back page, the winners were asked to make three types of decisions.

(a1) What do you give without knowing what the other owner of 10 euros will give?

(a2) What do you expect the other owner of 10 euros to give?

These are the questions posed in a “normal” solidarity game.

(b) What do you give if you know what the other will give?

The subjects had to indicate what they would give according to 12 cases; i.e. the strategy method was used. The results of (a) and (b) could be consistent and thus emphasize the relevance of the reaction curves also for (a), or not.

(c) What would you give if the other was informed about your gift in advance?

As (b), the comparison between (a) and (c) could indicate whether strategic motives play a role in solidarity decisions. (c) was also necessary to make (b) realistic. The participants were told that, for every group, it was decided by random if both winners decided under (a) or one under (b) and one under (c).

The losers' front page contained the information that they got nothing. Then they were asked what they expected to get from their co-players. In addition, they were asked how they *would have decided* if they had got 10 euros. The back page was the same as the winners' back page. The losers' hypothetical decisions are not analysed here.

The English translations of the instruction and decision forms as well as the complete results are in the Appendix.[4]

After all subjects had made their decisions their forms were collected. Some days later, the subjects received their earnings (after giving their code number and password) from the secretary of the chair who was not involved otherwise in the experiment.

III. Results

(a) Comparison with other experiments

Let us first compare the results of our questions (a) with the results of Selten and Ockenfels (1998) and Büchner et al (2003). In Table 1, we see that our subjects' gifts (23 % of their endowment) fall between the gifts of West German students (SO) and East German students (BCG).[5] The difference to SO is not significant. We find, however, significantly higher expectations than SO (t-test, 5% level). The difference between gifts and expectations (also significant on the 5% level) is as large as in the BCG experiments. The rank correlation between gifts and expectations of what others give is 0.58 in SO while we find only 0.25. All these correlations, however, are rather sensitive with respect to extreme behavior and expectations. The correlation (ours as well as SO's) is supported by several (5, 5) pairs, i.e. subjects who give 5 and expect the other to give 5, with the consequence that the benefactors have only

[4] This excel-sheet containing the results can be ordered from the authors. Please observe the German notation where the decimal point is substituted by a comma.

[5] Our students are 30 - 40 % Polish and 10 % from all over the world. The rest is from (mainly East) Germany.

5 euros left while the beneficiary has 10. In our experiment, there are three cases of zero gifts accompanied by “frivolous” expectations of a gift of 10 euros by the other beneficiary. Without these three (strongest possible) anticorrelation decisions, the correlation coefficient would have been 0.52 ($p = 2 \cdot 10^{-7}$). In Table 2, correlation coefficients (gifts and expectations according to (a)) are given for different types according to (b). All these coefficients are high except in one group. So SO’s question with respect to the nature of this correlation remains relevant.

	winners’ gifts (stand. dev.)	winners’ expectations (stand. dev.)	Correlation (p-values)	N
SO	0.246 (0.174)	0.247 (0.126)	0.58 (10^{-12})	120
BCG/SO	0.139	0.187	-	30
BCG/PPM	0.153	0.209	-	20
BHV	0.23 (0.18)	0.30 (0.20)	0.25 (0.007)	100

Table 1: Results of Solidarity Games (2 winners case). SO = Selten and Ockenfels (1998), BCG/SO = Repetition of SO by Büchner et al. (2003). BCG/PPM = Büchner et al’s (2003) results if winners are informed about their role. BHV = our results. Gifts are relative to the endowment.

(b) When knowing the other’s gift

Under (b), the subjects decided on their gifts with the knowledge of the contribution of others, their conditional gifts provide us with a “reaction curve”.

Let us start by describing individual behavior. We differentiated between constant and decreasing (crowding-out) reaction curves, imitation, and “else”. In Table 3 in the Appendix, further differences are indicated. The “else” case collected all those cases which could not be identified as one of the other types. 4 of the 100 winners did not provide us with complete reaction curves. The results are given in Table 2. We see that 37 subjects have downward sloping reaction curves. 8 of the imitation cases consisted of total imitators, i.e. subjects who wanted to give exactly the same as the other winner.

Types:		Const-ant	Crowding out	Imitation	Else	Incom-plete	Aggre-gate
Number:		15	37	25	19	4	100
Average x^a		1.2	3.49	1.07	2.86	2.75	2.33.
Average e		2.95	3.10	2.79	3.26	3.00	3.00
Average x^c		1.61	2.36	3.00	3.44	4.25	2.70
Correlation x^a to e (p-value)		-0.2 (0.78)	0.45 (0.003)	0.81 ($3 \cdot 10^{-5}$)	0.47 (0.02)	-	0.25
Consistency*: $\left\|x^a - x^b(e)\right\| \le 0.5$		14 (93 %)	22 (59 %)	16 (64 %)	12 (63 %)	-	67 %
Forecast by Consensus[+] $\|\Delta\| \le 0.5$	$\hat{x}^a$	14 (93 %)	23 (62 %)	-	13 (68 %)	-	70 %
	$\hat{e}$	3 (20 %)	21 (57 %)	-	9 (47 %)	-	46 %
Strategic First Movers	$\left\|x^a - x^c\right\| \le 0.5$	12	24	9	12	1	58
	$x^a - x^c > 0.5$	1	7	1	1	0	10
	$x^a - x^c < -0.5$	2	6	15	6	3	32

Table 2: Types according to reaction curves (b) and behavior in (a) and (c). *For integer expectations 0 < e < 10, $x^b(e) = ½(x^b(e - ½) + x^b(e + ½))$. + For forcasts of 0 and 10 the width of the interval of correct answers is 0.5; for forcasts $\hat{x} \in [0.5,\ 9.5]$, it is 1. Thus the average width is 0.63 for constant behavior and 1.00 for crowding-out behavior. In “else” behavior, sometimes an interval of forecasts results which caused an average width of correct answers of 1.63. The average width for imitation behavior is too large to deliver meaningful results.

The existence of these total imitators was a reason for us to have a closer look at imitation and be it only partial. 18 other cases start with (0, 0.5, …) or (0, 1, …) or (0, 0, 1, …), i.e. with 0 followed by the midpoint or the lower or upper limit of the first (second) interval. The imitation behavior lasts for different numbers of intervals (between 2 and 11) but contrary to the behavior of the 5 total imitators it breaks down at a certain contribution. 12 of the 25 imitators have a “$\cap$” shaped reaction function, i.e. they switch from imitation to crowding out. Figure 1 shows the average reaction curves of the two largest classes as well as the total average of reaction curves. The influence of imitatiors on the one hand and crowding-out behavior on the other is even clearer in Figure 2.

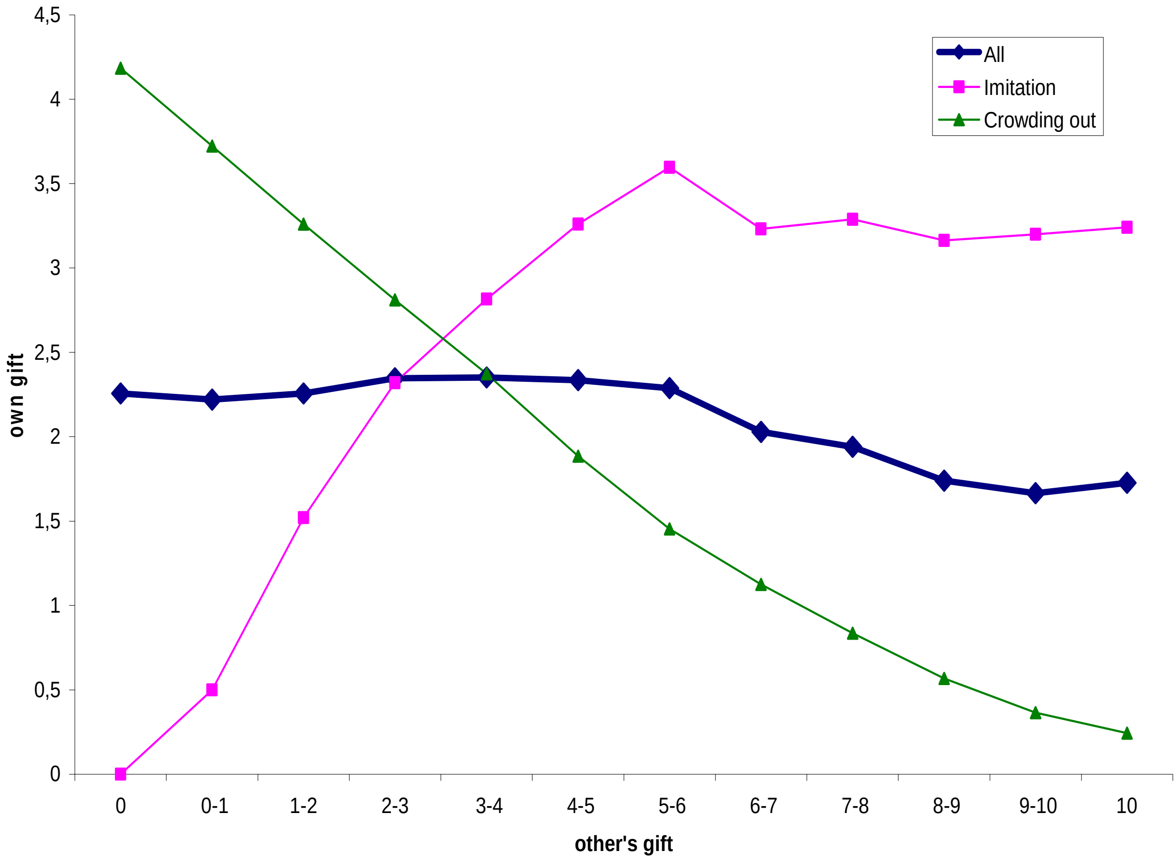

Figure 1: Reaction to others' gifts.

In Table 2 the frequencies of the different types according to the subject's reaction curves are given. In addition, we can compare their behavior in parts (a) and (c) of the experiment. The average x^a values show large differences across the groups. In a t-test all differences except constant/imitation and crowding out/else turn out to be significant ($p < 0.05$). The average expectations e, on the other hand, vary far less; we do not find significant differences except for crowding out/imitation ($p = 0.05$). Also the average x^c does not differ much, except for the "constant" group compared with the others. Consistency is measured by inserting the expectation e from part (a) into the reaction curve of part (b). As the subjects determine their reaction with respect to intervals like [3, 4) we defined consistency as a deviation not larger than 0.5. The average consistency is 67 % and even in the lowest consistency group we have 59 %.

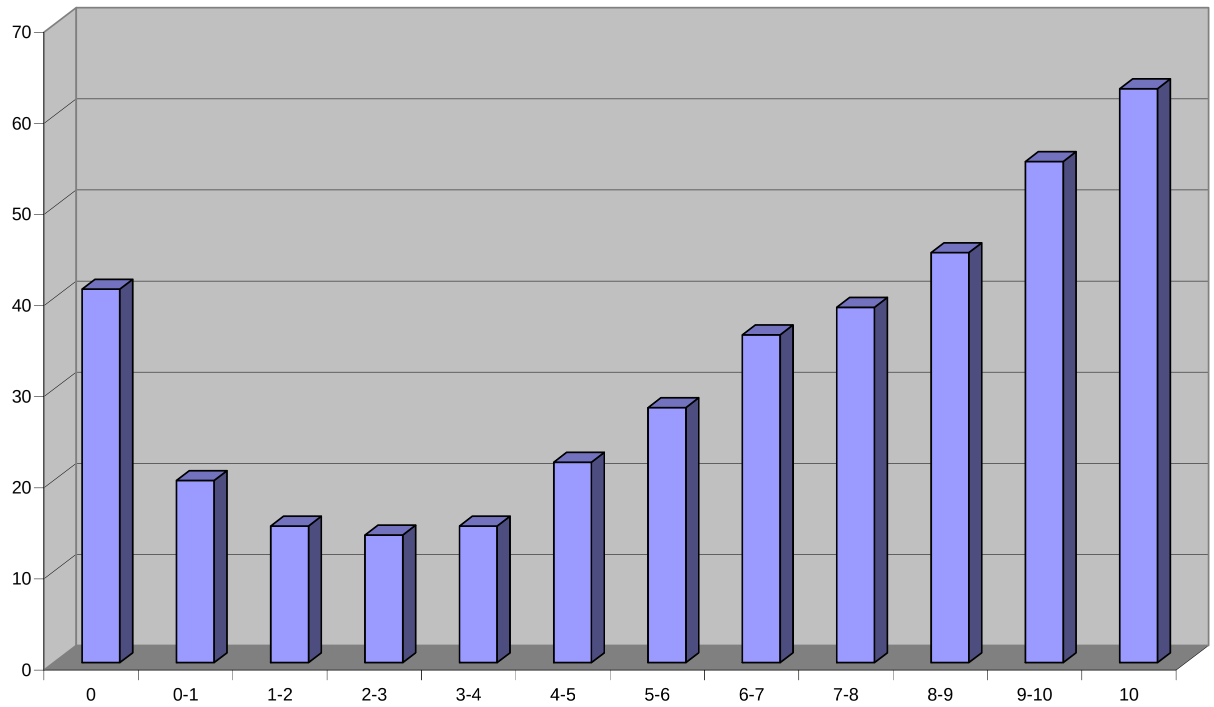

Figure 2: Percentage of 0-gifts

The correlation between x^a and e varies a lot among groups. It is not surprising that it is so large for imitators but the value for the crowding-out group is surprising – at least at first glance. If we assume, however, that the consensus which is expressed in the positive correlation stems from the subjects' assumption of similar or even identical reaction curves then $x^a = e$ and thus a positive correlation is also implied by crowding out behavior. The same applies for constant reaction curves.

The consensus hypothesis: Subjects expect others to decide according to the same reply function as they do.

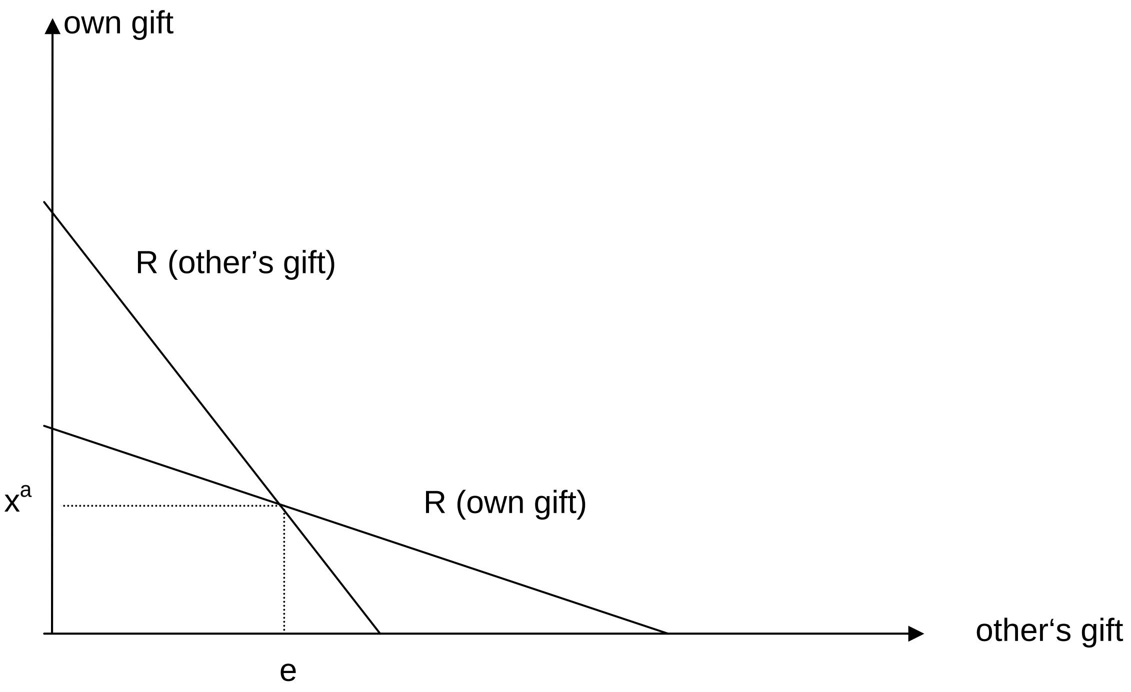

Figure 3: Consensus on reaction curves leads to $x^a = e$.

Contrary to these point expectations we get interval expectations in the case of imitators. For total imitators every expectation between 0 and 10 is an equilibrium expectation. As (often large) intervals have only little value as predictors we leave the imitating subjects out of this analysis. Under the remaining 71 subjects there are 50 subjects whose gift determined in (a) is among the equilibrium values or in a distance of not more than 0.5 which may be due to rounding (see above). The fit of the estimated e-values is worse, in particular in the case of constant behavior. (See Table 2.)

(c) Strategic gifts

With an average contribution of 2.70 euros, the subjects give a bit more under (c), i.e. if they know that the other winner is informed about their gift, than under (a). Comparing the decisions of the 100 winners we find that 58 times they kept their gift constant (= deviation smaller than 0.5). Strategic first mover behavior under the assumption of consensus would imply no change for the “constant” types, decreasing gifts for the “crowding out” types and increasing gifts for the “imitators”. For the behavior of the other subjects we have no apparent hypothesis. The results in Table 2 show that our expectations are met by and large by the types with constant and imitation behavior. The “crowding-out” types, however, do not seem to follow the hypothesised pattern though, perhaps, their decreasing reaction curve might be “too flat” to produce an effect larger than 0.5. Except for the comparison constant/else, χ^2-tests show highly significant values (p from 0.002 to $3 \cdot 10^{-15}$).

One possible further source of information about the subjects are their pseudonyms (see Table 3). In Bolle (1998), it turned out that pseudonyms of others (if known) may influence one’s behaviour. This is supported by Charness and Gneezy (2003) and also by Scharlemann et al (2001) where subjects could send signals to co-players by means of “smileys”. In this paper, we might perhaps find out how the pseudonyms are perceived by others (questions: is this person intelligent, generous, etc) and look for connections between these perceptions of the subjects and their behavior.

IV. Conclusion

In an extended Solidarity Game, we have investigated the causes of the positive correlation between one’s own gifts and expectations about what others give. We find that the largest class of reactions to known contributions of others consists of decreasing functions. Many of the other reaction functions decrease for medium and large values of the other’s solidarity contribution. The positive correlation and the negatively sloped average reaction curve seem to contradict one another. The contradiction disappears, however, if we assume the level of the reaction curves and the expectations to be positively correlated. This is implied if we assume that the subjects form “rational expectations” under the assumption that the other benefactor decides according to the same reaction curve. About 70 % of the gifts and 46 % of the expectations can be explained by such a (*false) consensus* effect. In addition, we found a lot of consistency between behavior in (a) and (b) (67 %). The impression of strategic and consensus driven behavior is, however, a bit dampened by the fact that only 6 of 37 “crowding out” types decreased their contribution in the first mover role.

For a large group of subjects, we found the wish to imitate the other, at least in the case of small gifts. That means, the reaction curves of (partial) imitators start with an increasing section which has a slope of 1. These persons seem to be uncertain about the social norm in such a situation and are ready to adapt by imitation[6] – as long as imitation is not too expensive.

Finally, the positive correlation between one's own gifts and expectations of others' gifts which, at first glance, looks rather peculiar, has a predominantly rational explanation. It seems to stem from (limited) imitation behavior and strategic contributions under the assumption that the other is similar to oneself.

[6] If money is collected in the office (for whatever purpose) the first contributors often set a norm.

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(Front page)

Number: ………………

Pseudonym: ………………………

General Instructions

Of all those present, groups of three are formed by chance. Two of the three (also selected by chance) get 10 euros, the third gets nothing. The two who get 10 euros, can give as much as they like to the third person.

We do not only ask for your decision, but you really get the money connected with your choice. If you are "the third person" you really get the money the two others give away.

Your decision can be made under three different kinds of information: (a), (b), or (c). You are to decide on each of the three cases. Later on, for every group it is determined by chance whether both receivers of 10 euros decide according to (a) or one according to (b) and one according to (c).

You have got 10 euros!

[In the case of a "loser": You have got 0 euros.

What do you think you will get altogether from the two others?

Reply: I believe I will get …..,….. euros.

Now we want to know how you would have decided, if you had been one of those who had got 10 euros.]

(Back page)

(a) What will you give if both owners of 10 euros do not know what the other gives?

Reply: I will give …..,….. euros.

What do you expect the other owner of 10 euros to give under these circumstances?

Reply: I expect the other to give …..,….. euros on average.

(b) What will you give if you know what the other owner of 10 euros has given?

Reply:

The other gives ... euros	**I give … euros**
0	
0 – 0.99	
1 – 1.99	
2 – 2.99	
3 – 3.99	
4 – 4.99	
5 – 5.99	
6 – 6.99	
7 – 7.99	
8 – 8.99	
9 – 9.99	
10	

(c) What will you give if the other is first informed about your contribution before he decides?

Reply: I will give ……,………. euros.

Rewards:

Rewards can be obtained from (date) onward in Room 242. For this purpose, please remember your number and your pseudonym.