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Abstract: In Dictator Game experiments where the information status of the recipient varies we find that a certain type of donator tends to reduce his offer when the recipient has incomplete information about the pie size. This result provides new evidence on those approaches on altruism, which assume that the donator takes care for the recipient's utility when making his altruistic choice.

1 Introduction

The analysis of altruistic behavior has almost simultaneously become attention in economics and psychology – see e.g. Simon [1957], Becker [1974] and Collard [1978] for the analysis of its economic aspects and e.g. Homans [1961], Bryan and Test [1967] and Rosenhan and White [1967] for the analysis of its psychological aspects. Altruistic Behavior (which is also called 'pro-social behavior' in psychological terminology) represents any behavior which has to do with sharing a pie (as in the Dictator Game), helping other people or donating. Altruistic behavior can be observed under many circumstances, in every-day situations as well as in situations of distress.

As in most other topics, psychological approaches are more concerned with the processes leading to altruistic or non-altruistic behavior while approaches in economics rather focus on the decisions of human beings which are then interpreted in the sense of altruism or in any other sense. The differing analysis is revealed when comparing the design and aims of economic with psychological experiments on altruistic behavior.

In economics the Dictator Game is the most prominent experiment to test the existence of altruism. In this game Person A, the dictator, is able to decide how to share a pie between

himself and Person B. Since the recipient is not able to react to the decision of the dictator, the dictator can be influenced by the recipient (if at all) only implicitly. Thus, the anonymously played Dictator Game is interpreted in the sense of a test for altruistic motives, since Person A is able to express his preferences with respect to his willingness to reduce his own level of consumption in favour of Person B.

The core results of Dictator Game experiments (see e.g. Forsythe et al. [1994]) is that approximately one-third of the participants give nothing while roughly two-thirds of the participants give somewhere between 20% and 50% of a pie of a \$10 size. This observation found support in later experiments by Hoffman et al. [1994], Camerer and Thaler [1995], Bolton and Zwick [1995], Eckel and Grossman [1996] Andreoni and Miller [2002] and Andreoni and Vesterlund [2001], where the modal and average offer to the recipient varied between 20% and 25%.

In contrast to this, classical psychological experiments on altruistic behavior focus on the conditions under which a certain person is ready to help a second person who is in need of help. They aim to find out to what extent the willingness to help the other person depends on conditions like being the only person around, or being together with a second or with many other persons, being together with friends or strangers (c.f. e.g. Latané and Rodin [1969], Wilson [1976] or Hansson and Slade [1977]). And they found out that the willingness for altruistic behavior depends very strongly on these differing conditions and framing.

Today the existence and relevance of altruism is accepted in both professions. However, the impact of altruistic behavior has rarely been considered in more general models.² The reason might be that altruism is an elusive concept, not only in theory, as Simon [1993] has highlighted, but also when it is tried to isolate altruistic from similar behavior in controlled experiments. From a theoretical point of view, it is difficult to define i) the utility of the recipient, ii) the utility and the cost of altruistic choices for the donator and iii) the motivation of the donator to make such choice.

The main difference between the two professions when trying to model altruistic behavior is that the majority of the psychological approaches view an altruistic choice as being determined by the intention of the donator who aims to increase the utility of the recipient. This means that the donator should have the ability to feel and to understand (as psychologists would argue) or should have the necessary information to know (as economists would say) what kind of choice will increase the utility of the recipient. This further means that the donator, when deciding about his choice, might be influenced by his beliefs about the recipient's beliefs, even if an experiment – like the Dictator Game – is played under complete anonymity.

With one exception, the most economic definitions approach altruistic choices from a consequential point of view. According to these models the donator aims to increase the income of the recipient (cf. e.g. Collard [1978]). It is only the model of Becker [1974] where it is assumed that altruistic moves aim to increase the utility of the recipient.

In this paper we will further investigate this decisive variable of altruistic behavior. In order to get a better understanding whether it is the utility of the income of the recipient which the donator aims to increase by his altruistic choice we have developed a modified Dictator Game where the recipient has only incomplete information about the pie size. We will use the typical Dictator Game (as determined by Forsythe et al. [1994]) as a benchmark and we will compare behavior in the usual Dictator Game with the modified Game.

In Section 2 we will very shortly describe the income-based and the utility-based approaches on altruism and we will discuss the implications of the Dictator Game under incomplete information for both approaches. In section 3 we will describe the setting of two Dictator Game Experiments: one under complete, one under incomplete information. In the latter experiment, the dictator knows the size of the pie while the recipient knows only the probability distribution of the potential pie sizes. In section 4 we will derive some predictions. Section 5 presents the results: Those dictators who received large pies either offered the recipient a share relatively close to the equal split of the large pie (and, thus, revealed the

true size of their pie) or they pretended to have received a small pie and offered the recipient half of the small pie or even less. This specific behavior can be explained only by altruism as deduced from the utility-based approach. Section 6 concludes.

2 A Dictator Experiment with an Uninformed Recipient

In this section, we will only give a very brief introduction of the two approaches on altruism, as they are used in economic theory. In most approaches on altruism, it is assumed that a person's utility is influenced by other persons' consumption of goods or by other persons' income.

$$U_i = V_i(x_1, \dots, x_i, \dots, x_n), \quad i=1, \dots, n, \quad \text{with } x_j = \text{income (or consumption) of person } j. \quad (1)$$

where x_i represents i 's consumption, and x_1, \dots, x_n represent the consumption of individuals j with whom altruist i interacts. Given (1), i 's utility is increased if j enjoys a higher income.

Gary Becker [1974] has proposed a different utility-based setting:

$$U_i = U_i(x_i, U_1, \dots, U_{i-1}, U_{i+1}, \dots, U_n), \quad i=1, \dots, n. \quad (2)$$

where $U_1, \dots, U_{i-1}, U_{i+1}, \dots, U_n$ represents the utilities of individuals j with whom altruist i interacts. i 's utility is increased if j 's utility ($j \neq i$) is increased or i is 'happy' if j is 'happy'.

The reason for the economists' preference for the income-based approach, however, is not only conviction but also tractability of the model (see also Bolle [1985]). If applied to the standard Dictator Game under complete information, both approaches lead to the same predictions about behaviour. Matters change in Dictator Games where the information status of the recipient is varied. In the usual Dictator Game under complete information, Person 1 (the dictator) is endowed with a known amount of money p which he can divide arbitrarily between himself by keeping x_1 and Person 2 (the recipient) by transferring x_2 . In the experiment we will present here, the Dictator Game is varied insofar as the dictator is

endowed with an amount p which is not known to the recipient. She only knows that $p = p_S$ with probability α and $p = p_L$, with $1 - \alpha$, and she knows $p_S < p_L$.³ In the subsequent analysis we will concentrate on those dictators who received a large pie.

Under the income-based approach on altruism – as suggested by Collard [1978] and others – it is easy to show that the dictator is expected to offer the recipient the same amount x_2 and keep $x_1 = p - x_2$ for himself, irrespective of the recipient's information status about the pie size p .

If the utility-based approach on altruism is applied, the dictator is expected to care about the recipient's beliefs on x_1 and about her utility parameters. To analyse the consequences of this model increases the analytical requirements. In particular, we need to consider what expectations each individual forms about the state of his fellow persons. Therefore, as a first step in analysing the incomplete information approach, it would be necessary to explain the formation of consistent expectations under incomplete information and then to solve the resulting systems of equations which allows to derive predictions about the expected behavior of the Dictator in a Dictator Game under incomplete information (for a detailed analysis c.f. Bolle and Kritikos [2004]). In this paper we will provide only a non-formal description.

Let us start with the expectations of the recipient. Experience from previous Dictator Game experiments implies that the recipient has expectations about the transfer x_2 she would receive under complete information. It is reasonable to assume that she expects no dictator to give more than half of his endowment. By giving more than $p_S/2$ the dictator would uncover that he has the large pie ($p = p_L$). By proposing less than $p_S/2$ he can make the recipient believe that $p = p_S$, at least with a certain probability.

Earlier psychological research on equity theory (cf. e.g. Walster et al. [1978]) and on the theory of justice (c.f. e.g. Mikula [1983] and Reis [1983]) may allow now for the assumption,

that there are two dimension which might increase the utility of the recipient, the absolute and the relative amount the dictator is transferring to the recipient. With respect to the relative amount it is further necessary to define what kind of relative amount will increase the utility of the recipient. Among the existing criteria for distributive justice (cf. e.g. Mikula [1983], Konow [2001]), the justice of equality seems to be the most appropriate with respect to the dictator game. Transferred to the Dictator Game under incomplete information this means that the recipient's utility is higher the closer the amount seems to be equal to the equal split of the pie⁴ and the higher the amount (in absolute terms) transferred to him.

Given that the distribution of p is common knowledge and given that the expectations of the recipient are consistent with those of the dictator, we expect to observe four different types of dictators, if endowed with a large pie p_L . A first type of dictators is expected to decide to transfer more than $p_S/2$, indicating that they were endowed with p_L . Since they are ready to reveal their type, they will give the same amount as under complete information. It makes sense to assume that these dictators are those types who give most under complete information. Of course, the border between this first type and the other types to be described is not exogenously given but determined by the analysis of the situation.

The second type of dictators (who received a large pie) will decide to transfer $x_2 \leq p_S/2$ under incomplete information. Dictators who would have proposed not much more than $p_S/2$ under complete information, may increase their utility by reducing x_2 below $p_S/2$. If dictators expect that the recipient's utility can be increased by making her believe that she received a substantial share of the small pie, they may decide to give less than $p_S/2$. Hence, the utility of the recipient and, consequently, the utility of the dictator will be increased.

On the other hand, x_1 and x_2 are not equal to their optimal values. The description of the two types makes it possible to distinguish between those who reveal the true size of their pie and those who hide behind the small pie. Those dictators (who would have given more than

half of the small pie in the complete information setting) will now have to compare the 'indirect' utility increase of the recipient from reducing their transfer to an amount less than half the small pie (but close to the seemingly equal split of the small pie) with the 'direct' utility decrease from reducing their transfer below the optimal level. It is reasonable to expect that the 'direct' utility decrease is higher the more x_2 has to be reduced under incomplete information in comparison to the optimal x_2 under complete information.

However, it is still open how much dictators pretending to have received the small pie are expected to propose. Under complete information, it would be optimal to offer $x_1 > p_S/2$, under incomplete information the dictator would like to reduce his proposal as little as possible. According to the analysis he would prefer to transfer an amount exactly equal to $p_S/2$ or just below $p_S/2$. Yet, if the recipient not only notes whether $x_2 \leq p_S/2$, but also takes into account the exact amount of x_2 , then $x_2 = p_S/2$ will make her "distrustful". Therefore, an extended analysis with a sophisticated updating process should show that not necessarily all types of dictators would propose an amount of approximately $x_2 = p_S/2$ but that every type may have a personal optimum. Of course, the dictator can hide his large pie only if there are dictators who would offer the same amount x_2 when endowed with a small pie.

There is a third type of dictators with p_L who would offer $x_2 < p_S/2$ even under complete information. They will further reduce x_2 , as well. Then, there is a fourth type of dictators who does not give anything under complete information. They do not change their strategy because of the change of the information status.

Conclusion: In comparing Dictator Game experiments with complete and incomplete information, the following expectations can be deduced: The Utility-based approach predicts for dictators endowed with p_L four different behavioural patterns. First, there are dictators who offer a larger share up to the equal split under complete information and who are

expected not to change behavior under incomplete information. The second type are those dictators who give not much more than $p_s/2$ and the third type those who give less than $p_s/2$ under complete information. Under incomplete information the second type will propose less (but close to) $p_s/2$, the third type will further reduce their offer and the fourth type who transfers nothing under both conditions. (See Figure 1, bold curve.) For more types of dictators the described monotone matching of types and contributions under complete information may be less strict. The expected behavioural changes should show the same, but less extreme tendency.

- insert Figure 1 about here -

3 Experimental Design and Procedure

DESIGN: The present experiment encompassed two different treatments, the basic Dictator Game (Game 1) and the Dictator Game under asymmetric information (Game 2). The basic Dictator Game aimed to confirm previous results and to serve as a baseline treatment for comparison with Game 2. In both treatments, a dictator was anonymously matched with a recipient. The dictator received an endowment of either 10 Euro (the large pie) or 1.15 Euro (the small pie).⁵ In Game 1 the recipient knew the endowment of the dictator. Game 2 differed from Game 1 only in one variable: the recipient did not know the exact size of the endowment but was informed that the dictator received a large pie with probability 2/3 and a small pie with probability 1/3. All other variables were kept constant in both games (for the Instructions see Appendix A).

ORGANISATION: 240 undergraduates from the Europe-University participated in the entire experiment – 120 in each session. They were recruited through announcements in lectures. Participation required appearance at a prearranged place and time and was restricted to one session. Upon arrival participants were randomly assigned to their roles as dictator (Person A) or recipient (Person B). In both treatments 40 dictators were endowed with the large and

20 with the small pie. Throughout the sessions participants were placed in two separate rooms. All experiments were conducted once, after the participants had received written and verbal instructions about the setting. All participants were randomly and anonymously matched.

PROTOCOL: In each session all dictators received an envelope containing the written instructions and the amount of the pie, split into many coins enabling the dictator to propose any amount to the recipient he preferred. The written instructions used the same script for both treatments with the only modification that in Game 1 the recipient was informed about the size of the pie the dictator had received and that in Game 2 the recipient was informed about the probability distribution with which the dictator had received either one of the two pies. To ensure complete privacy for the decision, cubicles were offered. The dictators put the amount devoted to the recipient back into the envelope, put the envelope into a box where all proposals were collected and pocketed their own share of the pie. The box was then transferred to room B and randomly distributed to the recipients after two neutral persons had registered the amount in each envelope in a third room. Thus, it was not possible to attribute any individual action to individual subjects.

REMARK ON THE ANALYSIS OF BEHAVIOR: When the experiment was designed it became clear that the smaller the small pie was in the incomplete information setting the easier it became to discriminate between the behavior of those dictators in the two treatments who received the large pie. At the same time, the smaller the small pie, the less it became possible to discriminate between behavior of those dictators in the two treatments who received the small pie. Since we decided that the decisions of dictators who received the large pie are our central focus, we chose the small pie to be 'very small' with €1,15. Accordingly, we will restrict the analysis to those dictators who received the large pie.

4 Predictions

Starting with the unique 'egoistic' equilibrium prediction, the dictator would make no positive offer to the recipient no matter how the recipient is informed about the pie size the dictator received (H0a). Application of the income-based approach on altruism is straightforward as well. It results in (H0b), the distribution of the dictator proposals should be the same under both conditions, irrespective of the information status of the recipients.

Application of the utility-based approach on altruism leads to the following hypotheses given the parameters of small and large pie and given the results presented in Figure 1. In comparison to Game 1, among those who received the large pie in Game 2 (where the recipient has incomplete information), we expect that

H1) more subjects will offer nothing or less than 0.6 Euro (around half the small pie),

H2) less subjects will offer amounts between 0.6 Euro and 2.6 Euro,

H3) about the same number of subjects will offer between 2.6 and 5 Euro.⁶

This leads to the overall hypothesis that dictators who were endowed with a large pie will make on average lower proposals under incomplete than under complete information.

5 Experimental Results

In a first step we examined whether the data of the present €10 Dictator Game under complete information is similar to the \$10 Dictator Game experiment of Forsythe et al. [1994, p. 366] - which served as a baseline treatment in previous studies. A comparison shows that the distribution of proposals, the modal offer (most of the participants offer between 20% and 25% of the pie) and the average payoff (22.3% in the Forsythe et al. and 20.4% in the present experiment) are similar. (No significant difference in behavior by Mann-Whitney U test, $p=0.2912$). This indicates that the behavior of the present 'population' is comparable with earlier observations.

The analysis of the present study focuses on the comparison of the dictator's willingness to transfer a certain share of his pie to the recipient when the information status of the recipient is varied. Starting with the 'overall hypothesis' of the average offer, dictators who had received the €10 pie in Game 2 proposed on average 11,4% of the pie, half of what dictators offered under complete information in Game 1 (20,4%). (An overview of all offers in the two games is given in Table 1.) A Kolmogorov-Smirnov Test verifies that the distribution of proposals is significantly lower in Game 1 than in Game 2 ($p < 0.01$). H_0a and H_0b can be rejected.

This leads directly to the three hypotheses H1 to H3. In Figure 2 we have ordered the results of Games 1 and 2 in such a way that the hypotheses can be compared. Starting with the share of participants who made proposals close to the unique 'egoistic' equilibrium outcome, i.e. nothing or less than 60 cent, we observe an increase from 23% to 60% in the asymmetric information game (in support of H1, Fisher's probability test shows $p = 0.017$).

This observation indicates that indeed some participants tried to signal to the recipient that they had received the small instead of the large pie. Moreover, the high share of participants giving even less than half the small pie further supports our approach in two ways (see also the distribution in Figure 2): not only participants who had given less than half of the small pie in game 1 reduced their offers further to (almost) zero, but also participants who had given slightly more than $p_s/2$ reduced their proposals to an individually calculated optimum which was not necessarily equal to $p_s/2$.

Figure 2 also provides answers to the two further hypotheses: In (H2) we hypothesised a sharp decrease of offers in the range between 0.60 and 2.60 Euro since it was expected that those dictators who gave less than $p_s/2$ in game 2 would have been of this type. Our data suggest this to be true since there were only 20% in Game 2 – as opposed to 50% in Game 1 – who offered an amount between 60 cents and 2.60 Euro (in support of H2, $p = 0.005$).

Coming to the final hypothesis (H3) it was asserted that dictators who transfer a relatively high share of the large pie under complete information would do the same thing under asymmetric information. The reason for this expectation is that this type of dictator might be ready to signal his large pie to the recipient. Since he is willing to sacrifice more than the average offer in favour of the recipient he probably expects the recipient to consider the proposal as utility increasing. In Game 1 the share of dictators of this type was 27%, in Game 2 it was 20%, showing no significant difference ($p=0.3$) between the settings.

Last but not least, some remarks should be made about the divisions of the small pie under incomplete information. As mentioned above, due to the small size of the small pie we did not expect any significant differences in behavior between persons in both settings and the experimental results showed that the decisions were indeed nearly the same. However, it is interesting to note that all dictators endowed with a small pie in the incomplete information game transferred either nothing or less than €0.6. Thus, it was possible for those persons A who were endowed with a large pie and who gave less than €0.6 (60% of the participants with the large pie gave less than €0.6 in the incomplete information game), not to reveal the true size of their pie, since all participants endowed with a small pie gave a similar amount to Person B. (This argument is, of course, based on Rational Expectations of the subjects.)

Result: The experiment provides support of the utility-based approach to altruism. While income-based approaches expect dictators to offer the same amount to the recipient irrespective of her information status we observe significant changes in dictator behavior once the recipient has incomplete information about the size of the pie. Only those dictators who offered more than the modal offer in the complete information setting behave in the same way when the recipient does not know their pie size. They expect the increase of the recipient's utility to be sufficient even if they reveal the size of their pie. All other dictators making positive proposals of less than or approximately the modal offer in the complete information setting decided to reduce their offers to half of the small pie or even less under

incomplete information. By doing so they may have expected to be able to increase the recipients utility more than by revealing the true size of the pie.

6 Summary

The present experiment compares the willingness of dictators to make offers to anonymous recipients when the information status of the recipient is varied. In the baseline treatment where the recipient is fully informed about the pie size, dictators give similar amounts as in previous studies. In the second treatment where the recipient is only informed about the probability distribution of the two pie sizes, dictators still give non-trivial amounts, but some of them significantly reduce their transfers. In comparison the complete information treatment, in the treatment with incomplete information about the two pie sizes we differentiate between four types of dictators (among those dictators who received a large pie): Dictators who keep the complete pie for themselves, dictators who transfer less than or little more than half of the small pie and dictators who offer up to the equal split of the large pie. Having received the large pie, the first and the fourth type of Dictators did not change their behavior under incomplete information. The intermediate types, however, instead of revealing their pie size, preferred to hide the amount of their own income by reducing the offer: They induced the recipient to believe that he had received a considerable or a small amount of the small pie instead of a small or a very small amount of the large pie.

Utility-based approaches on altruism (as they are more favoured in psychology than in economics) are able to give a thorough explanation of the observed behavior. Since dictators may have anticipated that recipients have a 'justice' component in their utility functions, they may propose offers which could be interpreted as considerable amounts of the pie, whatever its size. Thereby, dictators expected to increase the recipients' utility in a better way than by giving, for example, slightly more than half of the small pie as many of them might have done if the recipient had complete information about the pie size.

There is a second result important to be emphasised, namely in the sense that these choices can be interpreted as altruistic: We observe that some dictators are still ready to transfer almost half of the large pie although they could have easily hide behind the small pie, as well.

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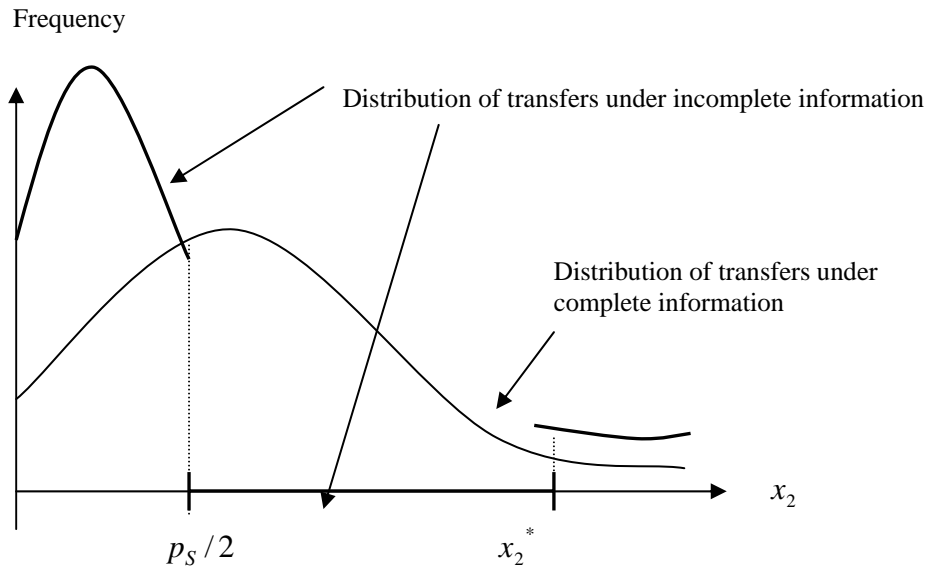


Figure 1: Expected changes of the distribution of transfers from a dictator endowed with m_L .

Percentage of offer

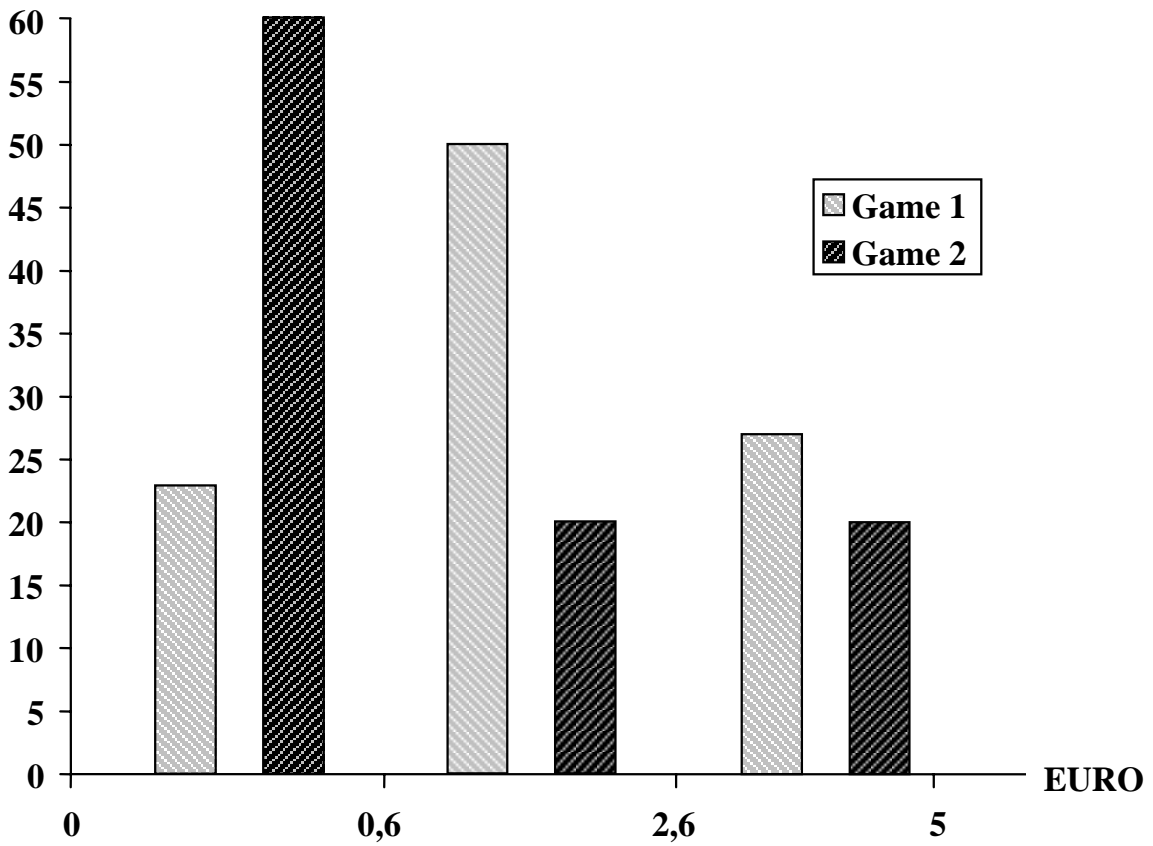


Figure 2: Cumulative Results of Dictator Transfers in Game 1 and Game 2 (according to Hypotheses 1 though 4)

Dictator Offer in	Game 1	Game 2
0.00	4	11
0.10	--	3
0.16	1	--
0.26	--	2
0.31	1	--
0.42	--	1
0.52	1	2
0.57	2	5
0.62	2	1
0.94	--	1
1.00	1	--
1.04	--	1
1.15	6	4
1.67	3	--
2.08	1	--
2.19	6	--
2.34	--	1
2.59	1	--
2.66	--	2
2.92	--	1
3.23	2	--
3.65	1	--
3.75	--	1
4.00	1	--
4.27	1	--
4.48	--	1
4.53	1	--
4.74	--	1
4.80	2	2
5.00	3	--

Table 1: Offers of Dictators in Game 1 (complete information) and Game 2 (incomplete information)

Appendix A: Instructions to the players in the Dictator Experiment

In the description the instructions for player A are presented. Differences corresponding to the two treatments are indicated in boldface. For the instructions of Person B the obvious changes were made.

Instructions For Player A

You have been asked to participate in an economics experiment on individual decision making. For your participation you may earn some money which will be paid to you right away. Before you make any decision please read carefully the following instructions. If you have any questions, don't hesitate to ask the experimenter.

In this experiment each of you will be paired with a different person who is in another room. This is room A and you are Person A. The person who will be paired with you is Person B in Room B. You will not be told who these people in Room B are either during or after the experiment, and they will not be told who you in Room A are either during or after the experiment. You will notice that there are other people in the same room with you who are also participating in the experiment. You will not be paired with any of these people. The decisions that they make will have absolutely no effect on you nor will any of your decisions affect them.

Game 1 is conducted as follows: A sum of DM 19.55 (DM 2.25) has been allocated to you in coins in the envelope. The person B who is matched with you knows that you have received this amount. You are now asked to propose how much of this each person is to receive. You are free to propose any amount you like to give to person B: nothing, something or the whole sum.

Game 2 is conducted as follows: A sum of DM 19.55 (DM 2.25) has been allocated to you in coins in the envelope. There are 39 (40) more players who received DM 19.55 and 20 (19) more players who received DM 2.25. Person B who is paired with you does not know the exact amount allocated to you. Person B knows that you received DM 2.25 with a probability of 33.3% and DM 19.55 with a prob. of 66.7%. You are asked to propose how much of the amount of DM 19.55 (DM 2.25) each person is to receive. You are free to propose any amount you like to give to person B: nothing, something or the whole sum.

For your decision you may use the cubicles in the room. You will have five minutes to come to a decision about your proposal. If you made your decision about the amount which you like to propose to person B, put the respective amount into the envelope and put the envelope into the box next to your cubicle. Then you may pocket the amount you have allocated to yourself right away. Do not talk to the other people in your room until your session is completed. Do not be concerned if other people make their decision before you.

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² Recent research showed that altruism is evolutionary stable, at least under certain conditions, cf. Bester and Güth [1999] and Bolle [2000].

³ Güth and Huck [1997] conducted a similar experiment where the recipient had incomplete information about the pie size. In contrast to the present experiment, they used the strategy method and had no control setting under complete information, which made it impossible to use their data for our test. It should also be emphasised that the focus of their paper was completely different to ours.

⁴ Recent theoretical approaches of Fehr and Schmidt [1999] and Bolton and Ockenfels [2000] also made use of psychological equity theories. However, these approaches are not apt for decisions under incomplete information as analysed here. See also Kritikos and Bolle [2001] for a different perspective in relation to these two approaches.

⁵ The experiment was conducted in November 2001 using German currency. Thus, the pie size was then 19.55 DM for the large and 2.25 DM for the small pie. Therefore, no prominence effects could occur in the experiment.

⁶⁶ Remember that the experiment was conducted in German currency where 2,6 Euro transfers to DM 5.