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MONEY DOES NOT INDUCE RISK NEUTRAL BEHAVIOR, BUT BINARY LOTTERIES DO EVEN WORSE

ABSTRACT. If payoffs are tickets for binary lotteries, which involve only two money prizes, then rationality requires expected value maximization in tickets. This payoff scheme was increasingly used to induce risk neutrality in experiments. The experiment presented here involved lottery choice and evaluation tasks. One subject group was paid in binary lottery tickets, another directly in money. Significantly greater deviations from risk neutral behavior are observed with binary lottery payoffs. This discrepancy increases when subjects have easy access to the alternatives' expected values and mean absolute deviations. Behavioral regularities are observed at least as often as with direct money payoffs.

KEY WORDS: Binary lottery payoffs, Choices under risk, Risk preferences, Design of experiments, Experimental economics

1. INTRODUCTION

A binary lottery is a simple or compound lottery which involves only two possible money prizes, a high one and a low one. Consider the situation of a decision maker who is confronted with the choice between two binary lotteries involving the same high and the same low prize. If the decision maker has monotonically increasing von-Neumann-Morgenstern utility for money, he or she must maximize the probability of winning the high prize. Actually one can come to the same conclusion on the basis of much weaker rationality postulates. It is sufficient to assume that the following two conditions are satisfied:

1.1. *Monotonicity*

The decision maker's utility for simple binary lotteries involving the same high prize with a probability p and the same low prize with the complimentary probability 1-p is monotonically increasing in p.

Theory and Decision **46:** 211–249, 1999.

1.2. *Reduction of compound binary lotteries*

The decision maker is indifferent between a compound binary lottery and a simple binary lottery involving the same prizes and the same probability of winning the high prize.

Both postulates refer to binary lotteries only. Reduction of compound binary lotteries is a much weaker requirement than an analogous axiom for compound lotteries in general.

It is now a wide spread practice in experimental economics to motivate subjects by payoffs in tickets for binary lotteries, rather than direct money payoffs. Cedric Smith (1961) discussed a payoff scheme of this kind in the framework of a theoretical paper and used the term ‘probability currency’ in this connection. Roth and Malouf (1979) were the first to use this payoff scheme in experiments. In this way, they wanted to induce risk neutrality, in the sense that subjects were to be motivated to maximize the expected value of their payoffs. Thereby, they had hoped to avoid the problem of different attitudes towards risk reflected by the shape of the subjects’ von-Neumann-Morgenstern utility functions.

The use of payoffs in binary lottery tickets in order to induce risk neutrality relies on the assumption that the subjects’ behavior satisfies appropriate rationality assumptions, at least the two postulates of monotonicity and reduction of compound binary lotteries stated above. If these assumptions are violated, it is by no means clear that payoffs in binary lottery tickets achieve their purpose.

The question whether payoff in binary lottery tickets does or does not induce risk neutrality is not completely new. To some extent it has been posed in the literature before. Table 1 presents an overview of the relevant studies known to us. Not all studies compared experience with payoffs in binary lottery tickets with others in which the same tasks were paid directly in money. Whether this was the case or not is indicated by the column ‘Tickets vs. Money’. The column ‘Interaction’ shows whether the task performed by the subjects involved strategic interaction with other subjects. In the case of strategic interaction additional uncertainty enters the picture. If one wants to examine the question whether payoffs in binary lottery tickets induce risk neutral behavior, it is necessary to avoid a confounding effect which may be introduced by strategic interaction. In Table 1 the only study which compares payoffs in binary lottery

Table 1. Experiments on risk neutrality and binary lottery payoffs

Study	Tickets vs. Money	Interaction	Observed effect of the binary lottery payoff scheme
Berg, Daley, Dickhaut and O'Brien (1986) Prasnikar (1992)	No	No	tendency towards expected value maximization positively correlated to the expected value difference between the two lotteries of a task
Rietz (1993)	No	Auctions	tendency towards expected value maximization if instructions are suitably chosen and subjects are very experienced
Millner and Pratt (1992)	Yes	2-person rent-seeking	more deviations from risk-neutral equilibrium by the *more risk-averse* subjects under the binary lottery payoff condition than by those under the direct money payoff condition
Cox, Smith, and Walker (1985, 1988) Walker, Smith, and Cox (1990) Cox and Oaxaca (1995)	Yes	Auctions	no systematic difference in the behavior of subjects under the binary lottery payoff condition, compared to the behavior of subjects under the direct money payoff condition
Cooper, DeJong, Forsythe, and Ross (1990, 1993)	Yes	Battle of sexes	
This study	Yes	No	more deviations from expected value maximization under the binary lottery payoff condition than under the direct money payoff condition; behavioral regularities (*anomalies*) stronger or equally strong for payoffs in binary lottery tickets

tickets with direct money payoffs and does not involve strategic interaction, is the one presented in this paper.

The column ‘Observed effect of the binary lottery payoff scheme’ in Table 1 presents the corresponding results of the concerning studies. In the first two studies by Berg, Daley, Dickhaut, and O’Brien (1986) and Prasnikar (1992) the authors tend to draw too optimistic conclusions with respect to the effectiveness of the binary lottery ticket payoff scheme, mainly because of the lack of a control group paid directly in money. The evidence provided by the frequency of violations and by the correlation measures presented in both studies is quite weak and does not deal with the issue whether similar or even better results in the tasks examined could be obtained with direct money payoffs.

The first indication that payoffs in binary lottery tickets might be counterproductive, in the sense that they move behavior farther away from risk neutrality can be found in the study by Millner and Pratt (1992). These 2-person-rent-seeking experiments involve strategic interaction. The same is true for the auction experiments by Cox, Smith, and Walker (1985) and Walker, Smith, and Cox (1990), as well as for the experiments with the battle of sexes game by Cooper, DeJong, Forsythe, and Ross (1989, 1990, 1993). In these studies no systematic differences between the effects of binary lottery payoffs and direct money payoffs were found. Rietz (1993) examines the influence of instructions and subjects’ experience on the effectivity of the procedure. His affirmative conclusions, however, are strongly criticized by Cox and Oaxaca (1995). Even if Rietz’s approach cannot completely be dismissed, it seems very difficult to test the induction of risk neutral behavior by applying econometric models to data from complex experimental games. Thus, we chose a non-interactive decision environment which in our view better isolates the possible effects of the procedure and enables a more straightforward statistical analysis.

The experiments presented in this paper show significantly more violations of expected value maximization in the treatments with payoffs in binary lottery tickets than in the treatments with direct money payoffs. The use of the binary lottery payoff scheme proves to be counterproductive. Not only does this procedure fail to induce risk neutrality, it even worsens results in this respect compared to direct money payoffs.

We also examined the question, to what extent well known behavioral regularities of choice under uncertainty also appear in treatments with payoffs in binary lottery tickets. It turns out that the common ratio effect, the reference point effect, the preference reversal effect, and incompatibility with completely ordered preferences respecting stochastic dominance are also observed in experiments with payoffs in binary lottery tickets, to some extent even more so than in others with direct money payoffs.

Sometimes these phenomena are referred to as ‘anomalies’. However, we prefer to speak of ‘behavioral regularities’, since these patterns of behavior are the rule rather than the exception, as shown by many experiments (cf. Kahneman and Tversky 1982; Camerer 1995). Our experiments seem to indicate that the subjects’ attitudes towards binary lottery tickets are not fundamentally different from those towards money. Both kinds of stimuli seem to be processed in a similar way. This results in similar patterns of behavior. In as far as there is a difference, it goes in the opposite direction from what would be expected on the basis of von-Neumann-Morgenstern utility theory.

Our results raise the question, why payoffs in binary lottery tickets tend to produce more violations of risk neutrality and to some extent stronger behavioral effects than direct money payoffs. At the end of the paper we shall discuss a possible explanation.

The conjecture suggests itself, that violations of expected value maximization are partially due to decision costs connected to tedious computations of expected values. In order to examine the validity of this hypothesis, we also performed experiments in which subjects could obtain expected values and mean absolute deviations from expected values by simply striking a key. Comparing the treatments with statistical measures available to those without, we surprisingly found less deviations from expected value maximization only in the direct money payoff condition, but not in the binary lottery payoff condition. Therefore it seems that the counterproductivity of the binary lottery procedure is greater if subjects have easy access to expected values and mean absolute deviations from them.

Table 2. Number of subjects in each of the four treatments

	Statistical measures not available		Statistical measures available on request	
Payoff in lottery tickets	LN	48	LS	24
Payoff directly in money	MN	48	MS	24

2. EXPERIMENTAL DESIGN

Table 2 shows the factorial design of our experiments. The four experimental treatments vary with respect to two dimensions. Payoffs may be in binary lottery tickets or directly in money, and statistical measures may be available on request or not (expected value and mean absolute deviation from expected value). The four treatments will be referred to by the abbreviations LN, LS, MN, and MS as indicated in the table. Each subject participated only once and only in one treatment. Altogether 144 subjects participated in the experiments, among them 62 students of economics, 55 students of law, and 27 others. The experiments were conducted in the *Laboratorium für experimentelle Wirtschaftsforschung* at the University of Bonn, Germany. The participants stayed in the laboratory for 1 1/2 hours on average and earned between DM15.50 and DM39.50 in this time. When the experiments were performed the exchange rate was about $0.60 for DM1.00.

Each subject first had to make 36 choices between two lotteries and then 14 lottery evaluations via the Becker-DeGroot-Marshak selling price elicitation procedure. In this procedure the subject has to name a selling price for the lottery, which is then matched with a random price in the range between zero and the highest payoff. The subject sells the lottery for the drawn random price, if it is higher than or equal to the named selling price. Otherwise the lottery is played out. It is well known that it is a dominant strategy in this procedure to name one's certainty equivalent of the lottery, if higher payoffs are preferred to lower ones.

In the experiments two consecutive tasks were combined to one 'round'. Under the binary lottery condition, payoffs were in terms of tickets for a 'grand' binary lottery at the end of the round (i.e. a 'grand' lottery took place after task 2, 4, 6, ...). Thousand tickets for the grand lottery correspond to the probability of one for winning the high prize, DM2.30. The low prize was DM0.30. The probability of winning the high prize was equal to the number of tickets earned in the two tasks of the round divided by thousand.

In the treatments with direct money payoffs, a window appeared on the screen announcing that the 'round' was over after every second task. This was done in order to keep the framing structure as similar as possible to that of the binary lottery payoff treatments. In this window the amount of money earned in the two preceding tasks of the 'round' was displayed on screen: the points won in the 'round' were 'converted' to money at a rate of DM0.002 per point and a lumpsum payment of DM0.30 was added. The exchange rate and lumpsum payment were chosen such that the DM expected values of the lotteries were equal across all treatments. Thus, the presentation of the point to money conversion induced artificial 'rounds' which were meant to minimize treatment differences based on subjects' perceptions by creating two-task round structures under both conditions.

In the treatments with statistical measures available subjects could obtain expected values (EV) and mean absolute deviations from expected values (MAD) by hitting a key. The values were then displayed on the screen when one of the corresponding buttons was pressed. Each call for an expected value or a mean absolute deviation was recorded by the experimental program. An on-screen calculator was available in all treatments.

The software for the experiments was developed using *RatImage* (Abbink and Sadrieh 1995). The lotteries were presented numerically, but the probabilities were also visualized graphically. The visual representation involved circles with sectors colored in magenta and yellow, whose sizes were proportional to the probabilities. After a choice has been made, a larger version of the corresponding circle with a gray ring on the border was shown on the screen. The gray ring had a display window on its top. The lottery was then 'played out' by using the circle as a wheel of fortune. The wheel would seemingly turn around with the color of the area showing through the display window. Finally, it would slow down and stop at a randomly chosen point with the color in the display showing which prize was won. The random choices were not pre-determined and therefore generally different for each subject. The main screen displays are shown in the appendix.

The instructions were given verbally and in a summarized form on a leaflet handed out to the subjects. The English translation of the hand-out for the binary lottery condition with statistical measures available can be found in Appendix A (the original text was in German). The handouts for the other treatments were analogous and are therefore not reproduced here. For the selling price elicitation tasks, the dominance property of stating the true valuation of the lottery was explained in detail, using an example lottery that was not part of the experimental tasks. In the introductory talks of the treatments with statistical measures available, the expected value and the mean absolute deviation was explained formally and verbally, also using examples that were not used as decision tasks in the experiment.

3. TASKS

Each subject first was confronted with thirty-six lottery choice tasks, in which one out of two lotteries had to be selected. Then fourteen further tasks followed, which involved the evaluation of lotteries by the Becker-DeGroot-Marshak selling price elicitation procedure (see Section 2).

The lottery choice tasks are listed in Table 3. In this table the lottery choices are grouped according to the behavioral regularities connected to the task. The number in the first column indicates the order in which the tasks were performed. Task number *k* was the *k*-th one presented. In each case the subject had to choose either lottery A or lottery B. The last column indicates a distinction between two types of lottery choice tasks. In tasks of type I the lottery with the higher expected value also has the higher mean absolute deviation from expected value. In tasks of type II one of both lotteries had both the higher expected value and the lower mean absolute deviation. As far as the mean absolute deviation can be considered to be an adequate description of the riskiness of a lottery in the eyes of a subject, one can say that in a choice task of type I a deviation from expected value maximization indicates risk-aversion, since expected value is sacrificed for a decrease of the mean absolute deviation. In choice tasks of type II a deviation from expected value maximization means that the subject selects the lottery with the lower expected value and the higher mean absolute deviation. This indicates risk-seeking behavior.

The distinction between choice tasks of type I and type II permits a classification of deviations from expected value maximization as risk-averse or risk-seeking. Of course, this classification depends on the use of the mean absolute deviation as a measure of riskiness. From the point of view of von-Neumann-Morgenstern utility theory, it would perhaps be more adequate to base the distinction on the standard deviation rather than on the MAD. If utilities are quadratic, decisions depend only on expected value and variance. The use of the variance instead of the mean absolute deviation, however, would change the classification for only one choice task, namely task 35, the third one listed under the heading ‘Common Ratio Effect’ in Table 3. In view of the fact that the mean absolute deviation was presented to the subjects in the treatments with available statistical measures, we decided in favor of a classification based on the mean absolute deviation.

The fourteen lottery evaluation tasks are listed in Table 4. All lotteries to be evaluated appeared in one of the choice tasks; the number of this choice task is indicated in the last column.

3.1. *Common ratio effect*

Table 3 shows two sequences of four choice tasks conducive to the common ratio effect. In both cases the same prizes can be won in all four lotteries A and B, resp., and the winning probabilities always remain in the same proportion, but become smaller from one line to the next. The common ratio effect occurs if a subject for higher winning probabilities chooses lottery A and for lower ones lottery B. Such decision behavior, which is not compatible with expected utility theory, can be explained by the fact that more attention is paid to the difference between the amounts which can be won if the difference between the winning probabilities is small. In the first sequence, the lotteries with the lower amount to be won (lotteries A) have the higher expected value, in the second sequence the lotteries with the higher amount to be won (lotteries B) have the higher expected value.

Table 3. Lottery pairs of the 36 choice decisions. Type I pairs are pairs in which the lottery with higher expected value is also the lottery with higher MAD. Type II pairs are pairs in which the lottery with the higher expected value is the lottery with the lower MAD

Common ratio effect

Pair	Lottery A	Lottery B	Type
7	380 with 90%; 0 with 10%	450 with 60%; 0 with 40%	II
13	380 with 45%; 0 with 55%	450 with 30%; 0 with 70%	II
35	380 with 30%; 0 with 70%	450 with 20%; 0 with 80%	I
25	380 with 15%; 0 with 85%	450 with 10%; 0 with 90%	I
15	210 with 90%; 0 with 10%	375 with 60%; 0 with 40%	I
23	210 with 45%; 0 with 55%	375 with 30%; 0 with 70%	I
5	210 with 30%; 0 with 70%	375 with 20%; 0 with 80%	I
33	210 with 15%; 0 with 85%	375 with 10%; 0 with 90%	I

Reference point effect

Pair	Lottery A	Lottery B	Type
29	350 for sure	200 with 60%; 450 with 40%	II
*19	–100 for sure	–250 with 60%; 0 with 40%	II

*) Preceding the lottery choice task 19, the subject received a payment of 450 points / lottery tickets.

Preference reversal effect

Pair	Lottery A	Lottery B	Type
17	150 with 90%; 50 with 10%	400 with 20%; 0 with 80%	II
21	200 with 90%; 0 with 10%	400 with 20%; 50 with 80%	II
9	200 with 90%; 100 with 10%	450 with 50%; 50 with 50%	I
27	200 with 90%; 50 with 10%	400 with 50%; 90 with 50%	I

Stochastic dominance

Pair	Lottery A	Lottery B	Type
36	450 with 10%; 0 with 90%	250 with 40%; 200 with 60%	II
24	450 with 20%; 0 with 80%	250 with 40%; 200 with 60%	II
10	450 with 30%; 0 with 70%	250 with 40%; 200 with 60%	II
28	450 with 40%; 0 with 60%	250 with 40%; 200 with 60%	II
8	350 with 50%; 0 with 50%	200 with 60%; 100 with 40%	I
16	350 with 60%; 0 with 40%	200 with 60%; 100 with 40%	I
22	350 with 70%; 0 with 30%	200 with 60%; 100 with 40%	I
18	350 with 80%; 0 with 20%	200 with 60%; 100 with 40%	I
12	450 with 50%; 0 with 50%	180 with 20%; 60 with 80%	I
20	300 with 50%; 0 with 50%	180 with 20%; 60 with 80%	I

Table 3. (continued)

	Others		
Pair	Lottery A	Lottery B	Type
1	300 with 50%; 100 with 50%	500 with 50%; 50 with 50%	I
2	400 with 20%; 100 with 80%	400 with 70%; 50 with 30%	I
3	100 with 50%; 300 with 50%	500 with 80%; 50 with 20%	I
4	400 with 80%; 50 with 20%	100 with 50%; 300 with 50%	I
6	300 for sure	490 with 40%; 270 with 60%	I
26	200 for sure	390 with 40%; 170 with 60%	I
34	300 for sure	450 with 20%; 200 with 80%	II
14	200 for sure	350 with 20%; 100 with 80%	II
30	500 with 50%; 0 with 50%	300 with 20%; 100 with 80%	I
32	300 for sure	490 with 80%; –160 with 20%	I
11	300 for sure	250 with 60%; 500 with 40%	I
*31	–200 for sure	–250 with 60%; 0 with 40%	I

*) Preceding the lottery choice task 31, the subject received a payment of 450 points / lottery tickets.

In the evaluation of our experiment, we counted those subject as exhibiting the common ratio effect, who with declining lottery probabilities changed more often in the predicted direction from A to B than in the opposite direction for both sequences together. It cannot be excluded that deviations are partially due to random factors, which work with equal probabilities in both directions. Therefore, it may be due to random influences if one subject deviates more in the predicted direction than in the opposite one. But nevertheless, the number of subjects compared with the number of those who show the reverse pattern indicates to what extent the effect is present in the data.

3.2. *Reference point effect*

Choice tasks 29 and 19 are objectively equivalent since the subjects received a lump sum payment of 450 points before choice task 19. It is known from the literature (Kahneman and Tversky 1982) that subjects are often risk-averse in the domain of positive payoffs and

Table 4. Lottery evaluation tasks. The column ‘Pair’ indicates the lottery choice task involving this lottery

No.	Lottery		Pair
37	150 with 90%,	50 with 10%	17
38	400 with 20%,	0 with 80%	17
39	200 with 90%,	0 with 10%	21
40	400 with 20%,	50 with 80%	21
41	210 with 90%,	0 with 10%	15
42	327 with 60%,	0 with 40%	15
43	200 with 90%,	50 with 10%	27
44	400 with 50%,	90 with 50%	27
45	380 with 90%,	0 with 10%	7
46	450 with 60%,	0 with 40%	7
47	200 with 90%,	100 with 10%	9
48	450 with 50%,	50 with 50%	9
49	380 with 30%,	0 with 70%	35
50	450 with 20%,	0 with 80%	35

risk-taking in the negative domain. This means that a subject, who does not make the same choice in choice tasks 19 and 29, will typically choose A in 29 and B in 19. Accordingly, we counted subjects as exhibiting the reference point effect if they followed this choice pattern.

3.3. *Preference reversal effect*

The preference reversal effect can be expected in the choice between two lotteries: one which yields a low amount with a high probability (the ‘secure lottery’, in our case lottery A), and another one which yields a high amount with a low probability (the ‘dollar lottery’, in our case lottery B). Preference reversal means that the secure lottery is chosen in the choice task, but the higher selling price is named for the dollar lottery in the Becker-DeGroot-Marshak selling price elicitation task. We count subjects as exhibiting the preference reversal effect if they deviate from the expected value maximization more often in the predicted direction than in the opposite one. As in the common ratio effect, the number of those who have more deviations in the predicted direction, compared to the number of those who have more deviations in the opposite direction, indicates the extent to which the effect is present in the data.

3.4. *Stochastic dominance*

The literature reports examples of stochastically dominated lotteries selected in pairwise choice tasks. This kind of violation of stochastic dominance hardly can be expected in choices between two lotteries with only two possible outcomes each. However, in sequences of choice tasks a phenomenon may be observed which violates the assumption of completely ordered preferences respecting stochastic dominance (Hoggatt, Selten, Crockett, Gill, and Moore 1978). Table 3 shows three sequences which may give rise to this phenomenon. In the two first sequences of four tasks each lottery B remains constant, and the lotteries A yield the same prizes with increasing probabilities for the higher prize. In these two sequences a violation occurs if in at least one of the sequences A is selected in a task with a lower probability for the high prize in lottery A, and B is selected in a task with a higher probability for the high prize in lottery A. The third sequence consisting of lotteries 12 and 20 varies the high prize instead of the probability of winning. Here a violation means that B is selected in choice task 12 and A is selected in choice task 20.

4. DEVIATIONS FROM EXPECTED VALUE MAXIMIZATION

All decisions of the subjects are presented in the tables of Appendix B. For each subject, we compute a measure of the extent to which he or she deviated from maximum expected value. For this purpose, we determine the difference between the maximum sum of all expected values obtainable in the fifty choice tasks minus the sum of the expected values for all choices actually taken by the subject.

Figure 1 shows cumulative frequency distributions for these deviations from maximum expected value both for the lottery payoff group and the monetary payoff group without the availability of the statistical measures. With the words ‘lottery payoff group’ we refer to the group with payoffs in binary lottery tickets. It can be seen that the curve of the lottery payoff group is to the left of the

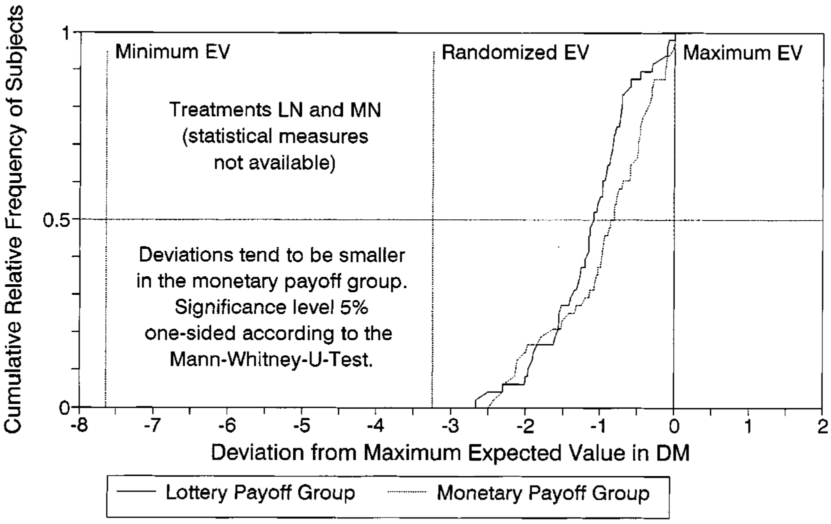

Figure 1. Cumulative relative frequency of subjects over total deviation from maximum expected value.

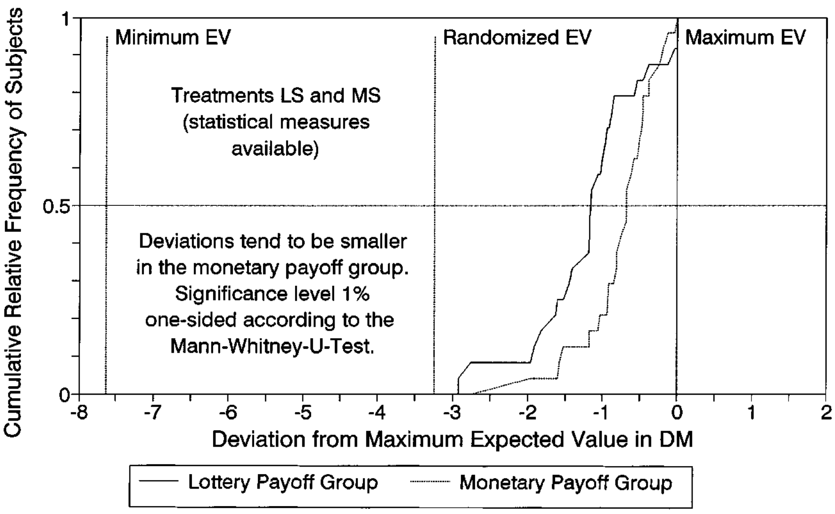

Figure 2. Cumulative relative frequency of subjects over total deviation from maximum expected value.

curve for the monetary payoff group in most of the support of the distribution. This indicates that the deviations from expected value maximization tend to be greater for the lottery payoff group. The Mann-Whitney-U-Test permits to reject the null hypothesis of no difference in favor of this alternative hypothesis at the 5% (one-sided) significance level. Figure 2 shows the same comparison for the treatments with statistical measures available. Here we can see an even clearer effect in the same direction. In spite of the smaller sample size, here the Mann-Whitney-U-Test permits to reject the null hypothesis of no difference in favor of the alternative hypothesis of greater deviations in the lottery payoff group at the one-sided significance level of 1%.

The results shown in Figures 1 and 2 clearly indicate that the use of payoffs in binary lottery tickets in experiments is counterproductive. This payoff mode does not induce risk neutrality, on the contrary, it moves behavior farther away from risk-neutrality, compared with direct money payoffs. Apart from their significance for the comparison of both payoff modes, our results also are devastating for expected utility theory as description of observed behavior. Moreover, it is not only expected utility theory which is refuted, but also any alternative theory which respects the two requirements of monotonicity and reduction of compound binary lotteries described in the introduction.

The question arises why payoffs in binary lottery tickets tend to increase deviations from expected value maximization compared to direct money payoffs. Moreover, it is also surprising that the availability of statistical measures sharpens the effect. Later we shall try to give an interpretation of these phenomena.

Table 5. Percentages of violations of expected value maximization

	Type I lottery pairs		Type II lottery pairs	
	without statistical measures	with statistical measures*	without statistical measures	with statistical measures*
Lottery group	27.6%	31.6%	22.6%	17.4%
Money group	24.0%	22.0%	18.6%	12.8%

*Column comparisons significant at the 5% level (one-sided)

5. CAPRICIOUSNESS

The question arises whether the increase of deviations from expected value maximization under the binary lottery condition indicates an increased tendency towards risk-averse or risk-seeking behavior. An increased tendency towards risk-aversion should be indicated by an increase of the percentage of violations in type I lottery choice tasks. Similarly, an increase of risk-seeking behavior should lead to more violations in type II tasks. Table 5 shows in the left hand two-by-two arrangement the percentages of violations in type I lottery choice tasks for the four treatments. The two-by-two arrangement on the right hand side shows the corresponding percentages for type II tasks. It can be seen that in both cases we get higher percentages for both binary lottery payoff conditions than for both direct money payoff conditions. For the treatments with statistical measures available the difference is significant on the 5% level (one-sided) according the Mann-Whitney-U-Test applied to the number of subjects exhibiting such deviations in each of both task types. In the treatments without statistical measures the difference is not significant.

Table 5 shows that the increase of the number of violations from expected value maximization does not indicate a shift of risk attitudes in a definite direction. Violations in type I tasks, where expected value maximization points to the more risky choice, and violations in the type II tasks, where it coincides with the less risky choice, both become more frequent. Of course, this could be due to a polarization effect which makes some subjects more risk-averse and others more risk-seeking. However, this is not the case. The same subjects tend to violate expected value maximization more in both types of tasks. In order to show this we define a measure of

Table 6. Average capriciousness in the four treatments

	Capriciousness	
	without statistical measures*	with statistical measures**
Lottery group	0.16	0.14
Money group	0.12	0.07

*Column comparison significant at the 2.5% level (one-sided)
**Column comparison significant at the 0.5% level (one-sided)

'capriciousness' as the minimum of the relative frequencies of deviations from expected value maximization in tasks of type I and type II, respectively. For a given subject let n_{I} be the number of violations in type I lottery choice tasks, similarly let n_{II} be the number of violations in type II tasks. $s_{\mathrm{I}} = n_{\mathrm{I}}/24$ and $s_{\mathrm{II}} = n_{\mathrm{II}}/12$ are the relative frequencies of deviations in tasks of type I and type II, respectively, since there are twenty-four type I tasks, but only twelve type II tasks. Our measure of capriciousness is

$$s = \min\{s_{\mathrm{I}}, s_{\mathrm{II}}\}.$$

The measure shows to what extent the relative frequency of deviations from expected value maximization in one type of task is matched by the relative frequency in the other task type. The measure expresses a tendency of the subjects to be erratic in the sense that their deviations from expected value maximization are sometimes in the direction of risk-aversion and sometimes in the direction of risk-taking. Table 6 shows average measures of capriciousness for the four treatments. The table shows that under the binary lottery payoff condition the averages are greater than under the direct money payoff condition. With statistical measures available, the averages are smaller than without statistical measures available. The comparisons between the direct money payoff conditions and the corresponding binary lottery payoff conditions both are significant at the 2.5% level (one-sided) in the case without statistical measures available and at the 0.5% level (one-sided) in the case with statistical measures available, according to the Mann-Whitney-U test applied to the capriciousness measures of individual subjects. The row effects are not significant.

We can conclude that paying in binary lottery tickets instead of directly in money, makes subjects more capricious in the sense that the same subject can be expected to deviate more often from expected value maximization both in the direction of more risk-averse and more risk-seeking choices.

6. BEHAVIORAL REGULARITIES

Figure 3 shows to what extent the behavioral regularities discussed in Section 3 appear in all four treatments. The bars show the relative

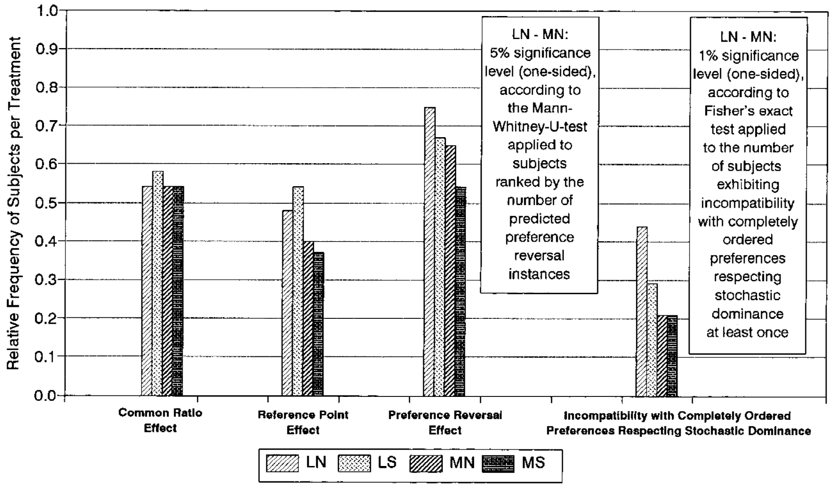

Figure 3. Relative frequencies of subjects making more choices in the direction predicted by behavioral regularities than in the opposite direction and relative frequencies of subjects exhibiting incompatibility with completely ordered preferences respecting stochastic dominance.

frequency of subjects who exhibit the corresponding effect in the sense explained in Section 3. Wherever there are differences between the values for the direct money payoff condition and the corresponding binary lottery payoff condition, the relative frequencies are higher in the binary lottery condition.

There seems to be little difference between corresponding treatments with and without statistical measures available. In the case of no statistical measures available, the differences between the binary lottery payoff condition and the direct money payoff condition are significant on the 5% level (one-sided) for the preference reversal effect, according to the Mann-Whitney-U test applied to subjects ranked by the number of preference reversals in the predicted direction, and 1% (one-sided) for incompatibility with completely ordered preferences respecting stochastic dominance, according to Fisher's exact test applied to the number of subjects exhibiting incompatibility with completely ordered preferences respecting stochastic dominance at least once.

We can conclude that paying in binary lottery tickets instead of directly in money either increases the frequencies with which the effects are observed, or does not change them significantly. This suggests that, whether the payoffs are amounts of binary lottery tickets, or whether they are amounts of money units, in the information

Table 7. Numbers of subjects with deviations from expected value maximization in the predicted and in the opposite direction

	Common ratio effect				Reference point effect				Preference reversal			
Treatment	LN	MN	LS	MS	LN	MN	LS	MS	LN	MN	LS	MS
No violations with respect to the effect	9	10	4	3	22	28	10	14	4	5	5	6
More violations in the predicted direction	26	26	14	13	23	19	13	9	36	31	16	13
More violations in the opposite direction	3	2	1	0	3	1	1	1	3	6	2	1
Equally many violations in both directions*	10	10	5	8	–	–	–	–	5	6	1	4

*Subjects without violations are not counted here, but in the first row.

processing of subjects they are both treated in a similar fashion. The only difference seems to be that behavior becomes more erratic and that some behavioral effects become more pronounced.

The common ratio effect, the reference point effect and preference reversal are directional in the sense that violations of expected value maximization in the opposite direction are also possible. The same is not true for the fourth regularity examined here. Therefore it is necessary to show that violations of expected value maximization tend to be mainly in the predicted direction. Otherwise one could not say that the first three regularities are present in our data. Table 7 shows numbers of subjects with deviations in the predicted and the opposite direction for the three behavioral regularities in the four treatments.

Since only one pair of tasks provided an opportunity for the reference point effect, the case of a subject with equally many positive numbers of violations in both directions could not arise for this regularity. Table 7 shows a clear majority of subjects with more violations in the predicted direction. This is true for all the three directional regularities and for all four treatments. In all cases the binomial test rejects the null hypothesis that among those subjects who did not deviate in both directions equally often, the probability of a subject having more violations in the predicted than in the opposite direction is equal to 1/2, at the 1% significance level (one-

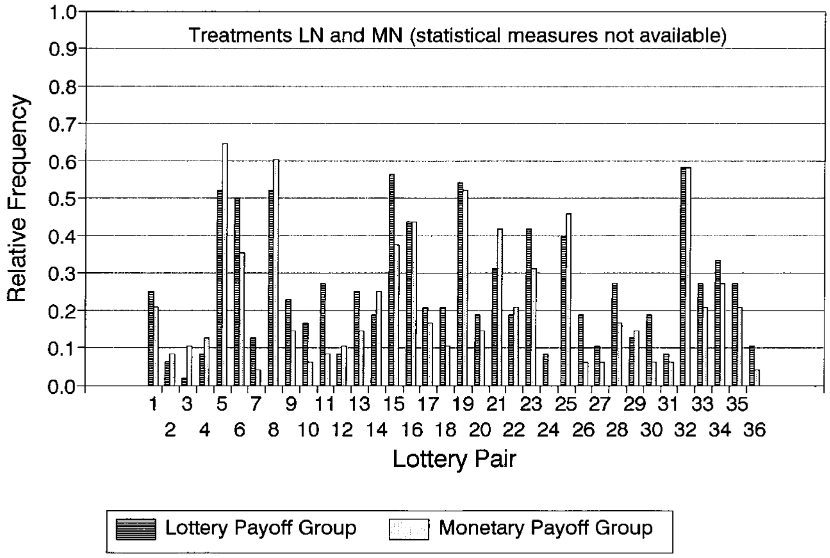

Figure 4. Relative frequencies of subjects violating the expected value maximization rule in the 36 choice decisions.

sided). This is true for all twelve columns of the table separately. In view of these results, there cannot be any doubt about the fact that our data clearly exhibit all three directional regularities. Moreover, it can be seen that the relative frequencies of subjects are very similar for different treatments (in order to see this it is important to remember that there are forty-eight subjects in the treatments without statistical measures available, but only twenty-four in the treatments with statistical measures available).

7. TASK DIFFERENCES AND VIOLATIONS OF EXPECTED VALUE MAXIMIZATION

The question arises whether some tasks are more conducive to violations of expected value maximization than others, and whether the different treatments differ in this respect. Figure 4 shows the relative frequencies of violations in the treatments without statistical measures. It can be seen that, apart from the fact that more violations are often in the lottery payoff group, there seem to be similar differences between the tasks under both treatments. The same can be said for the comparison of both treatments with statistical measures available shown in Figure 5. As we have already seen, the effect of

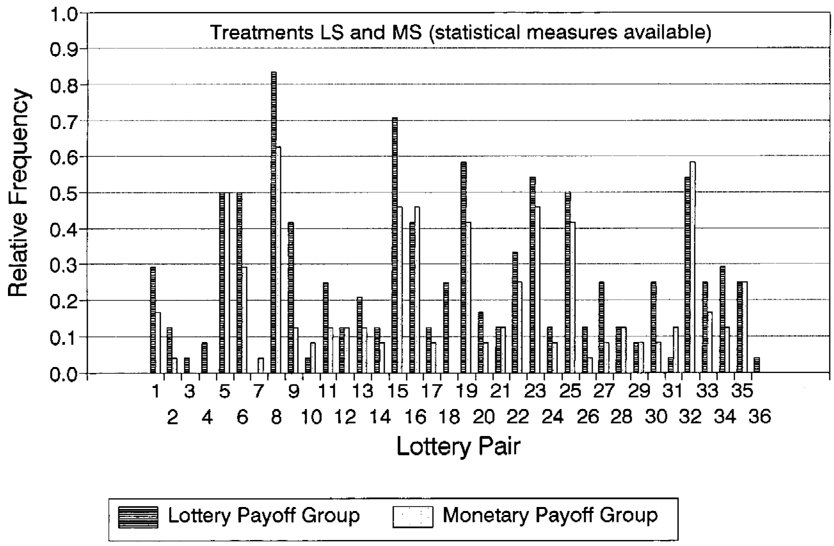

Figure 5. Relative frequencies of subjects violating the expected value maximization rule in the 36 choice decisions.

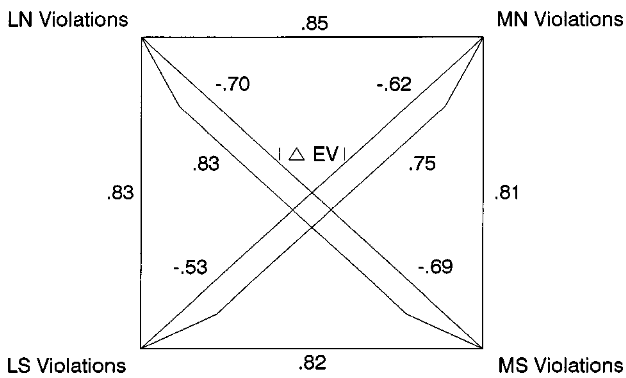

Figure 6. Spearman rank correlation coefficients of the number of violations of the EV-maximization rule per treatment and the absolute difference between the expected values of the two lotteries in the 36 choice decisions.
The distribution of EV-maximization violations over the 36 choice decisions are positively correlated in every pairwise comparison of the treatments. They are negatively correlated to the absolute difference between the expected values of the two lotteries. Significance level for all Spearman rank correlation coefficients is at least 0.2% one-sided.

more violations under the binary lottery payoff condition is stronger with statistical measures available. This is confirmed by the visual impression conveyed by a comparison of Figures 4 and 5.

Under all treatments, the decision processes of the subjects seem to respond to task differences in a similar fashion. Figure 6 shows Spearman rank correlation coefficients between numbers of violations in lottery choice decisions for all pairs of treatments. The figure also shows rank correlations between these violation numbers and the differences between expected values of the lotteries in the choice task. All rank correlations are significant at least at the 0.25% level (one-sided).

The high rank correlations of the numbers of violations in different treatments suggest that the way in which information is processed by the subjects does not differ very much from treatment to treatment. In all cases the difference between the expected values of both lotteries seems to be a similarly strong influence on the choices in different tasks.

8. RISK SENSITIVITY

In the binary lottery payoff condition, a subject whose behavior is guided by the maximization of the von-Neumann-Morgenstern expected utility should not be interested in a measure of riskiness for the purpose of choosing between two lotteries. The same is true under the much weaker rationality assumptions of monotonicity and reduction of compound binary lotteries explained in the introduction. However, in the direct money payoff condition, a subject who in principle behaves according to normative utility theory, but has difficulties of computation, may very well find it advantageous to be informed about mean absolute deviations.

According to conventional theory, information about expected values should be advantageous to subjects under the binary lottery payoff condition and, possibly, somewhat less valuable if payoffs are directly in money. In our experiments, information about expected values and mean absolute deviations were given only in response to separate requests. Figures 7 and 8 show the numbers of expected value requests for all fifty tasks in both treatments with statistical measures available.

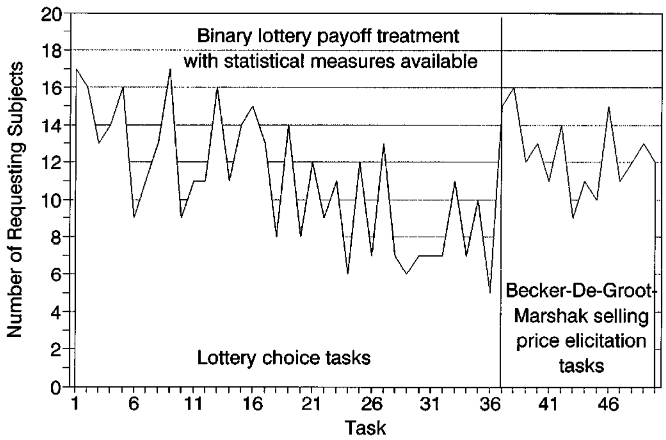

Figure 7. Number of subjects requesting the information on the expected value(s) in the fifty tasks of the experiment.

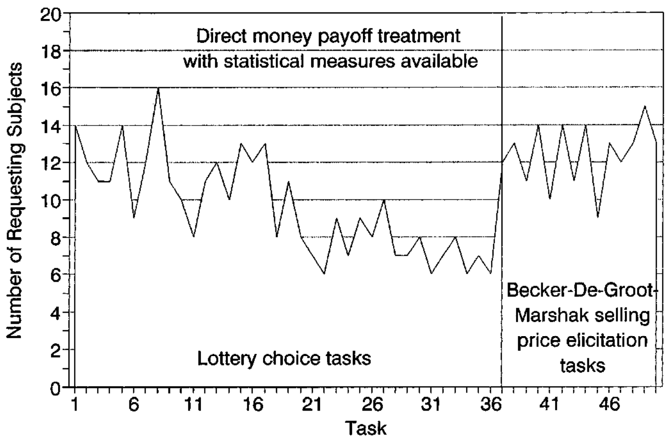

Figure 8. Number of subjects requesting the information on the expected value(s) in the fifty tasks of the experiment.

There seems to be little difference between both figures. In both cases, we see a declining trend for the lottery choice tasks but a leap to higher numbers of requests in the lottery evaluation tasks. This suggests that more requests are made while the situation is still new, in the beginning of the experiment. It also suggests that the lottery evaluation task is more conducive to a call of the expected value information. The lottery evaluation tasks require the determination of a lottery value and subjects may find the expected value useful as an anchor for the decision processes. For lottery choice tasks,

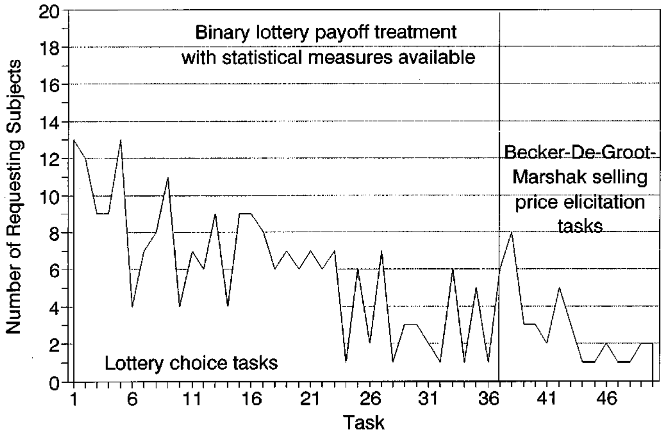

Figure 9. Number of subjects requesting the information on the mean absolute deviation(s) in the fifty tasks of the experiment.

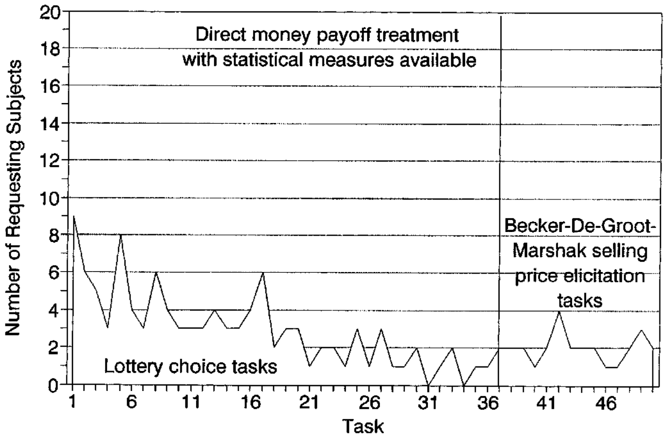

Figure 10. Number of subjects requesting the information on the mean absolute deviation(s) in the fifty tasks of the experiment.

however, the usefulness of expected values seems to be less obvious to the subjects.

Figures 9 and 10 show the numbers of mean absolute deviation requests under both treatments with statistical measures available. It can be seen immediately that there are more requests in the binary lottery payoff condition. This can be seen even more clearly in Figure 11. This figure shows the cumulative relative frequencies of subjects ordered according to the number of mean absolute deviation requests. In the thirty-six lottery choice tasks, both for the treatment with payoffs in binary lottery tickets and for the treatment

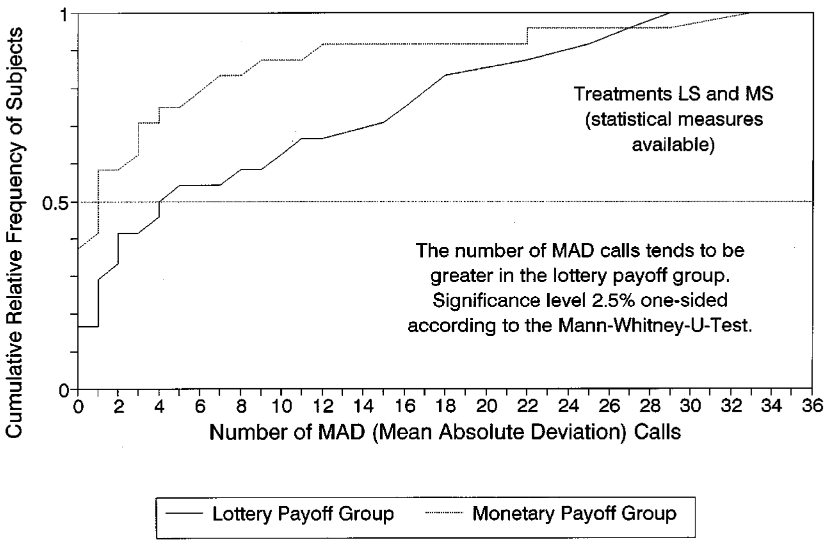

Figure 11. Cumulative relative frequency of subjects over the number of MAD calls in the 36 choice decisions.

with direct money payoffs, it can be seen that the curve for the treatment with direct money payoffs is mostly far to the left of that for the lottery payoff group. The difference is significant on the 2.5% level (one-sided), according to the Mann-Whitney-U test, applied to the numbers of calls of individual subjects.

Contrary to what conventional theory suggests, the demand for information on mean absolute deviations is significantly stronger in the binary lottery payoff condition. Clearly under this condition the subjects are more interested in the riskiness of the lotteries. However, this does not mean that paying in binary lottery tickets rather than directly in money makes subjects more risk-averse or more risk-taking. In the last section, we have seen that it makes them more capricious. They seem to become more sensitive to risk in the sense that they look more both at the dangers and the chances offered by riskier prospects.

Fears and hopes connected to lottery choices both seem to become more pronounced. Maybe the decision process can best be portrayed as an inner conflict with an uncertain result. Sometimes fear may get the upper hand, and sometimes hope may prevail. The stronger these forces are, the more uncertain the outcome of the inner conflict will be. In the sense that both fears and hopes become more pronounced, we can say that paying in binary lottery tickets instead of directly in money increases the risk-sensitivity and thereby the capriciousness of subjects. The increased risk sensitivity makes the outcomes of decision processes more uncertain. In this way, the behavior of the subjects becomes more capricious.

9. THE BACKGROUND RISK HYPOTHESIS

At the end of the last section, we have already partially explained how we interpret the fact that the frequencies of deviations from expected value maximization are greater for payoffs in binary lottery tickets than for direct money payoffs. We have seen that payoffs in binary lottery tickets instead of directly in money increase the demand for risk measures. We have interpreted this as an increase of risk sensitivity. The idea that increased risk-sensitivity makes the decision process more uncertain establishes a causal link from increased risk-sensitivity to increased capriciousness. However, it is not yet clear why payoffs in binary lottery tickets instead of directly in money should produce increased risk-sensitivity.

We think that the relevant difference between the two payoff schemes is *background risk*, or in other words, the risk connected to the total payoffs obtainable in the whole session. Figure 12 shows cumulative distributions of total payoffs both for the direct money payoff condition and the binary lottery payoff condition, under the assumption that in all choices expected values are maximized. The common expected value of the total session is indicated by a vertical line. It can be seen immediately that the variance is much greater in the case of binary lottery payoffs. This is due to the fact that the grand lottery which determines whether the small prize or the big prize is won contributes additional variance to the variance connected to direct money payoffs.

After having completed several tasks, a subject will begin to have a feeling for the risk involved in the payoff scheme. The impression of background risk gained in this way will influence the strength of hopes and fears. It is plausible to assume that the dangers and the chances connected to lotteries become more pronounced in a situation of high background risk. This assumption supplies the missing link in the causal chain by which we interpret the influence of the payoff modes on our experimental results. We refer to this interpre-

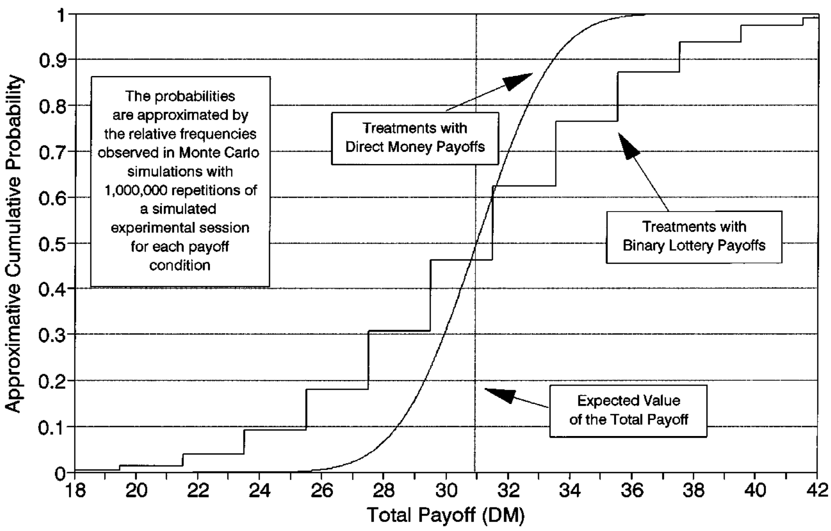

Figure 12. Cumulative distribution of the total experiment payoff received by an expected value maximizer.

tation as the *background risk hypothesis*. The causal chain can be depicted as follows:

Background risk $\xrightarrow{+}$ Risk sensitivity $\xrightarrow{+}$ Capriciousness $\xrightarrow{+}$ Frequency of violations

The symbol '+' indicates a causal link producing a positive correlation. Of course, the causal links in this chain are not directly confirmed by our data. Our experimental results are consistent with the background risk hypothesis, but further experiments are needed in order to see whether it is the correct explanation of the observed effects.

If the background risk hypothesis is correct, then the practice of paying only for a randomly selected subset of many tasks should also increase violations of expected value maximization, compared with other experiments in which all tasks are paid, and the same expected total payoff is provided. Obviously, the random selection of subsets of tasks increases background risk.

10. SUMMARY AND CONCLUSION

Our experiments have shown that the binary lottery payoff scheme does not induce risk neutrality, but on the contrary, it leads to stronger deviations from risk neutrality than the direct money payoff scheme. The shift away from risk neutrality is not due to a general tendency to more risk-aversion or more risk-seeking behavior, but rather to an increased capriciousness which means that a subject deviates more in both directions. We have also seen that the common ratio effect, the reference point effect, the preference reversal effect, and incompatibility with completely ordered preferences respecting stochastic dominance all occur under payoffs in binary lottery tickets with at least the same frequencies as for payoffs directly in money. For the last two effects, we even see a significant increase.

Our data suggests that the differences between tasks with respect to the frequencies of deviations from expected value maximization are similar in all four treatments. The parallels shown with respect to behavioral regularities and task differences strongly suggest that the way in which information is processed by the subjects does not differ much from treatment to treatment. Amounts of binary lottery tickets are treated in a similar fashion as amounts of money.

As we have seen, with statistical measures available, demand for information on the risk measure is stronger under the binary lottery payoff condition than with direct money payoffs. This suggests that payoffs in binary lottery tickets instead of directly in money increase risk sensitivity, in the sense that the dangers and chances connected to risk become more pronounced in the perception of subjects. We think that the increased risk sensitivity is due to an increased background risk connected to the total payoffs that can be obtained for the whole session.

An integrated explanation of our results is offered by the background risk hypothesis: the transition from direct money payoff to payoffs in binary lottery tickets involves an increase of the background risk. The increased background risk enhances risk-sensitivity. Higher risk sensitivity results in more capriciousness. Increased capriciousness causes more deviations from expected value maximization.

ACKNOWLEDGMENTS

Support by the Deutsche Forschungsgemeinschaft through the Sonderforschungsbereich 303 is gratefully acknowledged.

APPENDIX A

Instructions to the Subjects (binary lottery payoff, with statistical measures – the original text was in German)

First, we would like to welcome you to this experiment in decision making. We are pleased that you have registered for this experiment. In this experiment everyone decides for himself. The decisions and the outcomes of the subjects do not influence each other interdependently.

The Experiment. In this experiment you make decisions on *lotteries*. In each lottery you receive an amount with a specific probability, and another amount with the counter probability. The outcomes of the lotteries are random and independent of each other. You play 25 *rounds*. Each round consists of three *periods*: two decision making periods and a third period in which the *grand lottery* is run.

In the decision making periods you collect tickets for the grand lottery. For this purpose you make decisions according to two different methods described below. All payoffs of the decision making periods' lotteries consist of tickets for the grand lottery.

In the grand lottery you receive either the *high prize* (230 *talers*) or the *low prize* (30 talers). The probability of winning the high prize depends on your success in the decision making periods. Every ticket corresponds to 0.1% probability of winning the high prize.

In the first 18 rounds you make decisions according to the *simple choice method*. You select one out of two lotteries (lottery A or lottery B) which is then run. You can choose only one lottery.

In the remaining seven rounds the *sales method* is applied. One lottery is placed at your disposal, which you can either run or sell for tickets. You are requested to name the smallest amount in tickets that you are willing to accept in exchange for the lottery. After you have named this price, the *counteroffer* is drawn. It is in the range of 0 and the maximum amount that can be won in the lottery.

If the randomly drawn counteroffer is larger or equal to the minimum amount you stated, then you will not run the lottery (you then have 'sold' the lottery). If the drawn number is smaller than your minimum amount, then the lottery is run (the 'sale' did not take place). Note that it always pays to state the amount that the lottery is really worth to you.

Procedure. After the introduction, please take a seat in the cubicle with the participant number you were assigned, and close the curtain. During the experiment, any communication with other participants is prohibited. After the end of the experiment, please call the experimenter to receive your payment. *One taler is equivalent to one pfennig*.

Usage of the program. You can use the program by mouse as well as by keyboard. For mouse usage there are mouse buttons on the screen for all decisions. For keyboard usage, press the key corresponding to the highlighted character on the mousebutton. On top of the screen you will find the *menubar*. By this you can call additional features by either clicking the feature by mouse or by pressing the initial character highlighted yellow.

Help	Here you obtain help concerning the current decision making situation.
Calculator	The calculator can be used either by the mouse buttons or by the number block on the right of the keyboard.
Info	Here you obtain information concerning the current round.
ExpectedValue	The expected value of a lottery indicates the amount you would earn *on average* if you played the lottery very often (theoretically infinitely often). It is computed as the sum of the single payoffs multiplied by their probabilities. Example: If a lottery has an expected value of 2000, then you would earn on average 2000 per play, if you played the lottery very often.
MeanAbsDev	The mean absolute deviation indicates the average distance (weighted with probabilites) of the single payoffs from the expected value, again for the case of playing the lottery very often. It is a measure of the variability of a lottery's payoffs. The higher the mean absolute deviation, the more the payoffs vary. A sure payoff has a mean absolute deviation of 0. Example: If a lottery has an expected value of 2000 and a mean absolute deviation of 1000, then the payoffs per play of the lottery are on average 1000 away from the expected value.

APPENDIX B

The decisions of the subjects

VIOLATIONS OF EV MAXIMIZATION RULE AND STATISTICAL MEASURE CALLS: Binary lottery payoff treatment with statistical measures available

Task No.	Lottery A	Lottery B	Subject No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	+	*	+*	1
1	300 0.50; 100 0.50	500 0.50; 50 0.50	+*0	*0	+*1	+*1	0	1	*0	0	+*0	+*0	0	+*0	*0	*0	+*1	+*0	0	0	+*1	+*1	*0	+1	+*0	+*0	13	17	12	7
2	400 0.20; 100 0.80	400 0.70; 50 0.30	+*0	0	+*0	+*0	+*0	0	*0	*0	*0	+*1	+*0	0	+*0	*0	+*0	+*0	0	1	+*0	+*0	0	+1	0	*0	12	16	11	3
3	100 0.50; 300 0.50	500 0.80; 50 0.20	+*0	+*0	*0	+*0	0	0	*0	*0	+*0	1	0	0	+*0	0	*0	+*0	0	0	0	+*0	0	+0	+*0	*0	9	13	8	1
4	400 0.80; 50 0.20	100 0.50; 300 0.50	+*0	0	*0	+*0	0	0	*0	*0	+*0	0	+*0	0	+*0	0	*0	+*0	0	1	0	+*0	+*0	+*1	0	*0	9	14	9	2
5	210 0.30; 0 0.70	375 0.20; 0 0.80	+*0	*0	1	+*1	1	0	*0	*0	+*1	+*0	+*1	+*1	+*0	0	+*0	+*1	1	1	+*0	+*1	0	+*1	1	+*0	13	16	13	12
6	300 1.00; 0 0.00	490 0.40; 270 0.60	1	*0	+*0	1	0	1	*0	*0	+*1	0	1	0	1	1	*0	0	1	1	1	+*0	1	+*1	0	*0	4	9	4	12
7	380 0.90; 0 0.10	450 0.60; 0 0.40	+*0	*0	0	0	0	0	*0	*0	0	*0	+*0	0	+*0	0	+*0	+*0	0	0	0	0	0	+*0	0	+*0	7	11	7	0
8	350 0.50; 0 0.50	200 0.60; 100 0.40	+*1	*0	1	+*1	1	0	*0	*0	+*1	+*1	+*1	1	+*1	1	*1	+*1	1	1	1	1	1	+*1	1	*1	8	13	8	20
9	200 0.90; 100 0.10	450 0.50; 50 0.50	+*1	*0	*1	+*0	0	0	*0	*0	+*1	+*0	+*1	0	+*1	*1	*0	+*0	1	1	+*0	+*0	1	+*1	0	+*0	11	17	11	10
10	450 0.30; 0 0.70	250 0.40; 200 0.60	0	*0	0	0	0	0	*0	*0	+*0	0	+*0	0	+*0	*0	*0	0	0	0	0	1	0	+*0	0	0	4	9	4	1
11	300 1.00; 0 0.00	250 0.60; 500 0.40	+*0	*0	0	0	0	1	*0	*0	+*1	+*0	+*0	0	+*1	0	*0	+*0	1	1	0	0	1	0	0	+*0	7	11	7	6
12	450 0.50; 0 0.50	180 0.20; 60 0.80	1	0	0	+*0	+*1	0	*0	*0	+*0	0	+*0	0	*0	0	0	+*0	0	1	0	0	*0	+*0	0	*0	6	11	6	3
13	380 0.45; 0 0.55	450 0.30; 0 0.70	+*0	*0	0	+*1	0	0	*0	*0	+*0	1	+*1	0	*1	*0	*0	+*1	0	+*0	0	+*0	0	+*0	+*0	*0	9	16	9	5
14	200 1.00; 0 0.00	350 0.20; 100 0.80	*0	*0	1	0	0	0	*0	*0	*0	0	+*0	0	0	0	*0	+*0	0	0	+*1	0	*0	+*0	0	1	4	11	4	3
15	210 0.90; 0 0.10	375 0.60; 0 0.40	1	*0	1	+*1	0	0	*0	*0	+*1	0	+*1	1	+*0	+*1	*1	+*1	1	1	+*1	+*1	1	+*1	1	*1	9	14	9	17
16	350 0.60; 0 0.40	200 0.60; 100 0.40	1	*0	1	+*1	1	0	*0	*0	+*1	0	+*1	1	+*0	1	*0	+*1	0	1	+*0	+*0	*0	+*0	+*0	*0	9	15	9	10
17	150 0.90; 50 0.10	400 0.20; 0 0.80	0	*0	0	+*0	1	0	*0	*0	+*0	+*0	+*1	0	+*0	1	*0	+*0	0	0	0	0	0	+*0	+*0	*0	8	13	8	3
18	350 0.80; 0 0.20	200 0.60; 100 0.40	1	0	1	1	1	0	*0	*0	+*0	0	+*0	0	+*0	1	0	+*0	0	1	+*0	0	0	+*0	0	0	6	8	6	6
19	-100 1.00; 0 0.00	-250 0.60; 0 0.40	1	*0	0	1	1	1	*0	*0	*0	+*1	+*1	0	+*1	1	*1	+*1	1	0	+*1	0	+*1	*0	+*1	*0	7	14	7	14
20	300 0.50; 0 0.50	180 0.20; 60 0.80	1	0	0	+*0	0	0	*0	*0	+*0	0	+*1	0	+*0	0	0	+*0	0	1	0	0	0	+*1	0	0	6	8	6	4
21	200 0.90; 0 0.10	400 0.20; 50 0.80	+*0	*0	0	+*0	0	0	*0	*0	+*0	0	0	0	+*0	1	*0	+*0	0	1	+*1	0	0	+*0	0	*0	7	12	7	3
22	350 0.70; 0 0.30	200 0.60; 100 0.40	1	*0	1	+*0	1	0	*0	*0	+*1	0	+*1	0	+*0	1	0	+*0	0	1	0	0	0	+*1	0	0	6	9	6	8
23	210 0.45; 0 0.55	375 0.30; 0 0.70	1	*0	1	+*0	0	0	*0	*1	+*1	0	1	1	+*1	1	*1	+*0	0	1	+*1	+*0	0	+*1	1	0	7	11	7	13
24	450 0.20; 0 0.80	250 0.40; 200 0.60	0	*0	0	0	0	0	*0	*0	0	0	0	1	+*0	0	*0	1	0	0	0	0	0	*0	0	1	1	6	1	3
25	380 0.15; 0 0.85	450 0.10; 0 0.90	0	*0	0	1	0	0	*0	*0	+*1	1	1	1	+*0	*1	*1	+*1	0	1	0	+*1	0	+*0	+*1	*1	6	12	6	12
26	200 1.00; 0 0.00	390 0.40; 170 0.60	0	*0	+*0	0	0	1	*0	*0	*0	0	0	0	1	*0	0	0	1	0	0	0	0	+*0	0	0	2	7	2	3
27	200 0.90; 50 0.10	400 0.50; 90 0.50	0	*0	*1	+*0	1	0	*0	*0	+*0	0	1	0	+*1	*0	*0	+*0	1	1	+*0	+*0	0	+*0	0	0	7	13	7	6
28	450 0.40; 0 0.60	250 0.40; 200 0.60	0	*0	0	0	0	0	*0	*0	*0	*0	0	0	+*0	*1	0	1	0	0	0	0	0	0	0	1	1	7	1	3
29	350 1.00; 0 0.00	200 0.60; 450 0.40	0	*0	0	0	0	0	*0	*0	0	0	0	0	0	0	*0	+*0	1	0	+*0	0	0	1	+0	0	3	6	2	2
30	500 0.50; 0 0.50	300 0.20; 100 0.80	1	*0	1	0	1	0	*0	*0	*0	0	0	1	+*0	0	0	+*0	0	1	+*0	0	0	1	0	0	3	7	3	6
31	-200 1.00; 0 0.00	-250 0.60; 0 0.40	0	*0	0	0	0	0	*0	*0	0	0	0	0	+*0	0	*0	+*0	0	0	0	0	0	1	0	*0	2	7	2	1
32	300 1.00; 0 0.00	490 0.80; -160 0.20	1	*0	1	1	1	1	*0	*0	*1	1	1	1	1	0	*1	+*0	1	0	1	0	0	0	0	*0	1	7	1	13
33	210 0.15; 0 0.85	375 0.10; 0 0.90	0	*0	1	0	0	0	*0	*0	0	0	0	0	+*1	0	*0	+*0	1	0	+*1	+*0	0	+*1	+*1	*0	6	11	6	6
34	300 1.00; 0 0.00	450 0.20; 200 0.80	1	*0	0	1	0	0	*0	*0	*0	0	0	1	0	0	0	1	0	1	+*0	1	*1	0	0	*0	1	7	1	7
35	380 0.30; 0 0.70	450 0.20; 0 0.80	0	*0	0	0	0	1	*0	*0	+*0	1	0	0	+*1	1	*0	+*0	0	1	0	+*0	1	0	+*0	*0	5	10	5	6
36	450 0.10; 0 0.90	250 0.40; 200 0.60	0	*0	0	0	0	0	*0	*0	0	0	0	0	+*0	0	*0	0	0	0	0	0	0	0	0	1	1	5	1	1
Total number of MAD calls			11	1	4	17	2	0	0	0	22	8	18	2	27	1	4	29	0	1	16	15	2	25	10	5	220			
Total number of EV calls			12	31	8	17	2	0	36	35	30	10	18	2	30	10	28	29	0	1	16	15	7	24	9	23		393		
Total number of calls of both measures			11	1	4	17	2	0	0	0	22	8	18	2	27	1	4	29	0	1	16	15	2	22	9	5			216	
Total number of EV max violations			14	0	14	12	11	7	0	1	11	8	15	10	12	14	7	10	12	20	10	7	8	15	7	7				232

+ = Subject called MADs. * = Subject called EVs. 0 = Subject followed EV maximization rule. 1 = Subject violated EV maximization rule.

VIOLATIONS OF EV MAXIMIZATION RULE AND STATISTICAL MEASURE CALLS: Direct money payoff treatment with statistical measures available

Task No.	Lottery A	Lottery B	Subject No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	+	*	+*	1
1	300 0.50; 100 0.50	500 0.50; 50 0.50	0	*0	0	0	+*0	*0	+*0	+*0	*0	1	0	+*0	*1	+*0	0	0	0	+*1	+0	+*0	0	+*1	*0	*0	9	14	8	4
2	400 0.20; 100 0.80	400 0.70; 50 0.30	1	*0	+*0	0	+*0	*0	0	0	*0	0	0	+*0	0	+*0	0	*0	0	+*0	0	0	0	+*0	*0	*0	6	12	6	1
3	100 0.50; 300 0.50	500 0.80; 50 0.20	0	0	+*0	*0	+*0	*0	0	0	*0	0	0	+*0	0	*0	0	*0	0	+*0	0	0	0	+*0	0	*0	5	11	5	0
4	400 0.80; 50 0.20	100 0.50; 300 0.50	0	*0	*0	*0	+*0	*0	0	0	*0	0	0	+*0	0	+*0	0	*0	0	0	0	0	0	0	*0	*0	3	11	3	0
5	210 0.30; 0 0.70	375 0.20; 0 0.80	0	1	+*0	1	+*0	*0	*1	+*1	+*0	+*1	*0	+*0	0	+*0	1	*0	1	1	1	1	1	+*1	*0	*0	8	14	8	12
6	300 1.00; 0 0.00	490 0.40; 270 0.60	1	0	0	0	1	*1	0	+*0	0	0	0	+*0	*1	+*1	1	*0	0	0	1	0	0	+*0	*0	*0	4	9	4	7
7	380 0.90; 0 0.10	450 0.60; 0 0.40	0	*0	0	0	+*0	*0	0	0	*0	1	*0	+*0	*0	+*0	*0	*0	0	0	0	0	0	0	*0	*0	3	12	3	1
8	350 0.50; 0 0.50	200 0.60; 100 0.40	0	*1	+*1	+*1	+*0	*1	*0	*0	*0	1	*1	+*1	0	+*1	*1	*1	1	1	1	0	1	+*1	*0	*0	6	16	6	15
9	200 0.90; 100 0.10	450 0.50; 50 0.50	0	*0	0	0	+*0	*0	0	0	*0	0	0	+*0	0	+*1	1	*0	0	*0	1	0	0	+*0	*0	*0	4	11	4	3
10	450 0.30; 0 0.70	250 0.40; 200 0.60	0	*0	0	0	+*0	*0	0	0	*0	0	0	+*0	1	+*0	*0	*0	0	0	0	0	0	0	*1	*0	3	10	3	2
11	300 1.00; 0 0.00	250 0.60; 500 0.40	1	*0	0	0	0	*1	0	0	0	0	0	+*0	1	+*0	*0	+*0	0	0	0	0	0	0	*0	*0	3	8	3	3
12	450 0.50; 0 0.50	180 0.20; 60 0.80	1	0	0	0	1	*0	*0	0	*0	0	*0	+*0	0	+*1	*0	*0	0	0	0	0	+*0	0	*0	*0	3	11	3	3
13	380 0.45; 0 0.55	450 0.30; 0 0.70	1	*0	0	0	+*0	*0	*0	0	*0	0	*0	0	0	+*1	*0	+*0	0	0	0	0	0	+*1	*0	*0	4	12	4	3
14	200 1.00; 0 0.00	350 0.20; 100 0.80	0	*0	0	+*0	0	*0	*0	+*0	*0	0	1	0	0	+*0	*0	0	0	0	0	0	0	1	*0	*0	3	10	3	2
15	210 0.90; 0 0.10	375 0.60; 0 0.40	0	*0	*1	*1	0	*1	*0	*0	*0	0	0	+*1	0	+*1	*1	+*1	1	1	1	0	1	0	*0	*0	3	13	3	11
16	350 0.60; 0 0.40	200 0.60; 100 0.40	1	*0	0	+*0	0	*1	1	*0	*0	1	0	+*1	0	+*1	*1	+*1	1	*1	0	0	1	0	*0	*0	4	12	4	11
17	150 0.90; 50 0.10	400 0.20; 0 0.80	0	0	*0	0	0	*0	*0	+*1	*0	0	0	+*0	0	+*0	*0	+*0	0	0	0	+*0	0	+*1	*0	*0	6	13	6	2
18	350 0.80; 0 0.20	200 0.60; 100 0.40	0	0	0	0	0	*0	0	*0	*0	0	0	+*0	0	+*0	*0	0	0	0	0	0	0	0	*0	*0	2	8	2	0
19	-100 1.00; 0 0.00	-250 0.60; 0 0.40	0	*0	1	1	+*1	*1	0	*1	*0	0	1	+*1	1	+*0	*0	0	0	*0	0	1	0	1	*0	*0	3	11	3	10
20	300 0.50; 0 0.50	180 0.20; 60 0.80	0	0	0	0	0	*0	0	0	*0	0	0	+*0	0	+*1	*0	+*0	0	0	0	0	1	0	*0	*0	3	8	3	2
21	200 0.90; 0 0.10	400 0.20; 50 0.80	0	*0	*0	0	0	*0	1	0	*0	0	1	0	0	+*0	0	0	1	0	0	0	0	0	*0	*0	1	7	1	3
22	350 0.70; 0 0.30	200 0.60; 100 0.40	0	0	0	0	0	*0	0	0	*0	1	0	+*1	0	+*1	1	1	1	0	0	0	0	0	*0	*0	2	6	2	6
23	210 0.45; 0 0.55	375 0.30; 0 0.70	0	*1	0	1	1	*1	*1	1	*0	0	0	+*0	0	+*0	*0	1	1	1	1	0	1	0	*0	*0	2	9	2	11
24	450 0.20; 0 0.80	250 0.40; 200 0.60	0	*0	0	0	0	*0	0	0	*0	0	0	0	1	+*0	*0	0	0	0	0	0	0	1	*0	*0	1	7	1	2
25	380 0.15; 0 0.85	450 0.10; 0 0.90	1	*0	1	0	0	*0	*0	+*0	1	1	1	1	1	+*1	*0	0	0	0	0	+*1	0	0	*1	*0	3	9	3	10
26	200 1.00; 0 0.00	390 0.40; 170 0.60	0	*0	0	0	0	*0	0	*0	*0	0	0	0	1	+*0	*0	0	0	0	0	0	0	0	*0	*0	1	8	1	1
27	200 0.90; 50 0.10	400 0.50; 90 0.50	0	*0	0	0	0	*0	0	*0	*0	0	0	+*0	0	+*0	*0	+*1	0	1	0	0	0	0	*0	*0	3	10	3	2
28	450 0.40; 0 0.60	250 0.40; 200 0.60	0	*0	0	0	0	*0	0	0	*0	0	1	0	1	+*0	*0	0	0	0	0	0	0	1	*0	*0	1	7	1	3
29	350 1.00; 0 0.00	200 0.60; 450 0.40	0	*0	0	0	0	*0	0	0	1	0	*0	0	0	+*0	*0	0	0	0	0	0	0	1	*0	*0	1	7	1	2
30	500 0.50; 0 0.50	300 0.20; 100 0.80	0	*0	0	0	0	*1	0	0	*0	0	0	+*0	0	+*1	*0	0	0	0	0	0	0	0	*0	*0	2	8	2	2
31	-200 1.00; 0 0.00	-250 0.60; 0 0.40	0	0	1	0	0	*0	0	*0	*0	0	0	0	1	*0	0	0	0	0	0	0	1	0	*0	*0	0	6	0	3
32	300 1.00; 0 0.00	490 0.80; -160 0.20	1	*1	1	1	0	*1	1	1	*0	0	*0	1	1	+*1	1	1	1	1	0	0	0	0	*0	*0	1	7	1	14
33	210 0.15; 0 0.85	375 0.10; 0 0.90	0	0	*0	0	+*0	*1	0	0	*0	0	0	0	1	+*0	*0	0	0	1	1	0	0	0	*0	*0	2	8	2	4
34	300 1.00; 0 0.00	450 0.20; 200 0.80	0	0	0	0	0	*0	0	1	*0	1	*1	0	0	*0	0	0	0	0	0	0	0	0	*0	*0	0	6	0	3
35	380 0.30; 0 0.70	450 0.20; 0 0.80	0	*0	0	0	0	*0	0	0	*0	1	1	1	0	+*1	*1	0	0	0	0	1	0	0	*0	*0	1	7	1	6
36	450 0.10; 0 0.90	250 0.40; 200 0.60	0	*0	0	0	0	*0	0	0	*0	0	0	0	0	+*0	0	0	0	0	0	0	0	0	*0	*0	1	6	1	0
Gesamtzahl der MAA-Abrufe			0	0	4	3	12	0	1	6	1	1	0	22	0	33	0	7	0	3	1	3	1	9	0	0	107			
Gesamtzahl der EW-Abrufe			0	25	9	6	12	36	10	14	32	1	8	22	3	36	23	17	0	6	0	3	1	9	35	36		344		
Gesamtzahl der Abrufe beider Werte			0	0	4	3	12	0	1	6	1	1	0	22	0	33	0	7	0	3	0	3	1	9	0	0			106	
Gesamtzahl der Verstöße			8	4	6	6	4	10	5	6	2	9	8	8	12	13	9	7	8	9	7	4	7	10	2	0				164

+ = Subject called MADs. * = Subject called EVs. 0 = Subject followed EV maximization rule. 1 = Subject violated EV maximization rule.

VIOLATIONS OF EV MAXIMIZATION RULE: Binary lottery payoff treatment without statistical measures available

Task	Subject No.																																															
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
1	0	0	1	0	0	0	0	0	0	0	1	0	1	1	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	12
2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	3
3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	4
5	1	0	1	0	0	0	0	1	0	0	1	1	1	1	1	1	1	0	1	1	1	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1	1	25
6	1	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1	0	1	1	1	1	1	0	1	0	0	1	0	1	1	1	0	0	1	0	0	0	1	0	1	0	1	1	0	1	1	0	1	24
7	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	6
8	1	0	1	1	0	1	0	0	0	0	0	1	1	1	1	1	0	0	0	0	1	0	0	1	1	0	0	1	1	0	0	0	0	1	1	1	1	0	1	1	0	0	0	1	1	1	1	1	25
9	1	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	1	0	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	11
10	0	0	0	0	1	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	8
11	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	1	1	1	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	13
12	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	4
13	1	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1	12
14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	1	1	0	0	9
15	1	1	1	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	1	0	1	0	1	1	0	0	0	1	1	1	0	0	0	1	0	0	0	0	1	0	0	0	1	1	1	0	1	1	27
16	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	0	1	0	1	1	1	1	0	1	1	0	1	1	1	1	1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	0	21
17	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	1	0	1	10
18	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	1	0	10
19	1	0	1	1	0	0	1	0	0	1	1	1	0	0	0	0	1	0	0	1	0	0	1	1	1	1	1	1	1	0	1	0	0	1	0	0	1	0	1	1	0	0	0	1	1	1	1	1	26
20	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9
21	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	0	0	0	0	1	1	0	0	0	0	1	1	1	0	15
22	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	9
23	0	1	1	0	0	0	0	1	1	0	0	1	1	1	1	1	0	0	0	1	1	1	0	1	0	0	0	1	1	1	0	0	0	1	0	0	1	0	0	1	0	0	1	0	0	0	0	0	20
24	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	4
25	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	1	1	1	0	1	0	1	1	0	0	0	1	1	1	1	1	0	0	0	0	1	1	0	0	1	0	19
26	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	9
27	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
28	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	1	0	0	1	0	0	0	1	13
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	6
30	0	0	1	0	0	1	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	9
31	1	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	4
32	1	1	1	1	0	0	0	0	1	0	1	0	0	1	1	1	1	1	1	0	1	1	1	1	0	1	0	1	1	1	0	0	0	0	0	1	0	0	0	1	0	1	1	0	1	1	1	1	28
33	0	0	1	0	0	1	0	1	0	0	1	1	0	1	0	0	1	0	1	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	13
34	0	0	0	1	1	0	0	1	0	0	0	1	0	0	0	0	0	1	0	1	0	1	1	0	0	0	1	0	0	0	1	1	0	1	1	1	0	0	0	1	0	0	0	1	0	0	0	0	16
35	0	1	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	1	0	0	0	0	13
36	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	5
	14	7	12	8	9	10	1	7	5	6	9	13	8	15	14	11	10	6	10	12	21	10	5	14	9	3	13	11	16	12	4	1	0	14	7	8	8	8	14	10	1	6	7	14	9	11	12	13	448

0 = Subject followed EV maximization rule. 1 = Subject violated EV maximization rule.

The lotteries of the single choice tasks are shown in the data sheets concerning the treatments with statistical measures available.

VIOLATIONS OF EV MAXIMIZATION RULE: Direct money payoff treatment without statistical measures available

Task	Subject No.																																															
No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	.
1	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	10
2	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4
3	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
4	0	0	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
5	0	1	1	0	1	0	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	1	1	1	0	1	1	1	0	0	1	0	1	1	1	1	0	0	0	1	1	1	0	0	0	1	0	1	31
6	0	0	1	0	0	0	0	1	0	0	1	1	0	1	0	0	0	0	0	0	0	1	1	1	0	1	0	1	0	0	1	0	0	0	1	0	0	1	0	1	1	0	1	0	1	0	0	0	17
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	2
8	0	1	1	1	1	0	1	1	1	0	1	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	1	0	1	0	1	0	1	0	0	1	0	1	0	1	1	1	1	0	0	1	0	1	29
9	0	0	1	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	7
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	3
11	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	4
12	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	5
13	0	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	7
14	0	0	0	0	1	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	1	12
15	0	0	0	0	1	0	1	0	1	1	1	0	0	0	0	0	1	0	1	1	0	1	0	0	0	1	1	1	1	0	0	0	1	0	1	0	0	0	0	1	1	0	0	0	0	1	0	0	18
16	0	1	0	0	0	0	1	0	1	1	1	0	0	1	0	1	0	0	1	1	1	1	1	1	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	1	1	1	0	0	0	1	0	0	21
17	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	8
18	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	5
19	0	0	1	0	0	1	1	0	0	1	1	0	1	0	0	0	1	1	0	0	1	0	1	1	1	1	0	0	0	0	1	1	1	0	1	1	1	1	0	0	0	1	1	0	0	1	1	1	25
20	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	7
21	0	0	0	0	1	0	1	0	0	1	1	0	0	1	0	0	0	0	1	1	1	0	1	1	0	0	0	0	0	0	1	1	0	1	0	1	1	1	0	0	1	0	0	0	0	1	1	1	20
22	0	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	1	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	10
23	0	0	1	0	0	0	1	0	1	0	0	0	0	1	0	1	0	1	1	0	0	1	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	15
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	1	0	0	1	1	1	1	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	0	1	1	1	0	1	1	1	0	0	1	1	0	1	0	0	0	0	0	0	1	0	1	0	22
26	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	3
27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	3
28	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	1	0	1	0	8
29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	7
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	3
31	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	3
32	0	0	0	1	1	0	1	1	1	1	1	1	0	1	1	1	1	0	1	1	0	1	1	1	0	1	1	0	0	1	1	0	1	0	1	1	0	1	0	1	1	0	0	0	0	0	0	1	28
33	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	0	1	1	0	0	0	0	0	0	0	10
34	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	1	1	1	1	0	0	0	0	0	0	0	0	1	1	13
35	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	0	1	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	10
36	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
	0	4	14	4	8	4	14	7	17	9	11	4	1	12	1	6	10	8	9	7	8	16	14	14	3	11	9	11	2	4	9	11	7	4	12	10	6	15	0	11	17	6	3	0	5	6	11	8	383

0 = Subject followed EV maximization rule. 1 = Subject violated EV maximization rule.

The lotteries of the single choice tasks are shown in the data sheets concerning the treatments with statistical measures available.

EVALUATION OF LOTTERIES IN THE BECKER-DeGROOT-MARSHAK PRICE ELICITATION TASKS

Binary lottery payoff treatment with statistical measures available

No	Lottery	Subject No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	+	*
37	150 0.90; 50 0.10	* 50	*140	* 75	*+140	85	130	*140	*140	*120	*+140	*+122	150	30	*140	*140	*+141	141	100	*120	149	50	*+120	*+122	150	6	15
38	400 0.20; 0 0.80	* 80	* 80	200	*+ 80	60	250	* 80	* 80	*+ 50	*250	*+ 48	*+100	100	*+100	* 80	*+120	80	10	*100	250	200	*+ 40	*+ 0	*250	7	16
39	200 0.90; 0 0.10	*180	*180	190	*+170	200	180	*180	*180	*170	*180	*+164	200	150	*200	*180	*+181	181	156	190	199	100	190	*180	200	3	12
40	400 0.20; 50 0.80	50	*120	100	*+200	100	250	*120	*120	*100	*120	*+288	100	200	*120	*120	*+220	100	70	*280	350	300	150	*100	*250	3	13
41	210 0.90; 0 0.10	*100	*189	195	*190	190	180	*189	*189	*+170	*189	*+151	210	200	210	*189	*190	200	200	200	200	200	200	*189	210	2	11
42	375 0.60; 0 0.40	5	*225	200	*300	200	220	*225	*225	*+190	*225	*+ 45	*+250	0	*200	*225	*+290	150	100	*190	290	300	190	*+180	*260	4	14
43	200 0.90; 50 0.10	50	*185	190	*185	180	185	*185	*185	*+180	*185	*+158	200	*+185	200	*185	200	150	150	180	190	100	190	180	180	3	9
44	400 0.50; 90 0.50	90	*245	250	*245	180	245	*245	*245	*200	*220	*+ 90	250	*245	*300	*245	350	200	120	*280	290	50	310	200	300	1	11
45	380 0.90; 0 0.10	1	*342	300	*350	320	350	*342	*342	*300	*342	*+273	380	*342	380	*342	370	343	350	360	370	380	200	*342	300	1	10
46	450 0.60; 0 0.40	1	*270	*220	*270	200	270	*270	*270	*200	*270	*+ 54	200	*270	*+300	*270	*350	160	200	*250	220	150	190	*200	*225	2	15
47	200 0.90; 100 0.10	100	*190	150	*190	150	190	*190	*190	*180	*190	*+172	200	*190	199	*190	200	190	120	*180	199	100	195	*190	180	1	11
48	450 0.50; 50 0.50	1	*250	250	*200	250	250	*250	*250	*200	*250	*+ 50	250	*250	*300	*250	350	100	200	*300	300	200	250	*250	250	1	12
49	380 0.30; 0 0.70	1	*114	100	*+100	100	115	*114	*114	* 50	*114	*+ 45	200	*114	* 80	*114	*190	30	50	*100	200	1	110	0	*200	2	13
50	450 0.20; 0 0.80	1	* 90	200	*+ 90	0	150	* 90	* 90	* 50	*150	*+ 54	200	*400	* 50	* 50	*180	100	50	* 40	200	1	90	0	300	2	12
Number of MAD calls		0	0	0	6	0	0	0	0	4	1	14	2	1	2	0	5	0	0	0	0	0	2	2	0	39	
Number of EV calls		4	14	2	14	0	0	14	14	14	14	14	2	8	10	14	9	0	0	10	0	0	2	10	5		174

Direct money payoff treatment with statistical measures available

No	Lottery	Subject No. 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	+	*
37	150 0.90; 50 0.10	150	*140	* 90	150	120	*140	*120	*140	*140	120	*135	*+120	100	*+140	120	65	125	*145	140	130	150	140	*140	*140	2	12
38	400 0.20; 0 0.80	400	*100	*100	* 80	30	* 80	80	*100	* 80	200	* 80	*+150	50	*+ 80	*100	200	75	* 60	200	200	200	100	* 80	* 80	2	13
39	200 0.90; 0 0.10	2	*190	190	180	180	*180	*150	*170	*180	100	*180	*+180	150	*+180	180	190	180	*180	180	180	200	175	*180	*180	2	11
40	400 0.20; 50 0.80	400	*100	*100	*120	60	*120	*100	*100	*120	175	*200	*150	50	*+120	*100	200	100	*120	150	300	175	250	*120	*120	1	14
41	210 0.90; 0 0.10	210	200	205	*189	150	*189	130	*200	*190	100	*180	*+189	200	*+189	200	200	200	*190	190	200	155	199	*190	*189	2	10
42	375 0.60; 0 0.40	375	*200	*186	*+225	230	*+160	*230	*200	*225	125	*225	*+175	200	*+200	*200	250	275	*190	220	250	275	270	*200	*225	4	14
43	200 0.90; 50 0.10	200	*190	196	*185	120	*185	130	*175	*185	130	*170	*+150	190	*+185	*180	190	190	190	190	190	200	190	*185	*185	2	11
44	400 0.50; 90 0.50	400	*200	*270	*245	300	*245	*250	*219	*280	200	*200	*+250	50	*+200	*220	200	275	*245	250	300	300	294	*245	*245	2	14
45	380 0.90; 0 0.10	380	300	370	*342	300	*342	250	350	*340	350	*340	*+300	250	*+342	350	300	350	*340	350	300	350	345	*342	*342	2	9
46	450 0.60; 0 0.40	450	*200	*290	*+220	400	*200	230	*250	*270	250	*250	*200	300	*275	*250	200	275	*200	310	350	300	333	*270	*270	1	13
47	200 0.90; 100 0.10	100	190	*190	*180	180	*190	*180	*180	*190	120	*180	*+190	100	*190	*190	175	190	190	185	180	200	175	*190	*190	1	12
48	450 0.50; 50 0.50	200	*220	*230	*250	100	*250	270	*300	*250	220	*200	*+225	150	*+225	*250	200	250	*210	250	350	300	295	*250	*250	2	13
49	380 0.30; 0 0.70	180	*180	*100	*114	*+150	*100	*120	*200	*110	200	*100	*+190	70	*+114	*100	200	100	*100	130	300	200	170	*114	*114	3	15
50	450 0.20; 0 0.80	150	* 80	*100	* 90	*+ 90	* 50	*100	230	* 90	200	*800	*+225	40	* 90	*100	200	100	100	170	250	200	250	* 90	* 90	2	13
Number of MAD calls		0	0	0	2	2	1	0	0	0	0	0	12	0	11	0	0	0	0	0	0	0	0	0	0	28	
Number of EV calls		0	11	10	12	2	14	8	12	14	0	14	14	0	14	10	0	0	11	0	0	0	0	14	14		174

* = Subject called expected value. + = Subject called mean absolute deviation.

LOTTERY EVALUATIONS IN THE BECKER-DeGROOT-MARSHAK PRICE ELICITATION TASKS: Binary lottery payoff treatment without statistical measures available

Task No.	Lottery	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
37	150 0.90; 50 0.10	75	120	120	100	10	140	140	130	130	135	100	50	140	120	130	100	100	150	150	140	150	140	160	130
38	400 0.20; 0 0.80	100	200	150	200	50	175	80	200	310	100	50	35	350	50	100	150	40	250	75	300	80	80	250	100
39	200 0.90; 0 0.10	50	150	170	180	99	182	180	200	190	170	160	188	190	200	200	200	150	180	180	180	200	180	181	180
40	400 0.20; 50 0.80	100	250	100	300	350	200	120	200	200	100	100	40	350	100	100	200	100	200	200	300	80	200	200	120
41	210 0.90; 0 0.10	75	100	190	190	200	200	189	210	195	200	210	90	190	200	200	200	150	200	200	200	210	180	190	200
42	375 0.60; 0 0.40	100	150	200	300	300	291	225	200	290	180	100	110	300	150	300	250	100	200	154	300	223	250	250	200
43	200 0.90; 50 0.10	0	180	170	180	190	191	185	200	190	180	200	180	180	180	200	200	125	190	190	180	200	150	150	190
44	400 0.50; 90 0.50	150	180	250	200	350	348	245	200	300	230	200	299	270	200	100	300	165	300	250	300	200	200	200	245
45	380 0.90; 0 0.10	80	220	320	350	380	350	342	380	350	350	350	340	330	300	380	350	380	350	350	350	380	250	350	350
46	450 0.60; 0 0.40	150	180	200	220	300	286	270	200	350	200	200	70	300	150	200	220	200	300	200	250	270	300	320	272
47	200 0.90; 100 0.10	50	170	170	180	190	181	190	200	190	190	200	200	180	190	200	190	175	180	200	180	200	170	170	191
48	450 0.50; 50 0.50	100	200	250	300	300	301	250	200	300	300	200	250	275	200	200	400	200	350	225	380	225	300	311	240
49	380 0.30; 0 0.70	100	120	150	200	200	190	114	200	200	100	50	25	160	80	100	180	175	200	100	180	114	150	350	114
50	450 0.20; 0 0.80	200	100	170	100	350	375	90	200	300	200	30	20	200	50	100	300	50	200	200	250	90	225	380	130

Task No.	Lottery	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
37	150 0.90; 50 0.10	140	140	120	140	145	150	140	135	140	149	100	125	100	100	150	110	140	150	100	120	125	150	130	100
38	400 0.20; 0 0.80	180	150	250	10	50	100	80	90	80	61	200	100	100	150	200	200	80	200	200	100	280	250	90	250
39	200 0.90; 0 0.10	190	190	150	150	190	150	180	185	180	180	170	180	180	160	120	150	180	200	150	160	175	130	190	180
40	400 0.20; 50 0.80	120	150	150	100	150	100	120	129	120	350	200	150	60	100	150	300	120	150	50	200	300	280	300	250
41	210 0.90; 0 0.10	200	195	160	190	200	150	189	200	189	169	200	190	180	190	200	190	189	200	200	195	170	200	180	185
42	375 0.60; 0 0.40	290	200	200	180	220	200	219	200	225	199	300	200	200	320	200	300	225	300	290	190	220	250	250	255
43	200 0.90; 50 0.10	200	190	170	170	190	150	185	190	185	111	150	180	180	180	200	170	185	180	150	180	160	190	200	190
44	400 0.50; 90 0.50	200	200	200	170	250	300	245	330	245	321	200	245	250	270	100	300	245	300	300	230	300	300	310	290
45	380 0.90; 0 0.10	370	350	270	250	350	280	342	350	342	126	300	350	300	350	200	350	342	380	300	320	330	350	370	350
46	450 0.60; 0 0.40	250	220	300	150	220	300	270	260	270	259	300	300	200	400	250	400	270	350	120	213	300	300	400	300
47	200 0.90; 100 0.10	200	180	180	180	190	180	180	190	190	100	200	190	190	180	110	180	190	200	200	185	170	190	190	180
48	450 0.50; 50 0.50	300	300	280	201	300	300	250	250	250	222	300	250	250	400	75	400	250	350	300	200	317	300	350	300
49	380 0.30; 0 0.70	100	200	190	102	75	100	90	150	114	141	200	100	100	200	200	250	114	200	50	195	250	200	150	200
50	450 0.20; 0 0.80	120	100	200	50	120	200	225	150	90	111	200	150	100	150	320	100	90	250	14	200	250	250	215	250

LOTTERY EVALUATIONS IN THE BECKER-DeGROOT-MARSHAK PRICE ELICITATION TASKS: Direct money payoff treatment without statistical measures available

Task No.	Lottery	Subject No.																							
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
37	150 0.90; 50 0.10	141	120	75	140	140	145	100	130	100	110	100	140	139	100	140	120	100	120	130	80	140	75	100	60
38	400 0.20; 0 0.80	81	50	25	155	140	200	200	85	20	24	100	80	80	80	80	100	150	150	150	250	210	200	300	399
39	200 0.90; 0 0.10	181	180	200	185	188	201	150	19	150	150	180	180	180	150	180	170	180	180	180	150	191	90	100	199
40	400 0.20; 50 0.80	121	60	40	200	140	200	300	105	200	200	200	120	180	150	120	75	120	120	200	275	210	200	350	100
41	210 0.90; 0 0.10	190	190	210	200	196	205	140	210	200	150	200	189	189	100	189	150	189	190	180	180	200	209	190	200
42	375 0.60; 0 0.40	226	100	375	280	150	275	250	220	200	100	300	225	225	100	220	150	225	250	200	280	290	50	300	150
43	200 0.90; 50 0.10	186	180	200	190	195	195	190	185	170	150	50	185	190	150	180	150	185	170	185	175	192	199	222	80
44	400 0.50; 90 0.50	246	200	200	275	200	300	300	245	200	250	200	245	245	200	245	170	245	210	300	300	210	90	500	150
45	380 0.90; 0 0.10	343	350	380	350	340	360	380	380	250	200	0	342	342	200	340	300	342	300	350	330	362	200	300	379
46	450 0.60; 0 0.40	271	200	150	320	225	360	200	225	200	250	300	270	270	200	270	200	270	380	325	350	350	100	400	300
47	200 0.90; 100 0.10	191	180	200	190	195	195	200	185	150	100	100	190	190	170	190	170	190	180	185	160	192	100	200	180
48	450 0.50; 50 0.50	251	100	100	350	250	360	200	250	300	200	300	250	250	200	250	100	250	250	280	300	360	50	400	300
49	380 0.30; 0 0.70	115	50	20	200	130	256	150	125	10	100	0	114	114	150	110	100	114	120	190	200	210	50	300	200
50	450 0.20; 0 0.80	91	50	10	200	170	300	200	100	1	1	300	90	90	150	90	150	225	100	200	220	210	15	350	200

Task No.	Lottery	Subject No.																							
		25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
37	150 0.90; 50 0.10	150	88	130	85	141	130	100	100	130	140	140	147	140	50	140	140	120	100	140	130	10	130	110	45
38	400 0.20; 0 0.80	80	250	63	120	81	200	150	120	80	80	280	200	200	200	80	80	50	250	80	80	5	60	150	150
39	200 0.90; 0 0.10	180	150	178	155	181	180	170	150	190	180	180	189	180	250	180	190	180	180	180	175	200	200	185	100
40	400 0.20; 50 0.80	120	200	100	90	125	200	130	200	100	200	200	225	150	350	120	80	120	200	120	100	10	150	80	150
41	210 0.90; 0 0.10	200	175	202	180	192	200	170	150	190	189	190	189	200	230	189	200	200	180	189	189	15	210	200	120
42	375 0.60; 0 0.40	225	200	181	210	231	200	260	175	200	225	280	225	230	100	225	200	150	250	225	200	374	200	220	175
43	200 0.90; 50 0.10	190	120	176	185	187	190	170	130	175	185	180	185	185	200	160	160	180	175	185	180	200	200	180	120
44	400 0.50; 90 0.50	280	300	239	254	250	210	220	275	250	250	280	269	250	400	245	250	100	300	245	240	10	250	365	250
45	380 0.90; 0 0.10	350	250	335	300	345	350	350	275	350	340	350	342	350	250	345	300	360	300	180	342	379	380	350	250
46	450 0.60; 0 0.40	258	400	235	300	275	300	300	325	270	270	280	297	270	100	200	180	120	350	270	240	200	200	300	200
47	200 0.90; 100 0.10	180	150	188	185	195	190	185	165	185	190	180	190	190	200	190	180	150	180	190	190	199	200	170	140
48	450 0.50; 50 0.50	225	320	250	300	255	300	300	225	300	300	300	275	250	300	250	200	250	300	250	250	150	250	250	210
49	380 0.30; 0 0.70	150	150	107	120	115	150	200	155	114	115	200	195	120	100	110	150	100	200	114	114	1	180	140	150
50	450 0.20; 0 0.80	150	250	76	60	200	200	150	215	90	200	200	300	100	100	100	200	100	250	90	85	1	150	300	200

REFERENCES

Abbink, K. and Sadrieh, A. (1995), RatImage – Research Assistance Toolbox for Computer-Aided Human Behavior Experiments, SFB Discussion Paper B-325, University of Bonn.

Becker, G.M., DeGroot, M.H. and Marschak, J. (1964), Measuring utility by a single-response sequential method, *Behavioral Science*, 9: 226–232.

Berg, J.E., Daley, L.E, Dickhaut, J.W. and O'Brien, J.R. (1986), Controlling preferences for lotteries on units of experimental exchange, *Quarterly Journal of Economics*, 101: 281–306.

Camerer, C. (1995), Choice under risk and uncertainty, in J.H. Kagel and A.E. Roth (eds.), *Handbook of Experimental Economics*. Princeton University Press, Princeton, 617–673.

Cooper, R., DeJong, D.V., Forsythe, R. and Ross, T.W. (1990), Selection criteria in coordination games: some experimental results, *American Economic Review* 80: 218–233.

Cooper, R., DeJong, D.V., Forsythe, R. and Ross, T.W. (1993), Forward induction in the battle-of-sexes games, *American Economic Review* 83: 1303–1316.

Cox, J.C. and Oaxaca, R.L. (1995) Inducing risk-neutral preferences: further analysis of the data, *Journal of Risk and Uncertainty* 11: 65–79.

Cox, J.C., Smith, V.L. and Walker, J.M. (1985), Experimental development of sealed-bid auction theory; calibrating controls for risk aversion, *American Economic Association Papers and Proceedings* 75: 160–165.

Cox, J.C., Smith, V.L. and Walker, J.M. (1988), Theory and individual behavior of first-price auction, *Journal of Risk and Uncertainty* 1: 61–99.

Hoggatt, A.C., Selten, R., Crockett, D., Gill, S. and Moore, J. (1978), Bargaining experiments with incomplete information, in H. Sauermann (ed.), *Contributions to Experimental Economics*, Vol. 7, J.C.B. Mohr, Tübingen, 127–178.

Kahneman, D. and Tversky, A. (eds.) (1982), *Judgment Under Uncertainty: Heuristics And Biases*. Cambridge University Press.

Lichtenstein, S. and Slovic, P. (1971), Reversals of preference between bids and choices in gambling decisions, *Journal of Experimental Psychology* 89: 46–55.

Millner, E.L. and Pratt, M.E. (1992), A test of risk inducement: is the inducement of risk-neutrality neutral? Working Paper, Virginia Commonwealth University.

Prasnikar, V. (1993), Binary lottery payoffs: do they control risk aversion? Discussion Paper No. 1059 – Center for Mathematical Studies in Economics and Management Sciences, Northwestern University, Evaston, Illinois.

Rietz, T.A. (1993), Implementing and testing risk preference induction mechanisms in experimental sealed bid auctions, *Journal of Risk and Uncertainty* 7: 199–213.

Roth, A.E. and Malouf, M.W.K. (1979), Game-theoretic models and the role of information in bargaining, *Psychological Review* 86: 574–594.

Smith, A.B.C. (1961), Consistency in statistical inference and decision, *Journal of the Royal Statistical Society* 23: 1–25.

von Neumann, J. and Morgenstern, O. (1944), *Theory of Games and Economic Behavior*. Princeton University Press.

Walker, J.M., Smith, V.L. and Cox, J.C. (1990), Inducing risk neutral preferences: An examination in a controlled market environment, *Journal of Risk and Uncertainty* 3: 5–24.

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