PROSPECT THEORY IN CHOICE AND PRICING TASKS

William T. Harbaugh
University of Oregon
and N.B.E.R.
Eugene, Oregon 97403
bill@harbaugh.org

Kate Krause
University of New Mexico
Albuquerque, New Mexico 87131
kkrause@unm.edu

Lise Vesterlund
University of Pittsburgh
Pittsburgh, PA 15260
vester@pitt.edu

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Abstract: The most distinctive prediction of Prospect Theory is the following fourfold pattern (FFP) of risk attitudes: (1) risk-seeking over low-probability gains, (2) risk-aversion over low-probability losses, (3) risk-aversion over high-probability gains, and (4) risk-seeking over high-probability losses. Using simple and real gambles this paper provides a direct test of the FFP. We determine whether the predicted pattern is robust to repeated evaluation as well as to the method used to elicit preferences. While risk attitudes are found to be consistent with the FFP when subjects price a series of gambles, this is not the case when subjects choose between the gamble and its expected value. In this case choices are often the exact opposite of the FFP. This reversal of risk attitudes between the choice and pricing task holds both between and within subjects, and is robust to subjects simultaneously reviewing their decisions in the two tasks.

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1. Introduction

Economists and psychologists have frequently found that individuals faced with risky prospects make decisions that are inconsistent with expected utility theory.[1] A large number of alternative models have been proposed to better explain behavior under risk. Perhaps the most accepted of these is Cumulative Prospect Theory (CPT) by Tversky and Kahneman (1992). Camerer (1998), for example, argues that CPT is supported by the preponderance of evidence, and he suggests that it is time to abandon expected utility theory in its favor. This paper presents experimental results which suggest that the evidence in support of CPT, as well as of its predecessor Prospect Theory (Kahneman and Tversky, 1979), may not be as robust as past evidence has led us to believe.

Although both Prospect Theory and Cumulative Prospect Theory have been subjected to substantial experimental investigation, most tests focused on subjects' evaluations of complex lotteries, which were designed to simultaneously rank expected utility theory and alternative theories to one another. Direct tests of the prospect theories are very few. Perhaps the most obvious testable prediction of the two theories is the following fourfold pattern (FFP) of risk attitudes: (1) risk-seeking over low-probability gains, (2) risk-aversion over low-probability losses, (3) risk-aversion over high-probability gains, and (4) risk-seeking over high-probability losses. The few studies that directly test the FFP have been based either on subjects' choices between hypothetical gambles over losses and gains (see e.g. Tversky and Kahneman, 1992), or on subjects' reported monetary evaluation of real prospects over gains (see e.g. Kachelmeier and Shehata, 1992).

The objective of this paper is to determiner whether risk attitudes follow the FFP when evaluated over simple and real gambles with both losses and gains. Specifically, we examine evaluations of six simple prospects that generate a $20 loss or gain, with a 10%, 40%, or 80% probability. We

[1] See for example Schoemaker (1982) and Machina (1987) for reviews.

will test whether the FFP is robust to repeated evaluation of gambles as well as to the method used to elicit preferences. In keeping with past literature we consider two methods of elicitation. In one method subjects report their cash equivalent of the gamble, and in the other they choose between the gamble and its expected value.

Past research suggests that preferences over risky prospects may be sensitive to the elicitation method. Slovic and Lichtenstein (1968), Lichtenstein and Slovic (1971) and Lindman (1971) were the first to show that in some cases the price ordering of prospects is systematically different from the choice ordering.[2] When presented with two prospects, one with a high probability of wining a small amount and the other with a low probability of winning a large amount, most subjects choose the first prospect while pricing the second prospect higher than the first.[3] To explain this reversal it is argued that individuals focus on the probability of the prospects when making a choice between them, whereas the money at stake plays a larger role when pricing prospects. As suggested by Tversky and Kahneman (1992) this causes the stated price to exceed the certainty equivalents derived from choice.[4] The implication is that while choice and pricing elicitations may result in different inferred preferences, the differences in the implied risk attitude should be systematic. In particular, subjects in the price task should appear more risk-seeking over gains and more risk-averse over losses.

Our results are not consistent with this prediction. When individuals are asked to report their willingness to pay for a risky prospect we find that the FFP is an extremely good predictor of implied risk attitudes. For high-probability prospects, the majority is risk-seeking over losses and risk-averse over gains, while for low-probability events most risk attitudes are the exact opposite. Not only is the FFP consistent with both average and individual choices, but it is also robust to repeated evaluation of the gambles. Surprisingly the result changes dramatically when we ask subjects to choose between the gamble and its expected value. Here the implied risk attitudes do

[2] See Slovic and Lichtenstein (1983) for a summary of these early contributions.
[3] This result has later been carefully reexamined and replicated, see e.g. Grether and Plott (1979).
[4] For example, Tversky and Kahneman (1992) suggest that overpricing of risky prospects can explain the difference between the results they derive from a hypothetical choice task and that of Kachelmeier and Shehata (1992), who use a real price task. While Tversky and Kahneman (1992) find the traditional FFP, Kachelmeier and Shehata find

not have the predicted pattern. While we cannot reject the hypothesis that individuals on average are risk-neutral, the preferences revealed by the choice task are nearly opposite of that predicted by the FFP. We document this reversal of risk attitudes across tasks both between and within subjects, and we find that the reversal remains even when subjects are given the opportunity to review and change their price and choice task responses simultaneously. Thus the change of attitudes between price and choice is a robust phenomenon. Furthermore, since the implied risk attitudes from the two tasks are often the reverse of one another it cannot be argued that overpricing of prospects is what causes preference reversals between the two methods.

Our results show that the support for Prospect Theory is not as robust as previous evidence suggests. First, the documented FFP from hypothetical choices does not hold up when the gambles are real. Second, the support for the FFP found with the price procedure is reversed when subjects instead use the choice-based procedure to evaluate the gambles. Obviously one cannot argue that one elicitation method is superior to the other. However it is disturbing that risk attitudes are inconsistent with the FFP when using what appears to be the simplest and most easily understood elicitation procedure – giving people a choice between playing a simple gamble and taking that gamble's expected value.

In the next section of the paper we present and motivate our experimental design. We then show how the results support the conclusion that risk attitudes, and the existence of the four-fold pattern, are very sensitive to the elicitation procedure. Finally, to determine what causes reversals of attitudes across treatments, we conducted another set of experiments, which unequivocally demonstrate that the elicitation question drives the reversals between the choice and price tasks.

2. Experimental Motivation and Design

The key elements of Kahneman and Tversky's Prospect Theory and Cumulative Prospect Theory are a non-linear probability weighting function and a reference-dependent value function. As others have before them, they assume that individuals do not use the objective probability to

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massive risk-seeking for low-probability gains and no evidence of risk-aversion for high-probability gains. See also

evaluate the likelihood of an outcome. Instead individuals are assumed to overweight low-probability events and underweight high-probability ones.[5] As for the value function, they assume that it is concave for gains and convex for losses, implying that people tend to be risk-averse over gains and risk-seeking over losses. To model the finding that losses often loom larger than gains, they also assume that the value function is steeper for losses than for gains.

The FFP of risk attitudes is the direct implication of these assumptions. If correct then risk attitudes reflect along two different dimensions. Conditional on either a loss or a gain we should see reflection when moving from a low- to a high-probability prospect, and conditional on either a high- or a low-probability prospect we should see a reflection of risk attitude when gains are replaced by similar sized losses.[6]

The objective of our experiment is to test whether individuals' implied risk attitudes are consistent with the FFP when they are asked to evaluate a set of six simple and real gambles. Each prospect involved a chance of winning or losing $20. Table 1 presents the six prospects that subjects were asked to evaluate.

Tversky, Slovic, and Kahneman (1990).

[5]Other examples of subjective utility theory are Edwards (1955), Ramsey (1931), Savage (1954), and Quiggin (1982). A regressive probability weighting function is consistent with overweighting low-probability prospects and underweighting high-probability ones. For reviews see for example Camerer and Ho (1994), who examine data from 11 experiments and find that a regressive probability weighting function best describes the data in all but two experiments. See also Tversky and Fox (1995), Wu and Gonzalez (1998), and Prelec (1998).

[6] In contrast to the standard interpretation Tversky and Kahneman (1992) make clear that "Prospect Theory does not imply perfect reflection in the sense that the preference between any two positive prospects is reversed when gains are replaced by losses (p. 306)."

Table 1: The Six Choices

Prospect Number	Probability	Stake	Expected Value
1	.1	+$20	$2
2	.4	+$20	$8
3	.8	+$20	$16
4	.1	-$20	-$2
5	.4	-$20	-$8
6	.8	-$20	-$16

Estimates of subjective probability weighting functions have found that the greatest overweighting occurs at probabilities of about 0.1, that subjective and objective probabilities are nearly equal at about 0.4, and that the greatest underweighting is at about 0.8.[7] Hence we are particularly interested in determining risk attitudes at prospects 1, 3, 4, and 6, since Prospect Theory predicts that people will be risk-seeking at prospect 1, risk-averse at prospect 3, risk-averse at prospect 4, and risk-seeking at prospect 6.

As mentioned earlier most previous experiments consider more complex gambles, however a couple of studies have elicited risk attitudes for similar simple gambles. For example, Tversky and Kahneman (1992) present 25 graduate students with a series of simple hypothetical gambles over both losses and gains. They asked the students to indicate a preference between a gamble and each of seven sure outcomes. To obtain a refined estimate of the certainty equivalent for the prospect, subjects were then presented with another seven sure outcomes, linearly spaced between a value of 25% higher than the lowest amount accepted in the first set and a value 25% lower than the highest amount rejected. Thus the data consist of a series of choices between a given prospect and several sure outcomes. The results show very strong support for the FFP. Another study by Kachelmeier and Shehata (1992) present Chinese, Canadian, and American subjects with a sequence of 25 simple lotteries over gains, and ask what price they would be willing to accept in return for their lottery ticket. The Becker-DeGroot-Marschak (BDM)

[7] See for example Tversky and Kahneman (1992) and Prelec (1998).

procedure from Becker et al. (1964) is used to generate the actual sales prices of the lottery. The results document substantial risk-seeking at low-probability prospects, but do not show risk-aversion at high-probability prospects. In a follow up experiment on a limited set of gambles they find evidence that the lack of risk-aversion most likely is due to the willingness-to-accept format of their elicitation. Similar to Knetch and Sinden (1984) they find that reported willingness to pay for a prospect is much lower than the reported willingness to accept. Harbaugh, Krause, and Vesterlund (2000) also consider a set of simple games and investigate risk preferences of individuals ranging in age from five to 64. To simplify the protocol for the youngest subjects they use a simple choice-based elicitation procedure, which asks subjects to choose between a risky prospect and its expected value. The incentives in the experiment were real and choices were solicited over both gains and losses. Their results indicate that children exhibit risk attitudes that are the exact opposite of the FFP, and although this pattern diminishes with age they do not find adults behaving in a manner consistent with the FFP.

While it is possible that the alternative subject pool or the specific set of prospects drives the results of Harbaugh et al. (2000), their finding does raise doubt about the robustness of the FFP. Using real monetary incentives and the typical undergraduate subject pool this paper will carefully test the FFP. As the past literature has based elicitations either on choices or on the reported monetary equivalent of the gamble, we examine both of these elicitation methods. Specifically we compare a price-based procedure to a choice-based procedure similar to that of Harbaugh et al. The choice procedure simply asks individuals to choose between a gamble and its expected value. The price procedure is more complicated. Here we ask subjects to report the most they are willing to pay to play a gamble over gains, or the most they are willing to pay to avoid playing a gamble over losses.[8] The reason for using the willingness-to-pay format is to limit the amount of "overbidding" found in Kachelmeier and Shehata (1992). A BDM procedure was used to determine whether subjects would get the risky prospect or would pay the randomly

[8] With this procedure the willingness-to-pay and the choice decisions are slightly different over gains. Because people must pay to play the gambles, their payoff is reduced by the random price drawn. We address this issue in Section 4. Note that the willingness-to-accept format presents a similar difference over losses where subjects accept a payment in return for the gamble.

determined price to play the gamble (gain), or avoid the gamble (loss).[9] We explained the BDM procedure separately for losses and for gains. Each explanation included an example, a test of understanding, and then a further discussion.

The protocol was specifically designed to distinguish between actual preferences and elicitation effects. We therefore made participants review their decisions multiple times before the decisions were made final. To determine whether potential differences in elicitation were both between- and within-subject phenomena, all subjects were asked to evaluate the prospects using both the choice and price methods. Ninety-six college students from a variety of majors at the University of New Mexico participated in the experiment. Sixty-four students used the choice method first and 32 used the price method first.[10] We refer to subjects who first completed the choice method as "choice-subjects" and those who first completed the price method as "price-subjects."

Only one person at a time participated in an experimental session.[11] Each experimental session lasted about 30 minutes. Upon arriving at the lab the student was directed to a partition, where he or she could make decisions without being observed by the experimenter. Subjects were randomly assigned to be either a price- or a choice-subject. After reading the instructions for the initial elicitation method, subjects were shown a sample prospect and spinner. They were told they would be asked to make six decisions, and that one decision would be picked randomly to count for their payoff.[12] They were then given $22 in single dollar bills, and asked to evaluate separately each one of the six prospects. The odds for the gambles were shown both numerically and using spinner cards of the sort used in board games.[13] We refer to this initial decision as the first-round decision. After completing the initial evaluation (one set of six decisions), the subjects were asked to lay all their decisions out on a table so that they could see them

[9] Instructions for both tasks are provided in the Appendix. As in Grether and Plott (1979) the random price is determined by three random draws from a bingo cage with each draw determining dollars, dimes, and pennies.
[10] Since we are unaware of previous studies that use the simple choice-based procedure of Harbaugh et al. (2000), we decided that it was desirable to have a larger subject pool for this task.
[11] Cox and Epstein (1989) and Slovic and Lichtenstein (1971) used a similar procedure.
[12] Camerer (1982, 1989) and Starmer and Sugden (1991) show that the procedure of randomly choosing one of several gambles elicits roughly the same preferences as when subjects make only one choice and play the gamble they choose.
[13] We allowed subjects to test the spinners as often as they wished during the experiment. The same spinners spun by the subjects were used to determine the outcomes of any gambles chosen for payment.

simultaneously. At this point they were given an opportunity to change any of their responses. We refer to decisions at this point as the second-round decisions.

We used a restart procedure to get the decisions for the second task. After the second-round decisions, subjects were asked to participate in another experiment, before their earnings from the first task were determined. Using a self-contained set of instructions, they were presented with the elicitation method that they had yet to complete.[14] Once again they were given $22, and asked to separately evaluate each one of the six prospects. After completing the six evaluations they were asked to review the six decisions simultaneously and could make any changes they wished.

Once both elicitation methods were completed, subjects were asked to review all twelve decisions simultaneously, and were given yet another opportunity to change their answers. This last and final round of decisions will be referred to as the third-round decision.[15] After completing the third-round decisions, we picked one prospect from each elicitation method, played the gambles as appropriate, and paid the subjects their net earnings in cash. Their earnings averaged $44, and ranged between $4 and $84.

In each method prospects were presented according to one of four different orders. An equal proportion of subjects was given each order. Two orderings presented the prospects in increasing order of probability (from 10% to 80%), with one ordering first presenting gains and then losses, and the other ordering first presenting losses and then gains. Two other orderings presented the prospects in decreasing order of probability (from 80% to 10%), once again one ordering first presented gains, and the other first presented losses. Subjects received the prospects in the same order for both the choice and pricing methods, and the order in which a person was shown the choices was determined randomly.

[14] This restart procedure provides us with initial responses that are comparable to those of others who have only used one elicitation task.

[15] Slovic and Lichtenstein (1971) use a similar review process where decisions were obtained three times, and subjects were reminded what their earlier decisions had been before entering the third and final round decision.

3. Results and Analysis

Using two different elicitation methods we will determine whether risk attitudes follow the FFP. We start by showing that subjects who first use the price task to evaluate gambles choose prices that are consistent with this pattern. Next we examine whether subjects who first use the choice procedure make choices that imply similar risk attitudes. We find that preferences are sensitive to the elicitation procedure. Behaviors in the choice procedure are almost opposite of that predicted by Prospect Theory. Thus, using real gambles we fail to replicate the FFP found by Tversky and Kahneman (1992) when using hypothetical choice.

To asses the robustness of the result we also determine whether these differences in risk attitudes hold when price-subjects use the choice task and choice-subjects use the price task to evaluate the gambles. The results show that the difference in risk attitudes between elicitation methods remain despite any ordering or wealth effects that might arise from already having completed a task. Examining third-round decisions, which were made after simultaneously reviewing and possibly changing the decisions made in the choice and pricing task, we find that a large number of subjects reverse their decisions between the two elicitation methods. This makes clear not only that the FFP is not a robust phenomenon, but also, in contrast to Tversky and Kahneman (1992), that one cannot explain preference reversals between elicitations by a general tendency to overprice risky prospects.

3.1. Price-Subjects in the Price Task

We first look at the first-round pricing decisions of the individuals who initially were asked to provide a cash equivalent for each risky prospect. The question of interest is whether risk attitudes vary across gambles. Table 2 presents the average and median prices reported by the 32 price-subjects. Based on these measures the fifth and last columns summarize implied risk attitudes and lists whether the reported willingness to pay is significantly different from the prospect's expected value. A subject is classified as risk-neutral if the reported price equals the expected value of the gamble. If the subject is willing to pay more than the expected value to play

the gamble over gains then she is classified as risk-seeking. Similarly she is classified as risk-seeking if she is willing to pay less than the expected value to avoid playing a gamble over losses.

Table 2: Price-subjects in the Price Task

Prospect			Mean reported price			Median reported price		
Description		Expected value	Price	p-value, Wilcoxon test	Mean risk attitude	Price	p-value, sign test	Median risk attitude
Gain +$20	1. p=0.1	$2	4.9	0.007	Seeking	2.0	0.078	Neutral
	2. p=0.4	$8	8.1	0.500	Neutral	7.0	0.170	Averse
	3. p=0.8	$16	12.2	0.000	Averse	12.0	0.000	Averse
Loss -$20	4. p=0.1	-$2	-5.7	0.000	Averse	-4.5	0.000	Averse
	5. p=0.4	-$8	-9.6	0.021	Averse	-9.0	0.064	Averse
	6. p=0.8	-$16	-12.6	0.000	Seeking	-13.0	0.000	Seeking

Notes: 32 subjects, first-round decisions. The Wilcoxon test assumes the price distribution is symmetric and tests the hypothesis that the mean and median of the distribution equal the expected value. The sign test does not assume symmetry and tests the hypothesis that the median of the distribution equals the expected value.

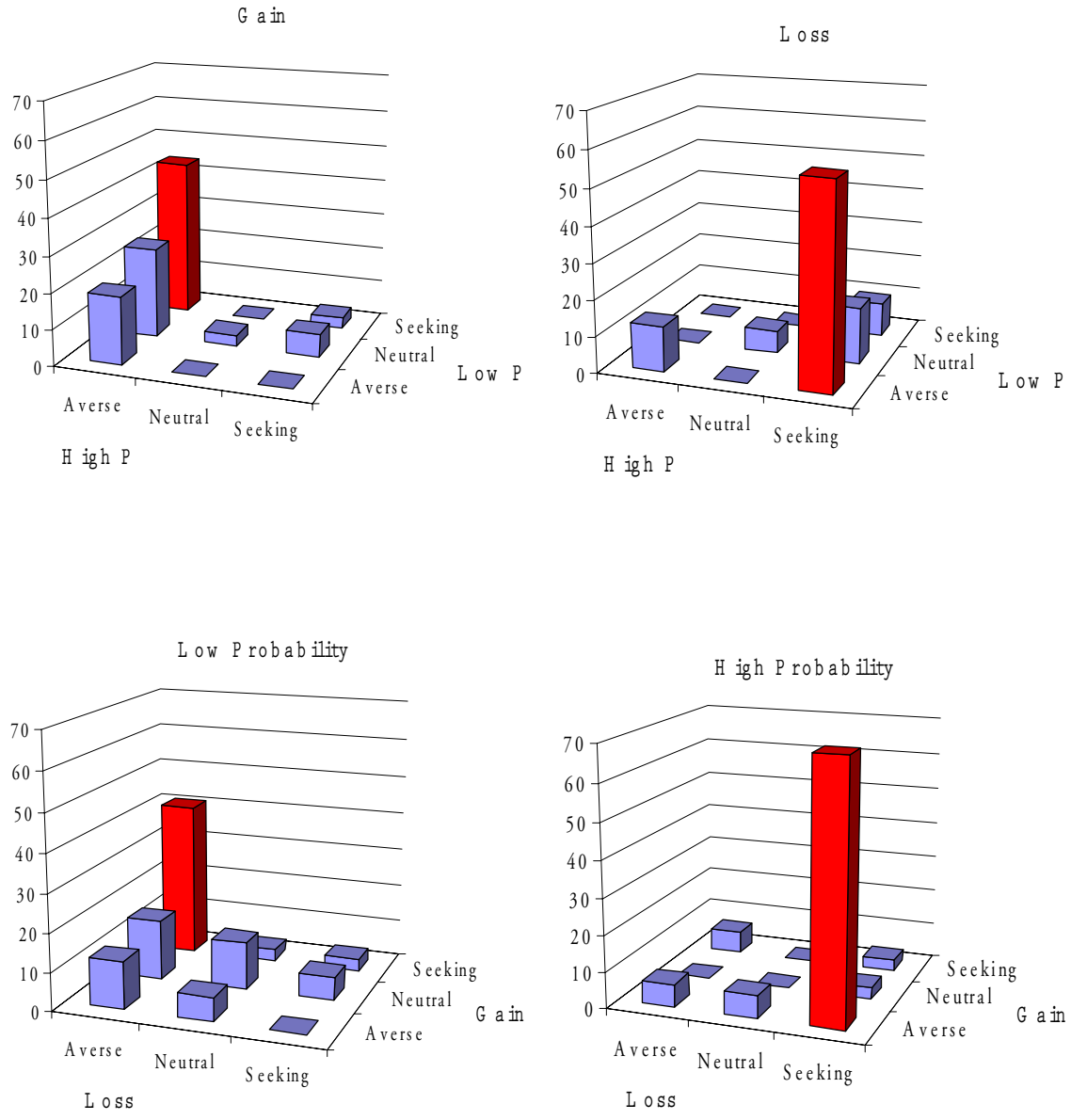
Confirming Kahneman and Tversky's hypothesis that individuals are loss averse we first note that losses loom larger than similar sized gains. Both the mean and median prices for a positive prospect are lower than that of a similar negative prospect.[16] Second, the mean reported prices suggest risk attitudes consistent with the fourfold pattern. Subjects are risk-seeking at low-probability gains and risk-averse at high-probability ones. Over losses, risk attitudes reflect and we see the opposite pattern. In all four cases the average attitude is significantly different from risk-neutrality. This pattern is also supported by the median prices. The only exception is prospect 1, where the median price equals the expected value of the gamble.

Table 2 shows that on average risk attitudes reflect in the predicted manner between losses and gains and between high- and low-probability events. A similar result is found within-subjects. To determine whether the individual's risk attitude reflects as predicted we examine the first-round

decisions of the price-subjects. Conditional on the stake of the prospect being a loss or a gain, the first panel of Figure 1 shows the proportion of subjects fitting into each of the possible combinations of risk attitudes when moving from high- to low-probability prospects. The second panel of Figure 1 shows the proportion with each combination of risk attitudes when conditioning on the likelihood of the stake and moving between prospects with a similar sized loss and gain. The highlighted cells are the outcomes predicted by Prospect Theory.

[16] Only in the case of prospect 2 and 5 can we reject the hypothesis that the absolute price reported for a loss equals that of the similar sized gain (p-value of the Wilcoxon test equals 0.03).

Figure 1: Risk Attitudes of Price-subjects in the Price Task



Note: 32 subjects, first-round decisions, percentages on vertical axis. The proportion with the predicted reflection between high- and low-probability prospects is 44% for gains and 56% for losses. For low-probability prospects 41% reflect as predicted between losses and gains, and for high-probability prospects 56% exhibit the reflection.

The support for the FFP of risk attitudes is striking. The modal cell in the price task is always that predicted by Prospect Theory, and in two of the four cases more than half the subjects are in this cell. As expected, risk attitudes reflect in two dimensions. Conditional on a gain or a loss, attitudes reflect when moving from a high- to a low-probability prospect, and conditional on a low- or a high-probability prospect, attitudes reflect when evaluating a loss rather than a similar sized gain.

As a test of the reflections we determine whether the proportion with the predicted risk attitudes exceeds the proportion that would be expected if subjects were equally likely to have any combination of risk attitudes. With three different risk attitudes and hence 9 possible combinations we use an exact binomial test of proportions to test the null that at most $1/9^{th}$ are in the cell predicted by Prospect Theory. In all four comparisons we can reject the null in favor of the alternative that more people are in the predicted cell, with p-values of 0.000. The same conclusion is reached when we test the hypothesis that at most 25% of the subjects who are never risk-neutral reflect in the predicted manner.[17] Thus the support for Prospect Theory is clear, whether we focus on reflection of risk attitudes between gains and losses, or between low- and high-probability prospects.

Alternative to testing for the predicted reflections we can examine the full FFP and determine whether the fraction who exhibit the entire pattern over the four prospects exceeds the fraction one would expect if individuals were equally likely to have any combination of risk attitudes. Looking only at first-round prices, we find that 10 of 32 subjects, or 34%, report prices that are fully consistent with the FFP.[18] Since there are 3 possible risk attitudes for 4 prospects, there are 81 possible combinations. Ignoring individuals with risk-neutral decisions there are 16 possible combinations. With p-values of 0.000 we reject the null that the proportion of all subjects choosing the FFP at most equals 1/81, as well as the hypothesis that at most 1/16 of the subjects who are never risk-neutral exhibit the FFP.

[17] p-values are at 0.002 or lower. Stronger tests are whether the majority of subjects reflect as predicted or whether all subjects have the predicted reflection. Throughout the paper we focus on the weaker test.
[18] At most 4 subjects choose any of the other combinations of risk attitudes.

To assess the robustness of the evaluations we asked subjects to review their decisions several times. Despite the fact that most took advantage of the opportunity to change decisions, this revision process does not diminish the support for Prospect Theory.[19] Table 3 presents the distribution of risk attitudes in each of the three rounds, where the highlighted cell illustrates those predicted by Prospect Theory. Across rounds we continue to see the FFP, and in all 12 cases we reject the null that at most 1/3 of the subjects are in the predicted cell.[20]

Table 3: Price-subjects in the Price Task, Risk Attitudes by Prospect and Round.

	Low probability (p=0.1)						High probability (p=0.8)					
	Gain (+$20)			Loss (-$20)			Gain (+$20)			Loss (-$20)		
	Round			Round			Round			Round		
Risk attitude:	1	2	3	1	2	3	1	2	3	1	2	3
Averse	19	16	16	69	66	63	88	78	75	13	22	22
Neutral	34	34	34	22	25	25	3	6	9	6	6	6
Seeking	47	50	50	9	9	13	9	16	16	81	72	72

Note: 32 subjects, percentages in cells.

Not only does the FFP accurately describe average and individual behavior, but it is also robust to the reevaluation of decisions. We therefore conclude that individuals who are presented with the task of pricing a series of gambles will do so in the manner predicted by Prospect Theory.

3.2. Choice-Subjects in the Choice Task

Next we examine whether the support for the FFP is equally strong when we use a choice-based elicitation method, that is, when individuals are asked to choose between the gamble and its expected value. To compare the results to the price task this section only includes choices made

[19] Of 96 subjects only 19 never changed any of their decisions between the first and third rounds. Recall that second-round decisions are made after all six prospects in a task are reviewed, and the third-round decision is made after the subject has completed both tasks and reviewed the decisions of both.

[20] The p-value for the first-round low-probability gain prospect is 0.078. In the remaining 11 prospects we reject the null at the 5% level.

by the subjects who first used the choice task to evaluate the gambles. Reporting first-round decisions Table 4 shows the proportion of subjects choosing the gamble over its expected value, and the implied risk attitude.

Table 4: Choice-subjects in the Choice Task

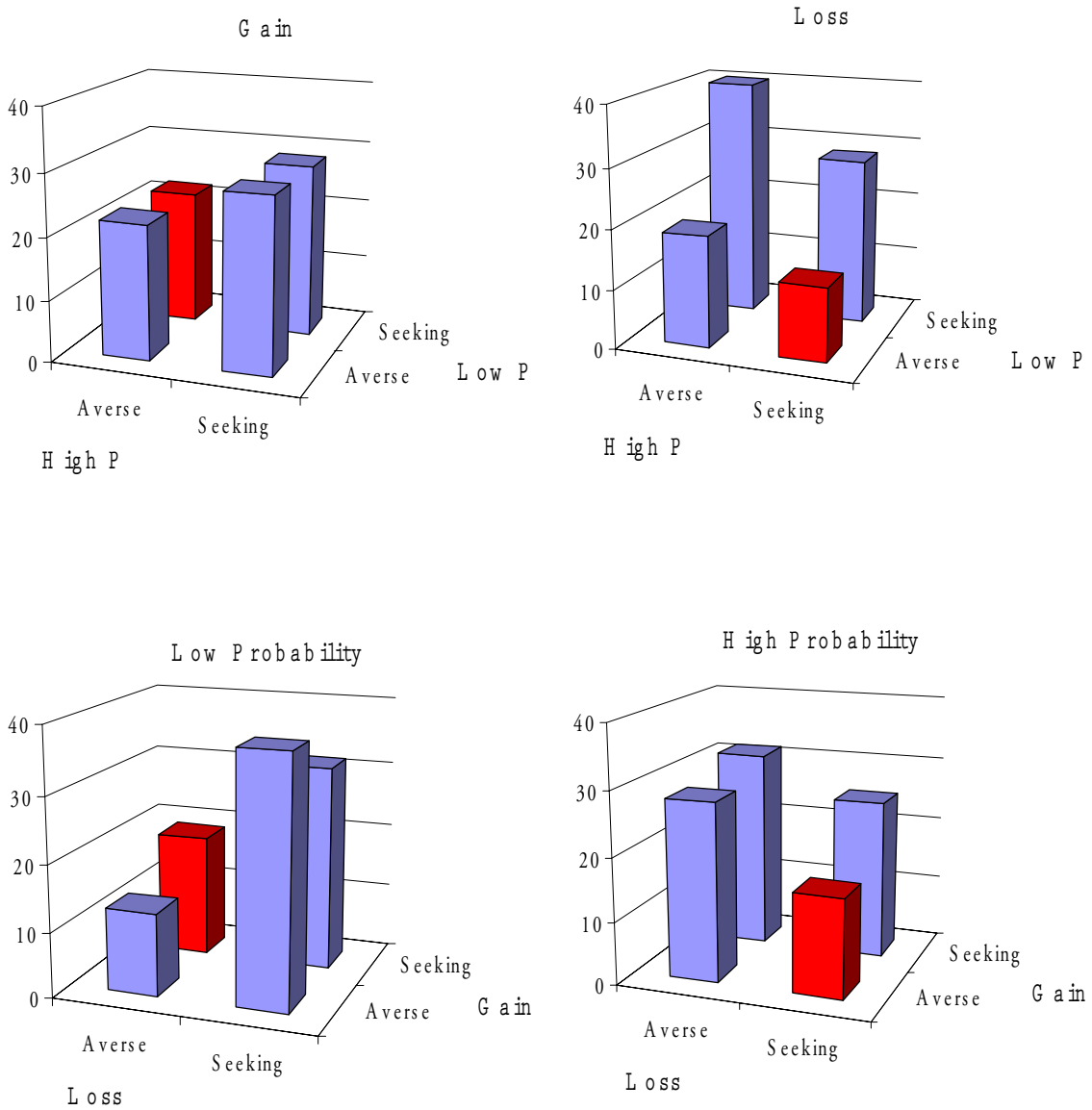
Prospect		Expected value	Percentage choosing gamble	p-value for exact test	Median risk attitude
Gain +$20	1. p=0.1	+$2	50.0	1.000	Neutral
	2. p=0.4	+$8	39.1	0.103	Averse
	3. p=0.8	+$16	56.3	0.382	Seeking
Loss -$20	4. p=0.1	-$2	68.8	0.004	Seeking
	5. p=0.4	-$8	56.3	0.382	Seeking
	6. p=0.8	-$16	40.6	0.169	Averse

Notes: 64 subjects, first-round decisions. The test is an exact binomial test of the null hypothesis that the proportion choosing the gamble = 0.5.

In contrast to the price method, decisions are not consistent with the FFP when we use the choice method. While often statistically indistinguishable from risk-neutrality, the implied risk attitudes are opposite of the prediction for the two high-probability prospects and for the low-probability loss prospect. This change in preferences is also apparent when we look at individual reflections in Figure 2. Once again the first panel examines the reflection of risk attitudes between high- and low-probability prospects conditional on the prospect being a gain or a loss, and the second panel illustrates reflection when changing a loss to a gain conditional on it being a low- or high-probability prospect. The highlighted cells illustrate the attitudes predicted by Prospect Theory.

The first noticeable difference relative to Figure 1 is that the distribution of risk attitudes is less extreme, and that a much smaller fraction of individuals exhibit the predicted pattern. In three of the four cases the cell predicted by Prospect Theory turns out to be the combination that we observe with the smallest frequency.

Figure 2: Risk Attitudes of Choice-subjects in the Choice Task



Note: 64 subjects, first-round decisions, percentages on vertical axis. The proportion with the expected reflection between high- and low-probability prospects is 22% for gains and 13% for losses. For low-probability prospects 19% exhibit the reflection between losses and gains, the comparable number of high-probability prospects is 16%.

Statistical tests of the reflections confirm what one would expect from the patterns in Figure 2. In none of the four cases can we reject the null hypothesis that at most 25% of subjects make the predicted choices (all p-values exceed 0.75). What is perhaps even more damaging is that the

modal choice is that opposite of the FFP. With the exception of the gain prospects, we can reject the hypothesis that, of the people who reflect risk attitudes, at least half reflect in the predicted manner.[21] The evidence on the entire FFP also lends little support to Prospect Theory. Only 4 of 64 subjects choose the full FFP. This is exactly the proportion one would expect to see if decisions were made at random.[22]

As with the price task the opportunity to revise decisions does not result in substantial changes in risk attitudes. Table 5 presents the attitudes for the three rounds of decisions. With the exception of the low-probability gain, the majority of choices are opposite of those predicted by Prospect Theory. In none of the twelve cases can we reject the hypothesis that at most half the subjects make choices consistent with the FFP. In fact choices resemble those of a risk-neutral population. Only for the low-probability loss prospect can we reject the hypothesis that individuals are equally likely to be risk-averse as risk-seeking. In contrast to the evidence from hypothetical choices by Tversky and Kahneman (1992) our results from real gambles are not consistent with the FFP.

Table 5: Choice-subjects in the Choice Task, Risk Attitudes by Prospect and Round.

	Low probability (p=0.1)						High probability (p=0.8)					
	Gain (+$20)			Loss (-$20)			Gain (+$20)			Loss (-$20)		
	Round			Round			Round			Round		
Risk attitude:	1	2	3	1	2	3	1	2	3	1	2	3
Averse	50	44	42	31	36	34	44	45	45	59	56	58
Seeking	50	56	58	69	64	66	56	55	55	41	44	42

Note: 64 subjects, percentages in cells.

[21] p= 0.298 when prospects are gains, whereas the p-value is below 0.050 in the three other cases.
[22] With p=0.573 we cannot reject the null that at most 1/16 choose the predicted pattern. Note also that 7 subjects make choices that are exactly opposite the FFP, and 10 subjects pick the expected value only for prospect 6.

3.3. Choice-Subjects in the Price Task and Price-Subjects in the Choice Task

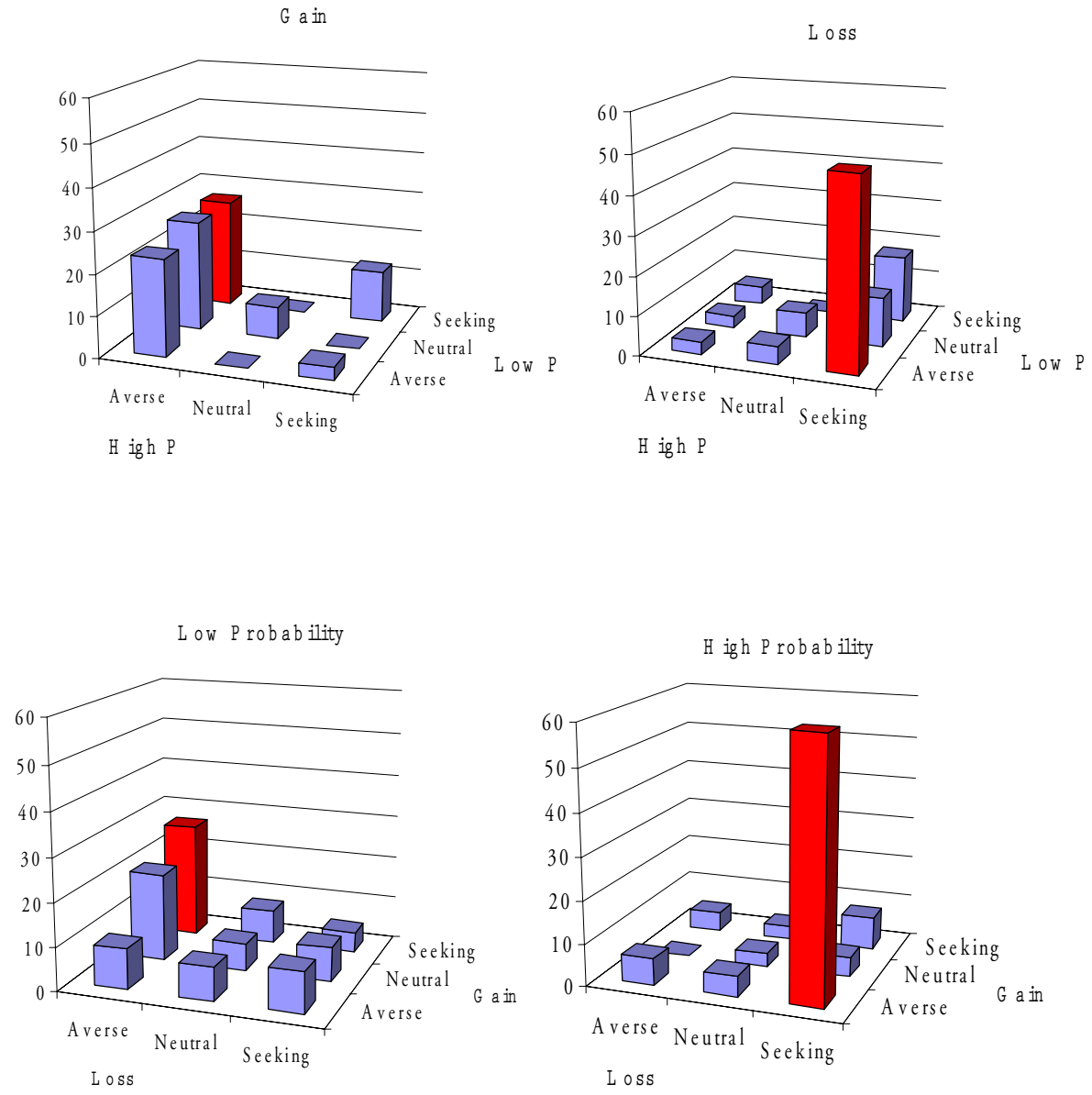
The first-task results show that decisions are consistent with the FFP when subjects are asked to price a prospect, but often opposite of the pattern when they are asked to choose between the prospect and its expected value. To test the robustness of this phenomenon this section looks at whether individuals who have been presented with one elicitation method will maintain their pattern of risk attitudes when asked to use a different elicitation method.

First we examine whether the choice-subjects continue to exhibit the non-FFP of risk attitudes of the choice task when presented with the price task. Looking at their first round decisions in the price task, Figure 3 shows that although they just made decisions in the choice task which were inconsistent with the FFP, we now see them making decisions that follow the predicted pattern.

While the distributions of attitudes are less extreme than those of the price-subjects shown in Figure 1, the modal choice continues to be that predicted by the FFP, with the evidence being particularly striking for the high-probability gambles. In each of the four cases we easily reject both the hypothesis that at most $1/9^{th}$ of all subjects reflect as predicted, and the hypothesis that at most ¼ of the subjects who are never risk-neutral exhibit the predicted reflection.[23]

[23] Including the risk-neutral decisions all four p-values are 0.000, and excluding the risk-neutral decisions all four p-values are below 0.005.

Figure 3: Risk Attitudes of Choice-subjects in the Price Task



Note: 64 subjects, first-round decisions, percentages on vertical axis. The proportion with the predicted reflection between high- and low-probability prospects is 27% for gains and 48% for losses. For low-probability prospects 27% reflect as predicted between losses and gains, and for high-probability prospects 65% exhibit the reflection.

Not only do we observe the predicted reflections, but the evidence in favor of the full FFP is also strong. With 12 of 64 subjects having the FFP of risk attitudes we can reject the hypothesis that

this at most is the proportion one would expect if subjects were equally likely to have any combination of risk attitudes.[24] The support for Prospect Theory is further strengthened when looking at prices across the three rounds, as shown in Table 6. Particularly interesting are the third-round decisions. At this point subjects are shown the decisions they made in both the price task and the choice task and are free to make changes to those decisions. Yet the FFP is maintained. Together tables 5 and 6 make clear that simultaneously reviewing choices for the two tasks does not alter the fact that decisions in the price task are consistent with the FFP, whereas those in the choice task are inconsistent with this pattern.

Table 6: Choice-subjects in the Price Task, Risk Attitudes by Prospect and Round.

	Low probability (p=0.1)						High probability (p=0.8)					
	Gain (+$20)			Loss (-$20)			Gain (+$20)			Loss (-$20)		
	Round			Round			Round			Round		
Risk attitude:	1	2	3	1	2	3	1	2	3	1	2	3
Averse	27	25	25	56	52	52	77	75	75	11	9	9
Neutral	34	36	36	22	23	25	8	11	11	11	11	11
Seeking	39	39	39	22	25	23	16	14	14	78	80	80

Note: 64 subjects, percentages in cells.

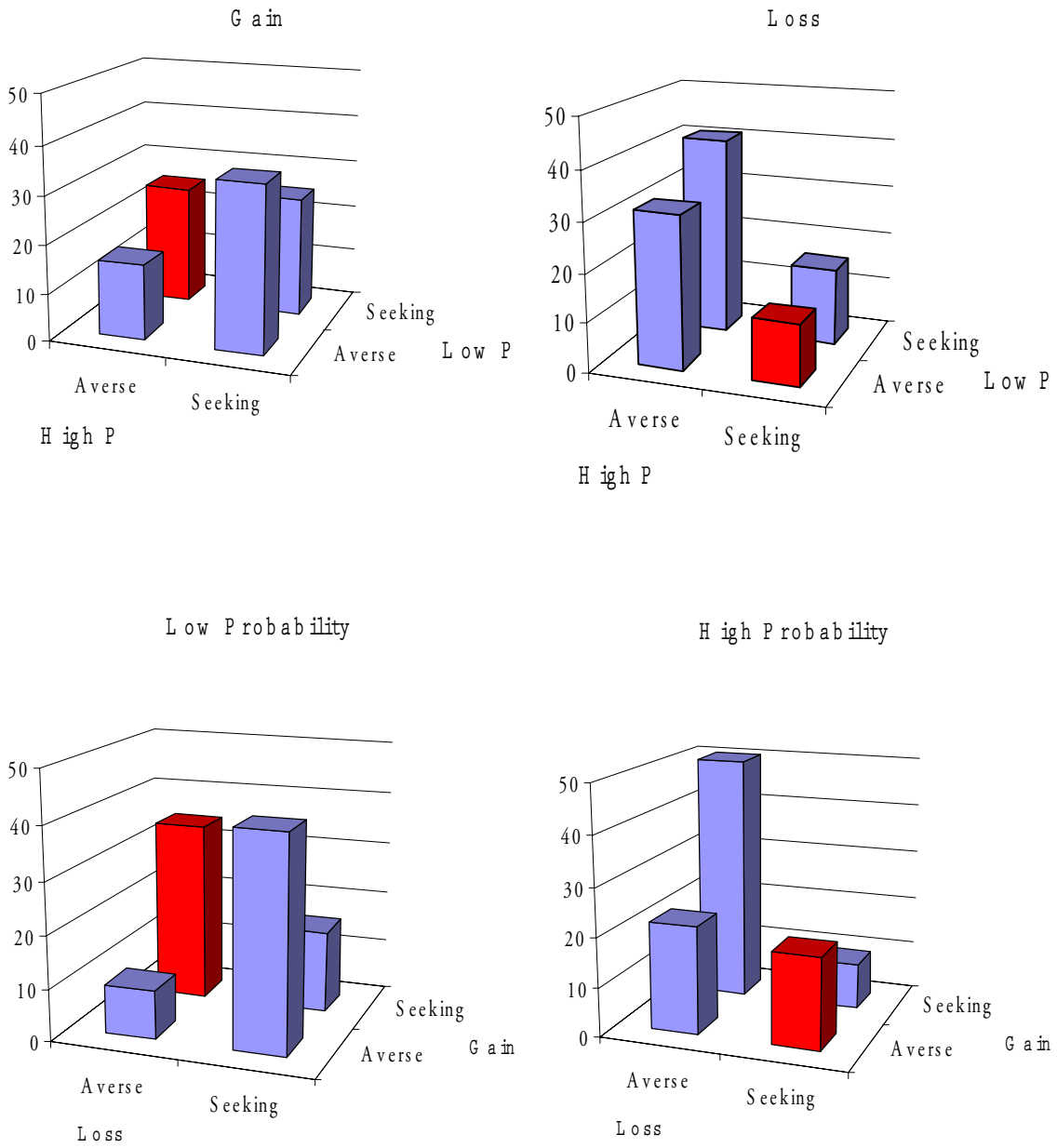
Whether the price task is the first or second task, it triggers responses consistent with Prospect Theory. Next we examine if the support for the FFP also is reversed when the price-subjects are asked to evaluate the prospects using the choice-task. Figure 4 illustrates the individual reflections in this case. As with the choice-subjects we see a substantial change in risk attitudes when price-subjects are asked to evaluate the gambles using the choice rather than the price method. Although price-subjects demonstrate the FFP in the price task, this is not the case when they are asked to choose between the gamble and its expected value. In fact the modal choice in the choice task is the exact opposite of the prediction. In none of the four cases can we reject the

[24] With p-values of 0.000 we reject that the proportion with the full FFP at most equals 1/81, and that the proportion of non-risk-neutral subjects with the FFP at most equals 1/16. Examining the combinations of risk attitudes reveals

hypothesis that at most 25% of subjects exhibit the predicted reflection (the smallest p-value is 0.154).

that 11 subjects make decisions consistent with the FFP with exception of the low-probability gain prospect where the decision is risk-neutral. No other combination of risk attitudes captures more than 4 subjects.

Figure 4: Risk Attitudes of Price-subjects in the Choice Task



Note: 32 subjects, first-round decisions, percentages on vertical axis. The proportion with the predicted reflection between high- and low-probability prospects is 25% for gains and 13% for losses. For low-probability prospects 34% reflect as predicted between losses and gains, and for high-probability prospects 19% exhibit the reflection.

Of the 32 subjects only 2 exhibit the full FFP over the 4 prospects, and we cannot reject that this proportion at most is what we would expect from random choice (p=0.603). Furthermore, the modal pattern is opposite of the FFP, with 9 subjects having this pattern of risk attitudes. Table 7

shows that the opportunity to revise decisions does not strengthen the support for Prospect Theory. With the exception of low-probability gains, choices are opposite of the prediction. However we can only reject the hypothesis that subjects are equally likely to be either risk averse or risk seeking for the high probability loss prospect.

Table 7: Price-subjects in the Choice Task, Risk Attitudes by Prospect and Round.

	Low probability (p=0.1)						High probability (p=0.8)					
	Gain (+$20)			Loss (-$20)			Gain (+$20)			Loss (-$20)		
	Round			Round			round			Round		
Risk attitude:	1	2	3	1	2	3	1	2	3	1	2	3
Averse	50	41	44	44	38	41	41	41	41	72	69	69
Seeking	50	59	56	56	63	59	59	59	59	28	31	31

Note: 32 subjects, percentages in cells.

3.4. Preference Reversals

Our experimental protocol was specifically designed to reduce inadvertent reversals. For example, prior to their third-round decisions, subjects review both their price and choice decisions and compare decisions across tasks. Yet the observation that subjects' third-round decisions are consistent with the FFP in the price task, but not in the choice task, suggests that individuals reverse decisions between the two tasks. In this section we examine these preference reversals.

As mentioned in the introduction, preference reversals across choice and price tasks are not a newly discovered phenomenon. What is new is the result that these reversals are not systematic in the manner predicted by Tversky and Kahneman (1992). They suggested that reversals are caused by a tendency to overprice prospects, thus subjects in the choice task should appear more risk-averse over gains, and more risk-seeking over losses. Our data on third-round decisions do not support this prediction. Over gains we find that 47% of the subjects who were risk-averse in the price task become risk-seeking in the choice task, whereas only 36% of those who were risk-

seeking in the price task become risk-averse in the choice task. Over losses the proportion of subjects who switch from one risk attitude to the other is 50%, independent of the original risk attitude. These reversals are shown in more detail in Table 8, which reports the conditional probability of a reversal of the decision in the choice task given the individual's decision in the price task. The shaded cells illustrate the risk attitudes consistent with the FFP.

Table 8: Preference Reversals between Tasks

Prospect			Percentage of subjects		
Probability	Domain	Attitude	Price task	Choice task	Reversal in choice task
Low (p=0.1)	Gain +$20	Averse	22	43	38
		Seeking	43	57	34
	Loss -$20	Averse	55	36	64
		Seeking	20	64	26
Medium (p=0.4)	Gain +$20	Averse	60	49	45
		Seeking	21	51	40
	Loss -$20	Averse	38	55	36
		Seeking	28	45	48
High (p=0.8)	Gain +$20	Averse	75	44	52
		Seeking	15	56	36
	Loss -$20	Averse	15	61	21
		Seeking	76	39	60

Note: 96 subjects, percentages in cells, third-round decisions. Because the price task allows for risk-neutrality one has to use caution when comparing the proportion of given risk attitude across tasks.

With the exception of low-probability gains, preference reversals are most likely to occur at the mass points of the predicted FFP. We see more than 50% of subjects changing behavior away from the FFP in the price task to the exact opposite in the choice task. In some cases the reversals are quite substantial. For example, in the high-probability loss prospect, 3/4 of subjects are willing to pay less than the gamble's expected value to avoid the risky loss, yet 3/5 of these same subjects choose the certain loss when given the choice between the gamble and a certain loss of

the expected value. Rather than systematic overpricing of gambles our results show that the predominant risk attitude at the two tasks are often the reverse of one another.

4. Discussion and Further Tests of Preference Reversals

Although our data suggest that reversals between treatments are caused by the choice- versus price-format of the elicitation, differences between the two treatments do not allow us to directly draw this conclusion. The purpose of our original experiment was to use a choice-based protocol similar to that of Harbaugh, Krause, and Vesterlund (2000) to first see if we could replicate their results using the standard subject pool. Second, we wanted to compare the results from the choice task with a price task where subjects are asked to report their willingness to pay for a prospect over gains, and their willingness to pay to avoid a prospect over losses. However, replicating the Harbaugh et al. (2000) protocol and using a consistent willingness-to-pay format resulted in a couple of differences between the two designs. To determine whether the elicitation question itself drives individual reversals we conducted another treatment of the experiment using instructions that eliminate other possible differences between the choice and price task. Since the price procedure clearly demonstrated the FFP of risk attitudes, we chose to revise the choice task to make it more comparable to the price task.

The alterations to the choice-task instructions were as follows. First, in the original choice task the subjects were not given the option of being indifferent between the risky and safe prospects. Our thought was that adding a choice of indifference would complicate the procedure and that it was unlikely to affect the elicited risk attitudes. If indifferent subjects randomly choose one of the two outcomes then the predominant risk attitude should still be the same. To assure ourselves that this was not the driving force behind the reversals, we allowed individuals in the new-choice task to choose a don't-care option. Subjects were informed that choosing the don't-care option meant that the flip of a coin would determine whether they would receive the expected value of the prospect, or the prospect itself.

Second, while the price and choice tasks are very similar in the loss domain, they differ in the gain domain. In the price task, subjects were asked to pay for the gain gamble, whereas subjects

in the choice task simply were asked to choose between the gamble and its expected value. Of the two tasks the choice task is therefore more attractive.[25] To make the new choice task more comparable to the price task, we modified the question such that the subjects now are asked to choose whether they will give up the gamble's expected value in return for the gamble.[26] While this alteration may affect the implied risk attitudes in the gain domain, it should have no effect on the preferences in the loss domain.

Using the revised instructions we conducted another treatment with 32 subjects. These subjects were first given the new-choice task and then the original price task. The experimental protocol and the subject pool for the new treatment were identical to the original treatments. As expected the change in protocol decreased earnings. In the new treatment average earnings were $35, and ranged between $16 and $58.

This new set of data allows us two sets of comparisons. First we can determine if reversals between subjects remain by comparing the decisions in the new-choice task to the decisions by the price-subjects in the price task. Second, by comparing the individual decisions in the new-choice task and the price task we can determine whether preference reversals remain a within-subject phenomenon.

Figure 5 summarizes the implied reflections of risk attitudes from the first-round decisions made by the new choice-subjects. First, we note that very few subjects make the risk-neutral choice. Second, we see that our earlier finding is robust: the implied risk attitudes are not consistent with the predicted FFP when using a choice-task. In none of the four cases can we reject that the

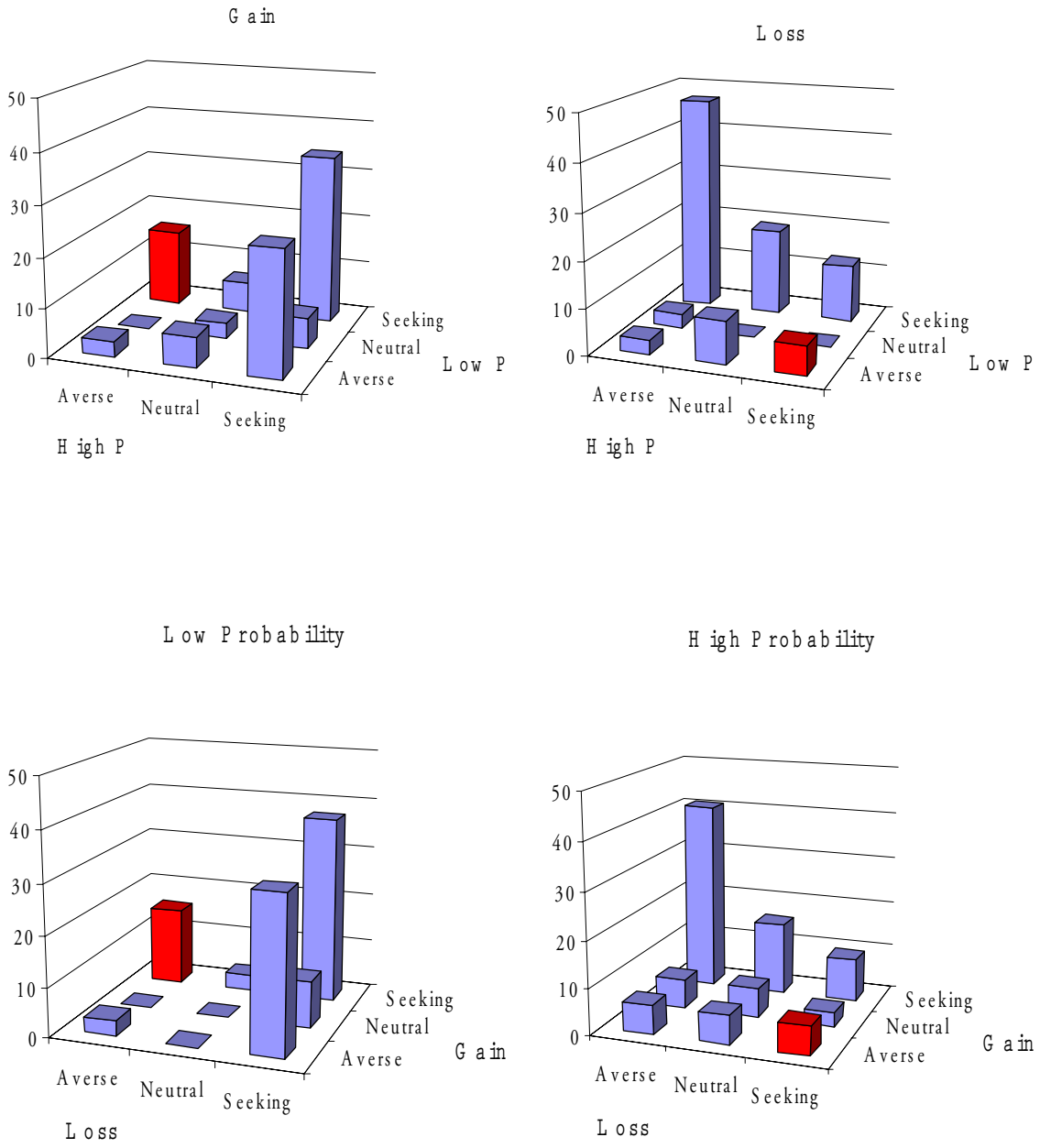
[25] Another important difference between the choice and price tasks over gains is that subjects in the choice task never will get the sense of loss. If the expected value of the gamble is chosen, the spinner is never spun. This does not hold in the price task. Here the subjects, in some cases will pay for a gamble only to realize that they didn't win any money. Note that this problem is inherent to the pricing task. If subjects were asked to state the amount they are willing to accept then a similar situation will arise over losses, where subjects would receive payments in return for accepting a negative prospect. Thus it may be argued that using a pricing task inherently results in mixed prospects. Changing the price task to be similar to that of the choice task would require that we framed the price task in terms of willingness to pay in the loss domain and willingness to accept in the gain domain.

[26] Instructions for the altered choice task are omitted for brevity; they are available upon request from the authors. Note that it is not possible to make the two procedures exactly comparable. While in the price task subjects may pay a randomly determined price below their willingness to pay, in the choice task the subject may have been willing to pay substantially more than the expected value.

proportion choosing the predicted outcome is no larger than what we would expect from random choices.[27] While more pronounced than in the original choice task, the modal choices are the exact opposite of the prediction. For both the high-probability prospects and the loss prospects, we reject the hypothesis that at least 50% of those who reflect risk attitudes do so in the predicted direction (both p-values are below 0.004).

[27] That is, we cannot reject that at most 1/9th of all subjects reflect as predicted, nor can we reject that at most ¼ of the subjects who never are risk-neutral exhibit the predicted reflection. The smallest p-value is 0.273.

Figure 5: Risk Attitudes of New-choice-subjects in the New-choice Task



Note: 32 subjects, first-round decisions, percentages on vertical axis. The proportion with the predicted reflection between high- and low-probability prospects is 16% for gains and 6% for losses. For low-probability prospects 16% reflect as predicted between losses and gains, and for high-probability prospects 6% exhibit the reflection.

Over the four relevant prospects none of the 32 subjects made choices that were consistent with the full FFP. Furthermore the modal pattern is the exact opposite of the FFP, with 5 subjects choosing this combination.

After evaluating the six gambles with the new-choice task, subjects were asked to evaluate the gambles using the price task. Examining these decisions we once again find that the risk attitudes derived with the price procedure are consistent with the FFP.[28] Combined this implies that although the same prospects are considered, subjects reverse their decisions when presented with a choice task rather than a price task. Table 9 presents this result quite clearly. Looking only at third-round decisions we see that of the subjects who were either risk-averse or risk-seeking in the price task, 42% had the opposite risk attitude when asked to evaluate the same gamble with the new-choice task. The preference reversal between tasks is quite substantial. The highlighted cells in Table 9 represent the predicted risk attitudes. While attitudes in the price task are close to the FFP, the decisions made using the new-choice task are not. Reversals away from the predicted pattern are substantial. Only at the low-probability prospect over gains does the choice task result in a larger fraction of subjects behaving in a manner consistent with the FFP.

[28] The figure is roughly the same as the price-task result for choice subjects.

Table 9: New-choice Subjects, Preference Reversals between Tasks

Prospect			Percentage of subjects		
Probability	Domain	Attitude	Price task	Choice task	Reversal in choice task
Low (p=0.1)	Gain +$20	Averse	28	16	56
		Seeking	34	78	9
	Loss -$20	Averse	53	16	82
		Seeking	28	84	22
Medium (p=0.4)	Gain +$20	Averse	72	28	43
		Seeking	19	53	0
	Loss -$20	Averse	53	28	47
		Seeking	31	53	20
High (p=0.8)	Gain +$20	Averse	78	22	56
		Seeking	19	63	17
	Loss -$20	Averse	16	50	0
		Seeking	75	22	46

Note: 32 subjects, percentages in cells, third-round decisions.

The evidence from this additional treatment shows that although individuals are asked to evaluate the exact same prospects, they will often reverse decisions when asked to use the price rather than the choice task to evaluate the prospects. If the majority of subjects have one risk attitude in the price task then the majority of subjects tend to have the opposite risk attitude in the choice task.

5. Conclusion

Having examined the behavioral implications of a series of estimated probability weighting functions, Neilson and Stowe (2001) find that the functional forms currently proposed in the literature are not suitable for application to many settings. They therefore conclude “that we are

not yet ready to replace expected utility with cumulative Prospect Theory for applied work."[29] The conclusion of this paper is similar, however the reason is quite different. Rather than being concerned about the estimated functional form of the probability weighting function, we are concerned about the robustness of the evidence that previously has been found to be consistent with the predictions of CPT. First, using real gambles we fail to replicate the documented FFP from hypothetical choices. Second, the support for the FFP found with the price procedure is reversed when subjects instead use the choice-based procedure to evaluate the gambles. If using a choice rather than a price elicitation to evaluate prospects reverses the pattern of risk attitudes, then we need to question how general the phenomenon truly is.

The protocol we used was specifically designed to give subjects the best opportunity to avoid inadvertent preference reversals. Yet we find that individuals tend to make choices consistent with the FFP when pricing prospects, but inconsistent with the FFP when choosing between the prospect and its expected value. Since the predominant risk attitude in the choice task tends to be the exact opposite of that of the price task, it is clear that the preference reversals between the two methods is not caused by a systematic overpricing of prospects.

The documented sensitivity to the elicitation method questions the general reliability of elicited risk attitudes. If revealed risk attitudes reverse when the task changes, then we cannot conclude that the decisions made in one task can be generalized to other risky prospects. In particular we cannot extend the substantial and strong support for the FFP in the pricing task to many of the real-world circumstances where people make choices between a relatively safe action and one that entails some risk.

If different tasks cause subjects to make different decisions then the consequences are substantial. Consider for example a person purchasing a new car. She may have a choice between a car with a particular safety feature that will protect against a remote but serious risk, and a car that does not have that feature. If this is perceived as a choice task, the car without the safety feature may be chosen. However, if the purchase is framed as a price task then the buyer may instead approach

[29] Included in the examination are the probability weighting functions of Prelec (1998), Tversky and Kahneman

the problem with a risk-averse attitude and therefore acquire the safety-equipped car. What is particularly puzzling about our results is that these implications are the exact opposite if the risk involved is large. While the presented results do not make clear whether the lack of robustness is a result of a fragile probability weighting function or value function, they do make clear that we need to use caution when making general inferences from solicited risk preferences.

(1992), Camerer and Ho (1994), Wu and Gonzalez (1996) and Gonzalez and Wu (1999) etc.

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Appendix:

Original Choice/Price Protocol:

Have subjects sign consents and draw the card that determines the ID. Check the treatment chart at the end of the packet to determine what order to show the gambles in. [Protocols in the correct order for every ID were prepared in advance.] Direct each subject to one partition. The subject sits behind the partition; an experimenter sits on the other side. The partition allows the subject to mark responses and place response slips in an envelope without being observed by the experimenter.

Introduction:

Thank you for coming and participating in this research. We are going to ask you to make some choices. There is no right or wrong answer; we just want you to make the choices you like best. We will not tell anyone what you decide. At the end we will give you any money that you earn privately. The whole thing should take about 30 minutes.

Then start with the "Choice experiment" (ID 64) or the "WTP experiment" (ID > 64) below.).

CHOICE EXPERIMENT:

We are going to start by giving you $22. This money has been provided by a research foundation, and it is yours to use in this study. *[Count out 22 ones. Put on the table, but don't give it to them yet, in case they lose.]* We are going to ask you to make some decisions in situations where you will either have a chance to earn some more money, or a chance to lose some of this money. Depending on your choices, and on chance, when we are all done you may end up with more or less money than this. The money that you end up with will be yours to keep, and we will pay it to you in cash at the end of the study.

We will ask you to make six decisions, but only one will count for your cash payoff. We will determine which decision counts by rolling a standard, six-sided die like this. *[Show the die.]* Since any decision might count, the best thing for you to do is to make each decision as if it is the one that counts for your payoff.

Then start with either the Gain choices the Loss choices below.

Gain choices:

I am going to ask you to make some choices. Each will be a choice between spinning a spinner for the chance to earn $20, or earning a smaller amount of money for sure.

Here's one example of the sort of choice we will ask you to make:

Show these on spinner cards. Also show a sample response slip.
The choice on this card is between getting $10 for certain, or spinning a spinner with a 50% chance of getting $20, and a 50% chance of getting $0.
You would have to decide whether you liked the certain $10 or the spinner best.

If you want to take the sure thing, you would mark an X in the box on the left. If you would want to spin the spinner at the end of the experiment and take whatever the arrow points to, you would mark an X next to the spinner symbol. After you have marked your choice, put the slip into your envelope and I will hand you your next one.

Remember that only one decision will count for payment, but that any one of them might be the one that counts. To be sure that you think carefully, we are going to ask you to take at least 30 seconds to think about your choice. You can have more time if you want it, but think carefully and please don't mark your choice until I tell you 30 seconds are up. If you would like to try the spinner, go ahead. Remember, the spin that will count for your payment is the one that you do after we have rolled the die.

*Put the first card on the table. Use **BLUE pens***
Do you have any questions about this part of the study?

Answer any questions.

Here is your first choice. *After about ten seconds, hand the response slip.*
I'll tell you when the 30 seconds are up. After you have marked your choice, put the slip into your envelope and I will hand you your next one.

Hand cards and slips according to the order, one at a time. Let the person put his own slip in his own envelope – the experimenter should never see the subject's responses, so don't let him hand the slip to you. When done, go to section marked "Loss choices" or "After all gain and loss choices" below, as appropriate.

Loss choices:

I am going to ask you to make some choices. Each will be a choice between spinning a spinner for a chance of losing $20, or losing a smaller amount of money for sure.

Here's one example of the sort of choice we will ask you to make:

Show these on spinner cards. Also show a sample response slip.
The choice on this card is between losing $10 for certain, or spinning a spinner with a 50% chance of losing $20, and a 50% chance of losing $0.
You would have to decide whether you liked the certain $10 loss or the spinner best.

If you want to take the sure thing, you would mark an X in the box on the left. If you would want to spin the spinner at the end of the experiment and take whatever the arrow points to, you would mark an X next to the spinner symbol. After you have marked your choice, put the slip into your envelope and I will hand you your next one.

Remember that only one decision will count for payment, but that any one of them might be the one that counts. To be sure that you think carefully, we are going to ask you to take at least 30 seconds to think about your choice. You can have more time if you want it, but think carefully and please don't mark your choice until I tell you 30 seconds are up. If you would like to try the spinner, go ahead. Remember, the spin that will count for your payment is the one that you do after we have rolled the die.

*Put the first card on the table. Use **BLUE pens***
Do you have any questions about this part of the study? *Answer any questions.*

Here is your first choice. *After about ten seconds, hand the response slip.*

I'll tell you when the 30 seconds are up. After you have marked your choice, put the slip into your envelope and I will hand you your next one.

Hand cards and slips according to the order, one at a time. Let the person put his own slip in his own envelope – the experimenter should never see the subject's responses, so don't let him hand the slip to you. When done, go to section marked "Gain choices" above or "After all gain and loss choices" below, as appropriate.

After all gain and loss choices:

When they have completed all six choices, place all six spinners in front of the subject in the order presented originally. Ask him to place his response slip below the same-numbered spinner. Give subject a ***RED pen.***

Please match the numbers on your decisions to the numbers on the spinners and place your decisions below the corresponding spinners. Now take a minute to look at all six of your choices. If you would like to change any of these decisions now, you may. We are not trying to get you to change your mind, we just want to make sure you have made the decisions you like the best. If you would like to change any of your decisions, please use this red pen to cross out your original response and write in your new decision. Your payment will be based on the last decision that you make. When you are done making your decisions, please put your response slips back in your envelope.

If Choice was done first (ID 64):

OK, thanks. We want to have you do one more experiment before we determine your payment. Here's how it works: *[Go to section marked "WTP experiment" below.]*

^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v

If Choice was done second (ID > 64):

OK, thanks. *[Go to section marked "Finish" below:]*

WTP EXPERIMENT:

We are going to start by giving you $22. This money has been provided by a research foundation, and it is yours to use in this study. *[Count out 22 ones. Put on the table, but don't give it to them yet, in case they lose.]* We are going to ask you to make some decisions in situations where you will either have a chance of earning some more money, or a chance of losing some of this money. Depending on your choices, and on chance, when we are all done you may end up with more or less money than this. The money that you end up with will be yours to keep, and we will pay it to you in cash at the end of the study.

We will ask you to make six decisions, but only one will count for your cash payoff. We will determine which decision counts by rolling a standard, six-sided die like this. *[Show the die.]* Since any decision might count, the best thing for you to do is to make each decision as if it is the one that counts for your payoff.

Then start with either the section marked "Gain WTP" or "Loss WTP" below.

Gain WTP:

Here's one example of the sort of choice we will ask you to make:

Show these on spinner cards. Also show a sample response slip.
The choice on this card is between getting $10 for certain, or spinning a spinner with a 50% chance of getting $20, and a 50% chance of getting $0.
Show these on spinner cards. Also show a sample response slip.

If you spun this spinner, you would have a chance to earn some money. We would like to know how much money you would be willing to pay to be allowed to spin this spinner.

To decide whether you spin the spinner, we're going to use the following procedure.

Procedure:

We are going to show you some spinners that show chances to earn $20. Some spinners will have a small chance to earn $20, some will have a bigger chance to earn $20. We will ask you to write down the MOST you would be willing to pay to spin that spinner. Suppose you wrote down one dollar. We don't necessarily let you spin the spinner for one dollar. If we did, you might be tempted to write down one dollar when you would really be willing to pay more than that to spin the spinner. Instead, we draw a *random* price from the bingo cage.

Here is how we determine the random price:

We will draw a ball from the bingo cage three times. The cage contains balls numbered 0 through 9. Our first draw will be for cents; our second draw will be for dimes.

For the third draw, the cage will contain balls numbered 0 through 22. The third number drawn will be for dollars.

For example, we might draw a 7 first, a 0 second, and a 1 last.
This results in a price of $1.07.

If the price we draw is greater than the price you wrote down, you don't get to spin.
If the price we draw is less than or equal to the price you wrote down, you do get to spin the spinner, but the price you pay is the one drawn from the bingo cage, not what you wrote down.

Given this, you should write down the most that you are willing to pay to spin.

Why? What you write down does not change the price you pay; it just determines whether or not you get to spin. Since the price you pay is beyond your control, you just want to make sure you spin whenever the price is less than your own maximum amount, and that you do not have to spin if the price you would have to pay is greater than that maximum amount.

Here's an example.

Let's say you are willing to pay $10 for one of the chances to earn some more money. It's pretty clear that you shouldn't write down $11: you might end up paying more to spin than it is worth to you. We want to show you that you shouldn't write down less than $10 either.

Suppose you would be willing to pay $10, but you write down $8. If we draw a price less than $8, say $7, you get to spin. You pay $7 to do so. This is a good outcome for you. You only have to pay $7 when you would have been willing to pay $10. But, notice that you would have been able to spin for $7 even if you had written down your true maximum price of $10.

Suppose we draw a price of $9. Since you wrote down $8 you don't get to spin and you don't have to pay. You keep the $22 you started with. But, notice that if you had written down $10, your true maximum price, you would have gotten to spin. That would have been a good outcome for you, since you would have been able to spin by paying just $9, and you are willing to pay $10. You would have done better by writing down $10.

Suppose we draw a price of $11. Since $11 is more than $8, you don't get to spin the spinner. That is also a good outcome for you, since you don't want to pay $11 to spin a spinner that is worth only $10 to you. But, notice that you would have gotten the same good outcome if you had written down $10 instead of $8.

No matter what price is chosen, you never do worse by writing down your true maximum price, and sometimes you do better.

Now we are going to ask you to answer some questions that let you try out this procedure. Your answers won't affect your earnings; we just want to make sure that we have explained this part of the study to you. If you have questions at any point, please ask.

Remember, this is just practice, you don't really earn any money, and you don't really have to pay any money.

Suppose there is a 50% chance of earning $10, and a 50% chance of earning nothing. *Show a card with a 50/50 spinner wheel.*

We want you to write down the amount of money you would be willing to pay for this 50% chance to earn $10. Think about it for a moment, to make sure you know what you are willing to pay.

Hand first quiz sheet and a BLUE Pen to subject to complete.

Try out the procedure:

Write down the most that you are **really** willing to pay to spin this spinner: (Remember, this is just for practice; you won't really have to pay any money now.)

_____

Now, suppose I draw a number that's $1 less than what you wrote down.

Will you get to spin? Circle **yes** or **no**.

If yes, how much will you pay for the opportunity to spin? $_____

Now, suppose I draw a number that's $1 more than what you wrote down.

Will you get to spin? Circle **yes** or **no**.

If yes, how much will you pay for the opportunity to spin? $_____

Now, suppose I draw exactly the same number that you wrote down.

Will you get to spin? Circle **yes** or **no**.

If yes, how much will you pay for the opportunity to spin? $_____

[Go through quiz, explain any errors.]

Now we are ready to make choices that might really count. Remember that we will toss a die to determine which choice will count for your payment.

Remember, if the price you write down is less than the price we pick, you will not be able to spin and you will just keep the $22 you started with. If the price you write down is more than the price we pick, you will have to pay the price we pick and then you will get to spin the spinner for a chance at additional earnings.

We are going to ask you to take at least 30 seconds to think about your choice. You can have more time if you want it, but think carefully and please don't mark your choice until I tell you 30 seconds are up. If you would like to try the spinner, go ahead. Remember, the spin that will count for your payment is the one that you do after we have rolled the die.

Do you have any questions about this part of the study?

Answer any questions. Put the first card on the table.

Here is your first choice.

After about ten seconds, hand the response slip.

I'll tell you when the 30 seconds are up.

Hand cards and slips according to the order, one at a time. Let the person put his own slip in his own envelope – the experimenter should never see the subject's responses, so don't let him hand the slip to you. When done, go to section marked "Loss WTP" or "After all gain and loss WTP decisions" below, as appropriate.

Loss WTP:

Show these on spinner cards. Also show a sample response slip.

Here's an example of the sort of choice we will ask you to make.
This spinner shows a 50% chance of losing $20, and a 50% chance of losing $0.
If you spun this spinner, you might lose some money. We would like to know how much money you would be willing to pay to not have to spin this spinner.

To decide whether you spin the spinner, we're going to use the following procedure.

Procedure:

We are going to show you some spinners that show chances to lose $20. Some spinners will have a small chance to lose $20; some will have a bigger chance to lose $20. We will ask you to write down the MOST you would be willing to pay to avoid having to spin that spinner. Suppose you wrote down one dollar. We don't necessarily let you avoid spinning the spinner for one dollar. If we did, you might be tempted to write down one dollar when you would really be willing to pay more than that to avoid the spinner. Instead, we draw a *random* price from the bingo cage.

Here is how we determine the random price:

We will draw a ball from the bingo cage three times. The cage contains balls numbered 0 through 9. Our first draw will be for cents; our second draw will be for dimes.

For the third draw, the cage will contain balls numbered 0 through 22. The third number drawn will be for dollars.

For example, we might draw a 7 first, a 0 second, and a 1 last.
This results in a price of $1.07.

If the price we draw is greater than the price you wrote down, you will have to spin and run the risk of losing some of your money. If the price we draw is less than or equal to the price you wrote down, you will not have to spin the spinner, but you will have to pay the price drawn.

Given this, you should write down the most that you are willing to pay to avoid having to spin.

Why? What you write down does not change the price you pay; it just determines whether or not you have to spin. Since the price you pay is beyond your control, you just want to make sure you do not have to spin whenever the price is less than your own maximum amount, and that you have to spin only if the price you would have to pay to avoid spinning is greater than your maximum amount.

Here's an example.

Let's say you are willing to pay $10 to avoid a chance of losing some money. It's pretty clear that you shouldn't write down $11: you might end up paying more to avoid the spin than it is worth to you. We want to show you that you shouldn't write down less than $10 either.

Suppose you would be willing to pay $10, but you write down $8. If we draw a price less than $8, say $7, you don't have to spin. You pay $7 to avoid spinning. This is a good outcome for you. You only have to pay $7 when you would have been willing to pay $10. But, notice that you would have been able to avoid the spin for $7 even if you had written down your true maximum price of $10.

Suppose we draw a price of $9. Since you wrote down $8 you will have to spin. Notice that if you had written down $10, your true maximum price, you would have avoided the spinner. That would have been a good outcome for you, since you would have been able to pay just $9 not to spin, and you are willing to pay $10. You would have done better by writing down $10.

Suppose we draw a price of $11. Since $11 is more than $8, you have to spin the spinner. That is also a good outcome for you, since you don't want to pay $11 to avoid the spinner. But, notice that you would have gotten the same good outcome if you had written down $10 instead of $8.

No matter what price is chosen, you never do worse by writing down your true maximum price, and sometimes you do better.

Now we are going to ask you to answer some questions that let you try out this procedure. Your answers won't affect your earnings; we just want to make sure that we have explained this part of the study to you. If you have questions at any point, please ask.

Remember, this is just practice, you don't really get or lose any money, and you don't really have to pay any money.

Suppose there is a 50% chance of losing $10, and a 50% chance of losing nothing. *Show a card with a 50/50 spinner wheel.*

We want you to write down the amount of money you would be willing to pay to avoid having to spin this spinner. Think about it for a moment, to make sure you know what you are willing to pay.

Hand quiz sheet. After quiz, go through, check answers, correct and discuss if necessary. Then hand cards and slips according to the order, one at a time.

Try out the procedure:

Write down the most that you are **really** willing to pay to avoid spinning this spinner:
(Remember, this is just for practice; you won't really have to pay any money now.)

_____

Now, suppose I draw a number that's one dollar less than what you wrote down.

Will you have to spin? Circle **yes** or **no**.

If no, how much will you pay to avoid spinning? $_____

Now, suppose I draw a number that's one dollar more than what you wrote down.

Will you have to spin? Circle **yes** or **no**.

If no, how much will you pay to avoid spinning? $_____

Now, suppose I draw exactly the same number that you wrote down.

Will you have to spin? Circle **yes** or **no**.

If no, how much will you pay to avoid spinning? $_____

OK, now we are ready to make choices that might really count. Remember that we will toss a die to determine which will count for your payment.

Remember, if the price you write down is more than the price we pick, you will not have to spin. You will just keep the $22 you started with minus the price we pick. If the price you write down is less than the price we pick, you will not have to pay any money, but you will have to spin the spinner to determine your earnings.

We are going to ask you to take at least 30 seconds to think about your choice. You can have more time if you want it, but think carefully and please don't mark your choice until I tell you 30 seconds are up. If you would like to try the spinner, go ahead. Remember, the spin that will count for your payment is the one that you do after we have rolled the die.

Do you have any questions about this part of the study?

Answer any questions. Put the first card on the table.

Here is your first choice.

After about ten seconds, hand the response slip.

I'll tell you when the 30 seconds are up.

Hand cards, slips, and list of 20 prices according to the order, one at a time. Let the person put his own slip in his own envelope – the experimenter should never see the subject's responses, so don't let him hand the slip to you. When done, go to section marked "Gain WTP" above or "After all gain and loss WTP decisions" below, as appropriate.

After all Gain and Loss WTP decisions:

When they have completed all 6, place all six spinners in front of the subject in the order presented originally. Ask him to place his response slip below the same-numbered spinner. Give subject a ***RED pen.***

Please match the numbers on your decisions to the numbers on the spinners and place your decisions below the corresponding spinners. Now take a minute to look at all six of your choices. If you would like to change any of these decisions now, you may. We are not trying to get you to change your mind, we just want to make sure you have made the decisions you like the best. If you would like to change any of your decisions, please use this red pen to cross out your original response and write in your new decision. Your payment will be based on the last decision that you make. When you are done making your decisions, please put your response slips back in your envelope.

If WTP was done first (ID > 64):

OK, thanks. We want to have you do one more experiment before we determine your payment. Here's how it works:

Go to "Choice protocol."

^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v^v

If BID was done second (ID 64):

Go to "Finish".

Finish:

OK, we just want to make absolutely sure that you have made the decisions that you prefer.

Lay out all 12 spinner cards (6 choice, 6 plain spinners) on the table, in the order presented. Hand subject ***a BLACK pen***.

Please match up your decisions with the spinners. Take a look at all of your choices. If you want to change any please use this black pen to cross out the old choice, and write in the new one. We are not trying to get you to change your mind, we just want to make sure you have made the decisions you like the best. Your payment will be based on the last decision that you make.

Ok, Thanks. Now we are going to figure out your payment.

For each experiment, roll the die to determine which card will be paid. Then let them spin if necessary to determine payment, first for choices, then for WTP.

If you spin this spinner, there is a chance that you will lose $20. What is the most you would be willing to pay to avoid having to spin this spinner?

$ _____

#_____

If you spin this spinner, there is a chance that you will lose $20. What is the most you would be willing to pay to avoid having to spin this spinner?

$ _____

#_____

If you spin this spinner, there is a chance that you will earn $20. What is the most you would be willing to pay for the opportunity to spin this spinner?

$ _____

#_____

If you spin this spinner, there is a chance that you will earn $20. What is the most you would be willing to pay for the opportunity to spin this spinner?

$ _____

#_____

Treatment Chart:

Order by ID number. Pen Order is the same for all: Blue then Red then Black.

1 – 16: Choice then WTP, Gains then Losses, Low then High (Order 1)

17 – 32: Choice then WTP, Losses then Gains, Low then High (Order 2)

33 – 48: Choice then WTP, Gains then Losses, High then Low (Order 3)

49 – 64: Choice then WTP, Losses then Gains, High then Low (Order 4)

65 – 72: WTP then Choice, Gains then Losses, Low then High (Order 1)

73 – 80: WTP then Choice, Losses then Gains, Low then High (Order 2)

81 – 88: WTP then Choice, Gains then Losses, High then Low (Order 3)

89 – 96: WTP then Choice, Losses then Gains, High then Low (Order 4)

Gamble Order:

Order 1. (low prob, gains first)			Order 2: (low prob, losses first)		
EV	Probability	Change in Wealth	EV	Probability	Change in Wealth
$2	.1	+20	-$2	.1	-20
$8	.4	+20	-$8	.4	-20
$16	.8	+20	-$16	.8	-20
-$2	.1	-20	$2	.1	+20
-$8	.4	-20	$8	.4	+20
-$16	.8	-20	$16	.8	+20

Order 3: (High prob, gain first)			Order 4: (High prob, loss first)		
EV	Probability	Change in Wealth	EV	Probability	Change in Wealth
$16	.8	+20	-$16	.8	-20
$8	.4	+20	-$8	.4	-20
$2	.1	+20	-$2	.1	-20
-$16	.8	-20	$16	.8	+20
-$8	.4	-20	$8	.4	+20
-$2	.1	-20	$2	.1	+20