THE FOURFOLD PATTERN OF RISK ATTITUDES IN CHOICE AND PRICING TASKS

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Abstract: Using simple gambles with real payoffs we examine the robustness of the fourfold pattern (FFP) of risk attitudes under two different elicitation procedures. That is, we determine if on average individuals are (1) risk-seeking over low-probability gains, (2) risk-averse over high-probability gains, (3) risk-averse over low-probability losses, and (4) risk-seeking over high-probability losses. We find that participants' risk attitudes are consistent with the FFP when using the Becker-DeGroot-Marschak procedure to elicit prices for the gambles. However, when instead relying on a simple choice-based elicitation where participants choose between the gamble and its expected value, individual decisions are not distinguishable from random choice. This sensitivity to the elicitation procedure holds both between- and within-participants, and it remains even when participants review their price and choice decisions simultaneously and are allowed to change them. Given the greater complexity of the price elicitation procedure this finding may be further evidence that an increase in cognitive load exacerbates behavioral anomalies.

1. Introduction

Individual decisions over risky outcomes often deviate from that predicted by expected utility theory, and alternative models have been proposed to better explain behavior.[1] Perhaps the most accepted alternative is cumulative prospect theory (CPT) by Tversky and Kahneman (1992).[2] Two central assumptions in CPT are that individuals are risk averse over gains and risk seeking over losses, and that they tend to overweight low probability events while underweighting the likelihood of high probability ones. As emphasized by Tversky and Kahneman (1992) a fourfold pattern (FFP) of risk attitudes is a distinctive implication of these two assumptions.[3] Specifically, it is predicted that when faced with a risky prospect people will be:

(1) risk-seeking over low-probability gains,

(2) risk-averse over high-probability gains,

(3) risk-averse over low-probability losses, and

(4) risk-seeking over high-probability losses.

The objective of this paper is to examine the robustness of the FFP using two different elicitation procedures. We asked 128 people to evaluate a small set of simple gambles with low and high probabilities of cash gains and losses. In one price-based procedure we use the Becker-DeGroot-Marschak (BDM) procedure to elicit participants' willingness to pay for the lotteries, and in the other choice-based procedure we ask them to choose between the gamble and its expected value. This allows us to observe whether individuals make decisions that are consistent with each of the four elements of the FFP, and whether those decisions are affected by the elicitation procedure.

We find that the FFP is a very good predictor of risk attitudes – but only when people are asked to report their willingness to pay for a risky prospect. When they are instead asked to choose between the gamble and its expected value, we find that their decisions are not distinguishable from random choice. This result holds both between- and within-participants and does not depend on the ordering of tasks. We also show that the change in elicited preferences

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[1] For reviews of the literature see for example, Schoemaker (1982), Machina (1987), and Starmer (2000). For examples of comparisons between the alternative models, see e.g., Harless and Camerer (1994), Hey and Orme (1994).

[2] Cumulative prospect theory is a generalization of prospect theory, Kahneman and Tversky (1979). Camerer (1998) argues that cumulative prospect theory is supported by the preponderance of evidence, and he suggests that it is time to abandon expected utility theory in its favor. Camerer (2000) makes a similar recommendation

[3] Tversky and Kahneman (1992, p. 306) write "The most distinctive implication of prospect theory is the fourfold pattern of risk attitudes."

between the two methods remains even after participants review their price and choice responses simultaneously and are allowed to change them.

There are several potential explanations for the sensitivity to the elicitation procedure. One such explanation may be found in the literature on dual selves.[4] The dual-self models argue that cognitive load may decrease an individual's ability to exert willpower over the more impulsive self. Thus an increase in cognitive load may result in more substantial behavioral anomalies. Interestingly a recent experimental study by Benjamin, Brown, and Shapiro (2006) shows that cognitive load increases both small-stakes risk aversion and short-run discounting. To the extent that the cognitive load of the BDM price elicitation mechanism is greater than in the choice based procedure our finding may be seen as further evidence that cognitive load exacerbates behavioral anomalies.

In Section 2 of the paper we present and motivate our experimental design. Section 3 and 4 show how the results support the conclusion that the FFP is present in pricing tasks, but not in choice tasks. Section 5 discusses various explanations for the sensitivity to elicitation procedure and concludes the paper.

## 2. Motivation and Experimental Design

As mentioned in the introduction, CPT's assumptions on the value- and probability weighting functions give rise to the FFP of risk attitudes. First, CPT assumes that preferences can be described by a reference-dependent value function $v(x)$, where x denotes the change in the payoff from a person's initial wealth position. Based on evidence that people are risk-averse over gains and risk-seeking over losses, the value function is assumed to be concave for gains and convex for losses, as shown in Figure 1, Panel a. Second rather than responding to the objective probability p it is assumed that individuals weight these by a non-linear probability weighting function $w(p)$. As individuals have been found to be insensitive to changes in the probability, the weighting function is assumed to be "regressive," and as shown in Panel b of Figure 1 to cut the diagonal from above. Thus people are assumed to overweight low probability events and underweight high probability ones. Kahneman and Tversky's predicted FFP results when the magnitude of $w(p)$ is large relative to $v(x)$. That is, the overweighting of low probabilities needs

to be large enough that people are risk-seeking for lotteries with low probability gains, while the underweighting of high probabilities must be sufficient to counteract the effect of the convexity of the value function over losses and result in risk-aversion for high probability losses. Note however that probability weighting alone will give rise to the FFP when individuals are risk neutral.
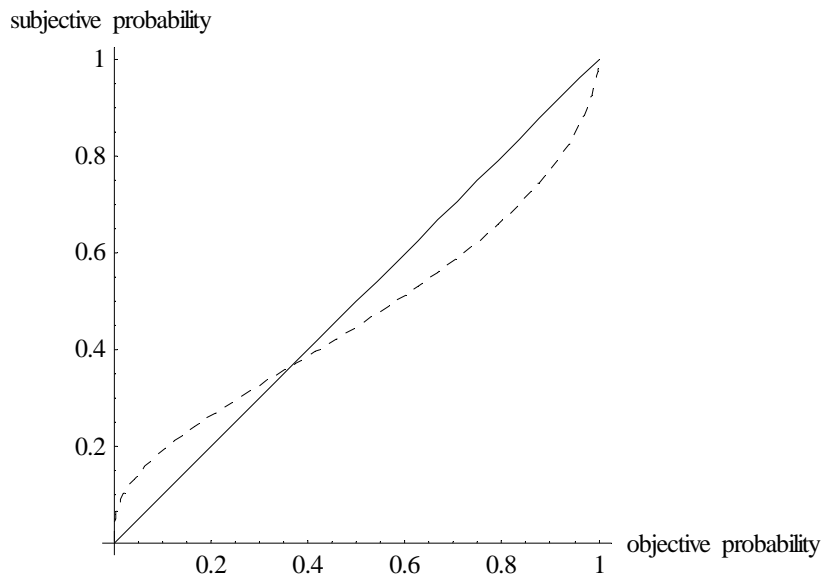
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[4] See e.g., Bernheim and Rangel (2004), Loewenstein and O'Donoghue (2005), Brocas and Carillo (2005), Fudenberg and Levine (2006), and Ozdenoren, Salant, and Silverman (2006).

Figure 1: The prospect theory value and weighting functions

Panel a: The value function
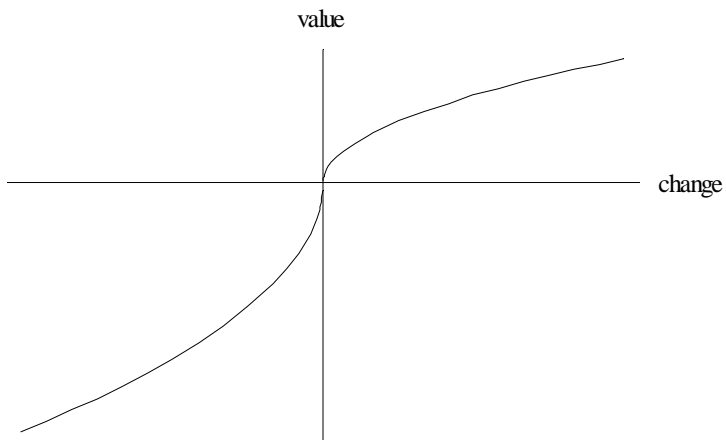
Panel b: The subjective probability weighting function

While there is a large experimental literature on decision-making under risk very few studies directly test the FFP of risk attitudes. The focus of much of the literature is on testing CPT against alternative models by relying on choices over a large set of relatively complex gambles. For example, Hey and Orme (1994) show people 100 pairs of (mostly) three-outcome lotteries and have them choose one of each pair, or report indifference. The lotteries are fairly complicated – for example, individuals chose between a lottery with 0.375 chance of £10, 0.125 chance of £20, and 0.5 chance of £30, and one with a 0.125 chance of £10, 0.750 chance of £20, and 0.125 chance of £30.[5] Other studies focus on estimating the shape of the value function, the weighting function, or both. Gonzalez and Wu (1999) use an iterative procedure to elicit certainty equivalents for 300 two-outcome gambles, all over gains, with varying probabilities and payoffs. Participants are paid $50 for completing the four-hour-long task, and in addition at least one participant is paid for at least one decision. The data helps them estimate both the probability weighting and the value functions, and they report that results from ten of the eleven participants, who were psychology graduate students, are consistent with the CPT predictions about the shape of these functions over gains.

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[5] The odds are shown with pie charts on a computer, and one randomly chosen decision is played for real money. Hey and Orne (1994) report that neither of several varieties of probability weighting models provide better explanations of the data than does expected utility theory. They repeat the experiment a week later, and find many differences in choices, suggesting that decision errors are an important aspect of decision-making in these experiments. See also, Harless and Camerer (1994) for analysis of 23 datasets consisting of choices over similarly complex gambles.

Direct tests of the FFP using real and simple gambles are scarce. The data for Kahneman and Tversky's 1979 paper came from survey questions about choices between an array of lotteries with large hypothetical gains and losses. Tversky and Kahneman (1992) presented 25 graduate students with a series of simple lotteries over smaller, but still hypothetical, losses and gains. They used an iterative procedure to obtain close bounds on the certainty equivalents for the lotteries, and found strong support for the FFP.[6] However behavior elicited from survey-type data need not mirror that over real cash lotteries (see e.g., Harless and Camerer, 1994, Camerer and Hogarth, 1999, and Battalio, Kagel, and Jiranyakul, 1990). More recently Holt and Laury (2002) conduct a direct comparison of decisions for hypothetical and real lotteries over gains, and find that people appear more risk-seeking when faced with hypothetical rather than real gambles. Laury and Holt (2007) present the same hypothetical/real comparison for decisions over gains and over losses, and find that while the hypothetical decisions are risk-averse over gains and risk-seeking over losses, with real gambles they are risk-averse for gains but risk-neutral for losses. As the Holt-Laury procedure relies on choices between pairs of lotteries with different probabilities and expected values, it does not enable a comparison of behavior between low- and high-probability lotteries, and as a result their papers do not shed light on the full FFP.

Others have allowed for high- and low-probability gambles, but focus solely on the gain domain. For example, Kachelmeier and Shehata (1992) presented Chinese, Canadian, and American participants with a sequence of 25 simple real lotteries over gains, and asked what price they would be willing to accept in return for their lottery ticket. They used the demand revealing Becker-DeGroot-Marschak procedure to elicit prices. The results show substantial risk-seeking for low-probability prospects, but do not show risk-aversion for high-probability prospects. In a follow-up experiment on a limited set of gambles they find evidence that the lack of risk-aversion is due to the willingness-to-accept format of their elicitation. Reported willingness to pay for a prospect is much lower than the reported willingness to accept.

Harbaugh, et al. (2002) is to our knowledge unique in using real and simple gambles to directly test the full FFP. They examine decisions over a small set of simple lotteries with cash payoffs, over gains and losses and with a range of probabilities. The participants range in age from five to 64. To make the protocol transparent for the youngest participants they use a very

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[6] Thus the elicitation method used by Tversky and Kahneman (1992) effectively asks participants to determine their willingness to pay for a hypothetical gamble.

simple choice-based elicitation procedure, asking people to choose between a risky prospect with one non-zero outcome, and its expected value. They find that children's risk attitudes diverge from the FFP, and while the divergence diminishes with age they do not find adults behaving in a manner consistent with the FFP.

This paper seeks to better understand why Harbaugh et al. (2002) in contrast to previous studies do not find evidence of the FFP. As previous evidence for the FFP has been observed by eliciting prices of a gamble, it may be that failure to observe the FFP is due to their choice-based elicitation procedure. Another possible explanation is that the unusual subject pool caused the results to diverge from the FFP. To address both of these explanations we determine if the FFP is robust to the elicitation procedure when using a standard subject pool. Specifically, we test the FFP of risk attitudes using simple lotteries for cash gains and losses over a range of probabilities. Risk attitudes are elicited using both choice- and price-based procedures. The choice procedure simply asks individuals to choose between a lottery and its expected value. The price procedure asks participants to report the most they are willing to pay to play a lottery over gains, or the most they are willing to pay to avoid playing a lottery over losses.[7] The BDM procedure is used to determine whether participants will pay a randomly determined price to play the lottery (gain), or to avoid the lottery (loss). We explain the BDM procedure separately for losses and for gains. Each explanation includes an example, a test of understanding, and then a further discussion.

Participants in the experiment were asked to evaluate the six prospects shown in Table 1. Prior estimates of the probability weighting function report, and Panel b of Figure 1 illustrates, that the absolute difference between the weighted probability and the objective probability is largest when the objective probability is 0.1 and 0.8, and that the functions cross at

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[7] 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 5. Note that the willingness-to-accept format presents a similar difference over losses where participants accept a payment in return for the gamble. We use the willingness-to-pay format to limit the "overbidding" that is frequently found with willingness-to-accept questions. When eliciting the monetary equivalent of a gamble one must elicit either a willingness-to-accept or willingness-to-pay measure. Schmidt, Starmer and Sugden (2005) develop a reference-dependent model that they call third-generation prospect theory. This model predicts preference reversals between choice and willingness-to-accept (WTA) evaluation tasks because loss aversion causes a decision-maker to require greater compensation to forego a potential gain. This perceived loss is not present in the choice task. As a result, a WTA preference elicitation mechanism will lead to higher valuations of a lottery than a choice task.

approximately 0.4.[8] Therefore we are particularly interested in determining risk attitudes for prospects 1, 3, 4, and 6, as we expect strong support for the FFP at these prospects.

Table 1: The Six Prospects

Prospect Number	Probability	Payoff	Expected Value	Predicted FFP of Risk Attitude
1	.1	+$20	$2	Seeking
2	.4	+$20	$8	Neutral
3	.8	+$20	$16	Averse
4	.1	-$20	-$2	Averse
5	.4	-$20	-$8	Neutral
6	.8	-$20	-$16	Seeking

The participants were college students from a variety of majors at the University of New Mexico. To allow for both between- and within-participants analyses, everyone evaluated the prospects using both procedures. Sixty-four students used the choice method first and thirty-two used the price method first. We selected to have a larger subject pool for the choice method since this version is less common when examining the FFP. After the first elicitation procedure each group then evaluated the gambles using the other method.[9] We refer to participants who first complete the choice method as "choice-participants" and those who first complete the price method as "price-participants."

Each experimental session lasted about 30 minutes and only one participant at a time was present. 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. Participants were randomly assigned to be either a price- or a choice-participant. After reading the instructions for the initial elicitation method, participants were shown a sample prospect and a spinner card of the sort used in board games. They were told they would be asked to make six decisions, and that one decision

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[8] See for example Camerer and Ho (1994), Gonzalez and Wu (1999), Prelec (1998), Tversky and Kahneman (1992), Tversky and Fox (1995), Wu and Gonzalez (1996).

[9] Please note that the participants were unaware that they would be asked to evaluate the prospects more than once.

would be picked randomly to count for their payoff.[10] We then counted out $22 in single dollar bills, put it on the table in front of them, and asked them to evaluate the six prospects, one at a time.[11] The odds for the gambles were shown both numerically and using spinner cards, and these same spinners were used by the experimenter to determine outcomes.[12] We refer to the initial decision as the first-round decision. At the time the first-round decision was made the participant had no reason to believe that it was not his or her final decision. After completing the initial evaluation of one set of six decisions, the participants were then asked to lay all their decisions out on a table so that they could see them simultaneously. At this point they were given an opportunity to change any of their responses.[13] We refer to decisions at this point as the second-round decisions.

We used a restart procedure to obtain decisions for the second elicitation procedure. After completing the second-round decisions of the first task, participants 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 second elicitation method. They were given another $22, completed the six evaluations, and were again asked to review the six decisions simultaneously and make any changes they wished. Once both elicitation methods were completed, participants reviewed all twelve decisions simultaneously, and were given a third and final opportunity to change their answers. After completing the third-round decisions, we picked one prospect from each elicitation method, played any gambles, and paid the participants their net earnings in cash, which averaged $44 and ranged between $4 and $84.

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[10] A similar procedure is also used by Tversky and Kahneman (1986), Starmer, Sugden, and Cubitt (1998), and Camerer (1989). When offering participants to change their decision once it has been randomly selected, Camerer (1989) finds that they don't use that option. Laury (2002) shows that the procedure of randomly choosing one of several gambles elicits roughly the same preferences as when participants are paid for all of the decisions they make.

[11] Prospect theory will not predict the FFP unless people view this $22 as "theirs." This might not be the case if people see this $22 as a windfall gain, rather than as compensation for the time involved in participating in the experiment. In section 2 we show that, in the pricing task, people exhibit the FFP as well as loss aversion. We take this as evidence that they do treat this payment as part of their endowment. Note also that this is the procedure that has previously been used to elicit risk attitudes over losses, see for example, Camerer (1989), and Battalio, Kagel, and Jiranyakul (1990).

[12] Hertwig, Barron, Weber, and Erev (2003) find that individuals overweight low-probability events in decisions from description, while they underweight such events in decisions from experience. While Hertwig et al. classify decisions in our experiment as being from description it is possible that prior experience with spinners lead individuals to underweight low-probability events.

[13] We thank Dale Stahl for suggesting this revision procedure.

People did not know they would participate in the second task, nor that they would be allowed to re-evaluate their choices, so the first-round decisions allow for a clean between-participants comparison of price and choice behavior. The opportunity for the revisions was included to reduce errors, but our general results are the same regardless of the round.

In each method prospects were presented according to one of four different orders. An equal proportion of participants was given each order. Two orderings presented the prospects in increasing order of probability (from 10 percent to 80 percent), with one ordering presenting gains first and then losses, and the other ordering presenting losses first and then gains. Two other orderings presented the prospects in decreasing order of probability (from 80 percent to 10 percent), once again one ordering first presented gains, and the other first presented losses. Participants 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. We find that decisions do not differ significantly across these orders.

3. Risk Attitudes for First-round Price Decisions

We start by reviewing the first-round average and median prices reported by the price-participants. These are shown in Table 2. A participant is classified as risk-neutral if the reported price equals the expected value of the gamble. If the participant 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 the amount she is willing to pay to avoid playing a gamble involving a loss is less than the expected value.

Table 2: Price-participants 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 participants, 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.

We first note that the prices reported for the low and high probability prospects differ substantially from the associated expected values.[14] Second, consistent with CPT's assumption of loss aversion we see 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.[15] Third, the mean reported prices imply risk attitudes that are consistent with the fourfold pattern. When presented with a prospect involving a gain participants 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. Thus, across participants the price elicitation results in risk attitudes that are very much in line with the FFP.

A similar result holds within-participants, where we directly can assess the individual reflections in risk attitudes when moving from low to high probabilities of winning, or when moving from the gain to the loss domain. Conditional on the stake of the prospect being a loss or

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[14] The prices found by Tversky and Kahneman (1992) also differ substantially from the expected value. For example they find a median reported price of $9 for a 10 percent chance of winning $50.

[15] Note however that only in the comparison 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).

a gain, the first panel of Figure 2 shows the proportion of participants whose reported prices suggest that they are risk averse versus risk seeking for the high- and low-probability prospects (High P and Low P, respectively). The second panel shows the proportion with each combination of risk attitudes when conditioning on the likelihood of the stake and recording risk attitudes for prospects with a similar sized loss and gain. The highlighted cells are the outcomes predicted by prospect theory.

The within-participant support for the FFP of risk attitudes is striking. The modal cell in the price task is always consistent with the predicted reflection of risk attitudes, and in two of the four cases more than half the participants are in the predicted cell. As predicted, 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; conditional on a low- or a high-probability prospect, attitudes reflect between a gain and a loss.

We determine statistically whether the proportion with the predicted risk attitudes exceeds the proportion that would be expected if participants 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 1/9th are in the cell predicted by the FFP of risk attitudes.[16] 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 < 0.001. The same conclusion is reached when we exclude those who are risk-neutral and test the hypothesis that at most 25 percent of the remaining participants reflect in the predicted manner.[17] Thus using the price elicitation there is substantial support for the FFP, whether we focus on reflection of risk attitudes between gains and losses, or between low- and high-probability prospects.

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[16] Given the size of the gambles it may be argued that the majority of participants should be risk-neutral, thus the null distribution is not obvious. We therefore consider outcomes when including and excluding risk-neutral participants.

[17] p-values are at 0.002 or lower. A stronger test of the FFP is whether the majority of participants reflect as predicted or whether all participants have the predicted reflection. Throughout the paper we focus on the weaker test.

Figure 2: Risk Attitudes of Price-participants in the Price Task
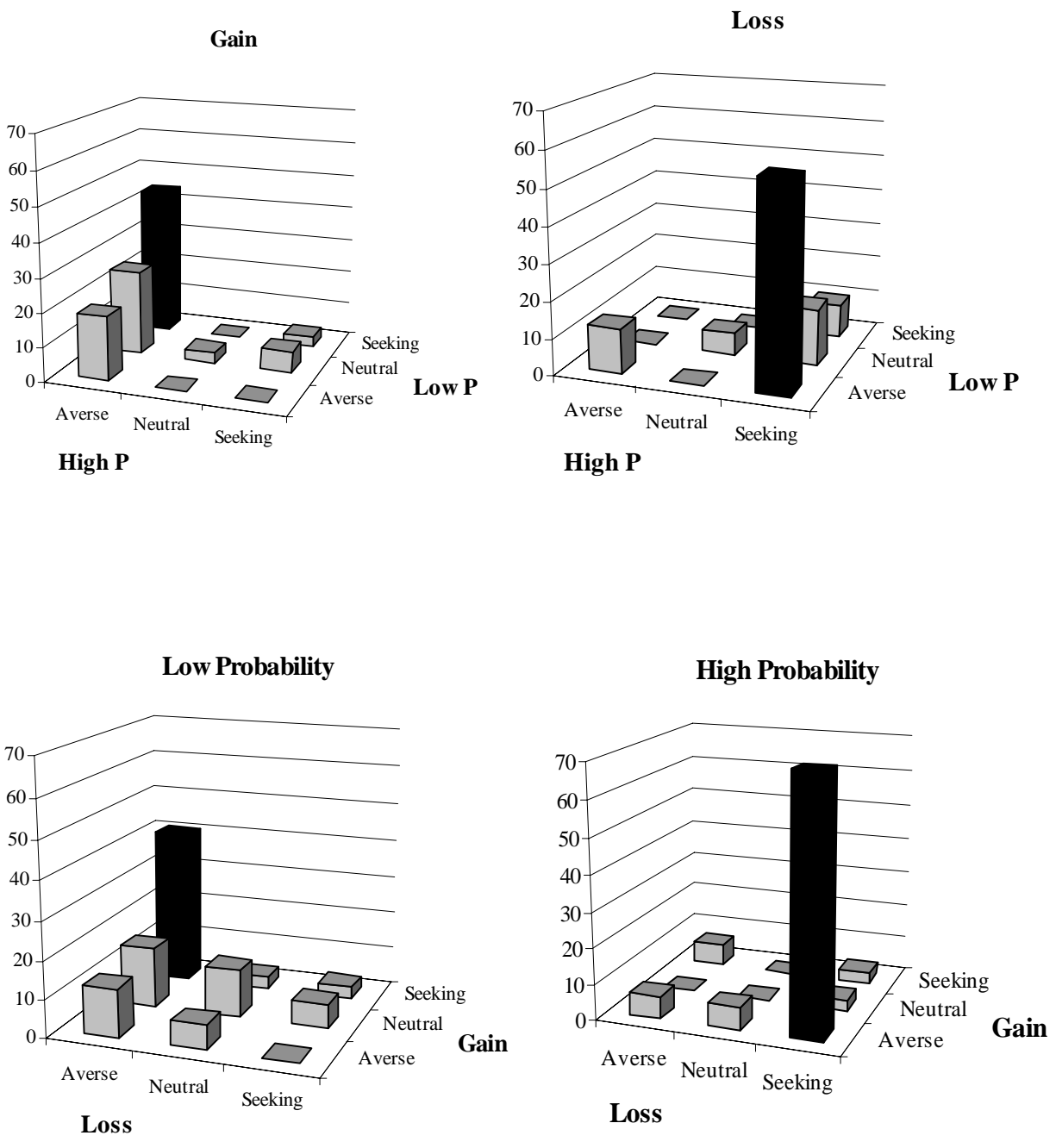
Note: 32 participants, first-round decisions, percentages on vertical axis. The proportion with the predicted reflection between high- and low-probability prospects is 44% for gains and 56% for losses. For low-probability prospects 41% reflect as predicted between losses and gains, and for high-probability prospects 56% exhibit the reflection.

While Figure 2 allows us to look at the two-way reflection it is also of interest to determine whether the fraction of those who exhibit the entire FFP pattern over the four prospects exceeds the fraction expected if people were equally likely to have any combination of risk attitudes. Looking only at first-round prices, we find that 10 of 32 participants, or 34 percent, report prices that are fully consistent with the FFP. At most 4 participants choose any of the other combinations of risk attitudes.

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 less than of 0.001 we reject the null that the proportion of all participants choosing the FFP at most equals 1/81, as well as the hypothesis that at most 1/16 of the participants who are never risk-neutral exhibit the FFP.

As a control for error, participants were given two opportunities to review and change their decisions. Most people chose to revise their decisions. Of 96 participants only 19 never changed any of their decisions between the first and third round. 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 participant has completed both tasks and reviewed the decisions of all 12 prospects. As shown in Table 3 the FFP remains despite these changes. For every one of the three rounds we can reject the null that at most 1/3 of the participants price the four relevant prospects in a manner consistent with the prediction.[18]

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[18] 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.

Table 3: Price-participants in Price Task, Risk Attitudes by Prospect and Round

Risk attitude:	Low Probability (p=0.1)						High Probability (p=0.8)					
	Gain (+$20)			Loss (-$20)			Gain (+$20)			Loss (-$20)		
	Round			Round			Round			Round		
	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 participants, percentages in cells. Highlighted cells show the FFP predictions.

4. Risk Attitudes for First-round Choice Decisions

While participants in the price task were asked to report a monetary equivalent for each of the six prospects, in the choice task participants only needed to decide whether they preferred the prospect or its expected value. Despite the prospects being the same across the two elicitations, we do find very different results. Table 4 shows the proportion of participants choosing the gamble over its expected value, and the implied median risk attitude for the first round choices. The implied risk attitudes tend to be statistically indistinguishable from risk-neutrality, and if anything they are opposite of that predicted by the FFP.

Table 4: Choice-participants 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 participants, first-round decisions. The test is an exact binomial test of the null hypothesis that the proportion choosing the gamble = 0.5.

The same result appears when we look at within-participant reflections in Figure 3. 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 reflections consistent with the FFP.

Figure 3: Risk Attitudes of Choice-participants in the Choice Task
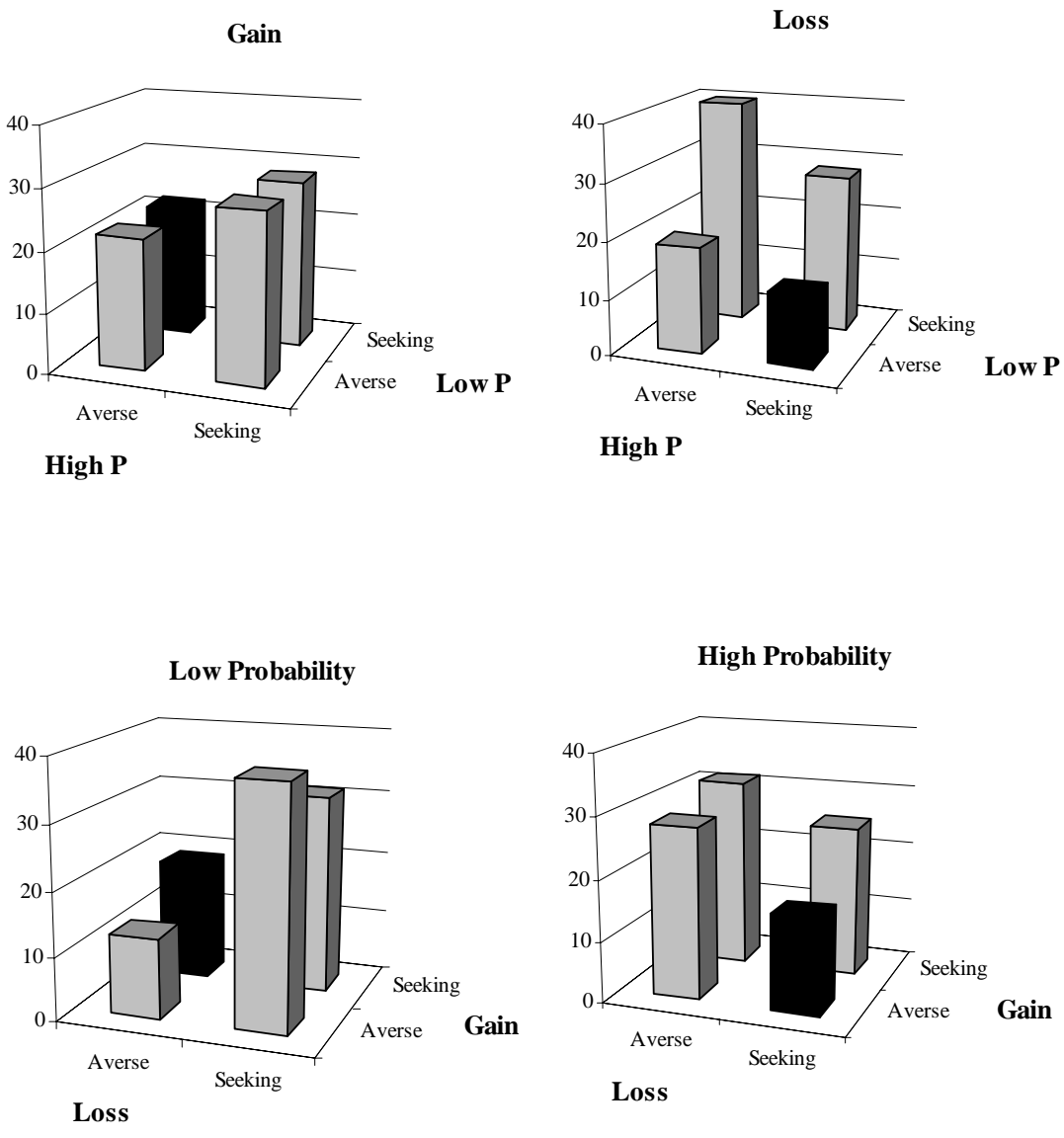
Note: 64 participants, first-round decisions, percentages on vertical axis. The proportion with the expected reflection between high- and low-probability prospects is 22% for gains and 13% for losses. For low-probability prospects 19% exhibit the predicted reflection between losses and gains, the comparable number of high-probability prospects is 16%.

The first noticeable difference from Figure 2 is that the distribution of risk attitudes is less extreme, and that a much smaller fraction of individuals exhibit the reflection predicted by the FFP. In three of the four cases the cell suggested by the FFP turns out to be the combination

that we observe with the smallest frequency. Statistical tests of the reflections confirm what one would expect from the patterns in Figure 3. In none of the four cases can we reject the null hypothesis that at most 25 percent of participants make the predicted choices (all p-values exceed 0.75). While risk attitudes do reflect between gains and losses and low and high probabilities – reflections are the modal outcome in each of the 4 cases –the pattern tends to be the 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.[19] The preferences elicited with the choice task also provide limited evidence for the entire FFP. Only 4 of 64 participants make choices consistent with the full FFP, precisely the proportion we would expect if the FFP had no predictive power.[20]

As with the price task the opportunity to revise decisions does not result in much change in the elicited risk attitudes. Table 5 presents the attitudes for the three rounds of decisions. In none of the twelve cases can we reject the hypothesis that at most half the participants make choices consistent with the FFP. Only for the low-probability loss prospect can we reject the hypothesis that individuals are as likely to be risk-averse as risk-seeking.

Table 5: Choice-participants 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 participants, percentages in cells. Highlighted cells show the FFP predictions.

The results for price-participants in the choice task and choice-participants in the price task (available from the authors) are essentially identical to the results presented above. Thus our

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

finding that the FFP does not arise in the choice-based procedure is robust to ordering effects and the expected wealth effect from participation in the first task.

5. Discussion and Conclusion

Presenting participants with a few simple gambles we find that the FFP of risk attitudes is sensitive to the preference elicitation mechanism. While the FFP accurately characterizes people's pricing decisions, it does no better than chance at predicting their choices between gambles and the corresponding expected value. In fact behavior in the choice task is often statistically indistinguishable from risk-neutrality. These results hold regardless of whether we start with the price or the choice task and are robust to simultaneously reviewing decisions under the two tasks.

Our study demonstrates that risk attitudes do not generally follow the FFP and raises the question of why the elicited risk attitudes differ between the price and choice tasks. One possible explanation is that the transparency varies between the two elicitation mechanisms. Making a choice between a lottery and a sure outcome is a simple and familiar task, while the pricing method used here and in previous experiments is more complicated. Individuals have limited experience pricing objects and may find it particularly difficult to price a gamble. Perhaps the inexperience causes them to adopt rules of thumb that generate the FFP of risk attitudes. For example, participants may pick a naïve rule whereby the price is selected about halfway between the best and the worst outcomes of the gamble, but moved a bit towards the more likely outcome. While the price rule may be the same for gains and losses, the risk attitudes implied by these prices would be the reverse of one another. For example, if a 10 percent chance of $20 is assessed at $5 in the gain domain and -$5 in the loss domain, then the individual is said to be risk seeking over gains and risk averse over losses. Thus naïve pricing rules could give rise to the FFP. It may be argued that the similarity in the absolute value of the reported prices for losses and gains in Table 2 is consistent with similar pricing rules in the two domains. The BDM procedure used to secure that the price elicitation is incentive compatible may be another reason why the FFP arises in the price task. Even if well understood this procedure may bias the reported prices in favor of the FFP. Specifically, the bounds on the distribution of the randomly determined prices may truncate the reported willingness to pay for gambles of low expected

value from the left, while those of high expected value are truncated from the right. Such a truncation can give rise to the FFP. Finally, the greater complexity of the BDM procedure may in and of itself cause the elicited preferences to differ between the two methods. As argued by the literature on dual selves, we may find greater behavioral anomalies when the cognitive load is high, because in such cases the restraint on the impulsive self is low. Thus the support of the FFP in the price task may be due to the cognitive load being greater than in the choice task.

Another reason why the price- and choice-based procedures elicit different preferences may be that they are less similar than they initially appear. While the evaluated prospects are the same, the possible payoffs vary between the two procedures. In addition to the randomly generated BDM price differing from the prospect's expected value, the potential outcomes of the price and choice task are rather different when evaluating gain prospects. In the price task participants are asked to pay for the gain gamble, whereas participants in the choice task are asked to choose between the gamble and its expected value.[21] Thus expected wealth is higher in the choice task and the prospect is solely in the gain domain. A participant either chooses the positive expected value or faces two possible outcomes: a gain of $20 or a gain of $0. In contrast it can be argued that the prospect in the price task is mixed over losses and gains. Specifically participants may end up paying for a gamble that does not win any money, thereby loosing the BDM-generated price. The anticipation of such a loss may cause the elicited price to be influenced by loss aversion.[22]

While we cannot adjust for the differences between paying a randomly determined price versus the expected value, it is possible to make the price and choice procedure more similar in the gain domain. We conducted an additional treatment to examine if our results were sensitive to such a modification. Since the objective of the paper is to examine the support for, and procedural invariance of, the FFP of risk attitudes and since the price task clearly demonstrates this pattern, the choice task was revised to be more comparable to the price task. Specifically, participants were asked to choose whether they would give up the gamble's expected value in

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[21] This type of inconsistency is also present in previous comparisons between price and choice elicitations, see e.g. Slovic and Lichtenstein (1968).

[22] It may be argued that using a price task inherently results in mixed prospects. If participants instead were asked to state the amount they are willing to accept then a similar situation will arise over losses. Some participants would receive payments in return for accepting a negative prospect, and then not lose any money. 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.

return for the gamble. In addition to modifying the choice task in the gain domain, we also expanded the participant's choice set to include an option of indifference.[23] That is, the participants could choose the prospect, it's expected value, or a don't care option, where the flip of a coin determines whether they receive the expected value of the prospect or play the prospect.

A total of 32 new participants, from the same subject pool, participated in the new treatment. Participants were first given the new-choice task and then the original price task. Our results show, first, that very few participants select the 'don't care' option.[24] Second, our earlier finding is robust. With the exception of the low-probability gain the implied risk attitudes for the majority of participants in the choice task is the opposite of that predicted by the FFP. Furthermore, the reflections of risk attitudes are not consistent with the prediction.[25] In none of the four examined reflections cases can we reject the hypothesis that the proportion reflecting according to the FFP is no larger than what we would expect from random choice.[26] With the exception of the low probability gain, the modal choices tend to be the exact opposite of the FFP prediction. In the three other cases, we reject the hypothesis that at least 50 percent of those who reflect risk attitudes do so in the predicted direction, with p-values below 0.004. Over the four relevant prospects none of the 32 participants made choices that were consistent with the full FFP. In fact the modal pattern was the exact opposite of the FFP, with 5 participants choosing this combination. After evaluating the six gambles with the new-choice task, participants 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. Thus despite the greater similarity in the two procedures we continue to find evidence of the FFP in the price task, but not in the choice task.

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[23] In the price task participants indicate risk-neutrality by reporting that they are willing to pay the gamble's expected value to play the gamble.

[24] For each prospect, an average of 14.5% are indifferent.

[25] 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.

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

Much like Slovic and Lichtenstein (1968) our results demonstrate that the price ordering of prospects can be very different from the choice ordering.[27] Looking only at third-round decisions we see that of the participants who were either risk-averse or risk-seeking in the price task, 42 percent had the opposite risk attitude when asked to evaluate the same gamble with the new-choice task.[28] If the majority of participants have one risk attitude in the price task then the majority of participants tend to have the opposite risk attitude in the choice task. For example, in the high-probability loss prospect, 3/4 of participants are willing to pay less than the gamble's expected value to avoid the risky loss, yet half of these same participants choose the certain loss when given the choice between the gamble and a certain loss of the expected value.

The consequences of procedural variance in risk attitudes are substantial. Not only does it raise the serious question of determining which procedure is appropriate when eliciting risk attitudes, but it may also have important implications for how we choose to present risky outcomes. 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 low probability of a large loss, 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 salesperson frames the decision as a feature available at an additional cost, it becomes a price task. The buyer may then approach the problem with a risk-averse attitude and buy the safety-equipped car.

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[27] Their example involved two lotteries, one with a high probability of winning a small amount and the other with a low probability of winning a large amount, but with equal expected values. They showed that most participants choose the high probability lottery over the low probability one, but priced the low probability lottery higher than the high probability lottery (See Grether and Plott (1979) for a careful replication of these results). To explain this preference reversal they argue that when making a choice people focus on the probability of the prospects, but when determining a price they focus on the payoffs. It is not clear how one would apply this explanation to the present scenario.

[28] Tversky and Kahneman (1992) proposed that reversals of the Slovic-Lichtenstein type are caused by a tendency to overprice prospects. Thus, in the choice task participants should appear more risk-averse over gains. Since the predominant risk attitude in the choice task tends to be the opposite of that in the price task, the preference reversals between the two methods can not be explained by a systematic overpricing of prospects. Looking at third-round results over gains we find that 47 percent of the participants who were risk-averse in the price task become risk-seeking in the choice task, whereas only 36 percent of those who were risk-seeking in the price task become risk-averse in the choice task.

References:

Battalio, Raymond, John Kagel, and Komain Jiranyakul. "Testing Between Alternative Models of Choice Under Uncertainty: Some Initial Results," *Journal of Risk and Uncertainty*, 1990, 3, 25-50.

Benjamin, Daniel J., Sebastian A. Brown, and Jesse M. Shapior. " Who is "Behavioral"? Cognitive Ability and Anomalous Preferences," Unpublished manuscript 2006.

Bernheim, Douglass and Antonio Rangel. "Addiction and Cue-triggered Decision Processes," *American Economic Review*, 94(5), 2004,1558—1590.

Brocas, Isabelle and Juan Carrillo. "The Brain as a Hierarchical Organization." CEPR Discussion
Paper No. 5168, August 2005.

Camerer, Colin. "An Experimental Test of Several Generalized Utility Theories," *Journal of Risk and Uncertainty*, 2, 1989, 61-104.

Camerer, Colin. "Bounded Rationality in Individual Decision Making." *Experimental Economics* 1, no. 2, 1998, 163-83.

Camerer, Colin. "Prospect Theory in the Wild: Evidence from the Field." In Choices, Values, and Frames. Daniel Kahneman and Amos Tversky (eds.) New York, Cambridge University Press. 2000, 288-300.

Camerer, Colin, and Teck-Hua Ho. "Violations of the Betweenness Axiom and Nonlinearity in Probabilities," with Teck Ho, *Journal of Risk and Uncertainty*, 1994, 8, 167-196.

Camerer, Colin, and Robin Hogarth. "The Effects of Financial Incentives in Economics Experiments: A Review and Capital-Labor-Production Framework," *Journal of Risk and Uncertainty*, 1999, 7-42.

Fudenberg, Drew, and David Levine, "A Dual Self Model of Impulse Control", *American Economic Review*, 2006, 96, 1449-1476

Gonzalez, Richard, and George Wu. "On the Shape of the Probability Weighting Function." *Cognitive Psychology*, 1999, 38, no. 1, 129-66.

Grether, David M., and Charles R. Plott. "Economic Theory of Choice and Preference Reversal Phenomenon." *The American Economic Review* 1979, 69, 623-38.

Harbaugh, William T., Kate Krause, and Lise Vesterlund. "Risk Attitudes of Children and Adults: Choices over Small and Large Probability Gains and Losses." *Experimental Economics,* 2002, 5, no. 1, 53-84.

Harless, David, and Colin Camerer. "The Predictive Utility of Generalized Expected Utility Theories," *Econometrica*, 1994, 62, 1251-1290.

Ralph Hertwig, Greg Barron, Elke U. Weber, Ido Erev. "Decisions From Experience and the Effect of Rare Events in Risky Choice," *Psychological Science*, 2004, 15 (8), 534–539.

Hey, John D, and Chris Orme. "Investigating Generalizations of Expected Utility Theory Using Experimental Data." *Econometrica,* 1994, 62, no. 6, 1291-326.

Holt, Charles A., and Susan K. Laury. "Risk Aversion and Incentive Effects." *American Economic Review,* 2002, 92, 5, 1644 - 55.

Kachelmeier, Steven J., and Mohamed Shehata. "Examining Risk Preferences under High Monetary Incentives: Experimental Evidence from the People's Republic of China." *American Economic Review*, 1992, 82, no. 5, 1120-41.

Kahneman, Daniel, and Amos Tversky. "Prospect Theory: An Analysis of Decision under Risk." *Econometrica*, 1979, 47, no. 2, 263-91.

Laury, Susan K. "Pay One or Pay All: Random Selection of One Choice for Payment." *Working Paper* (2002).

Laury, Susan K., and Charles A. Holt. "Further Reflections on Prospect Theory." In Cox, J.C. and Harrison. G. (eds.), Risk Aversion in Experiments (Experimental Economics, Volume 12), JAI Press, Greenwich, CT, forthcoming.

Loewenstein, George and Ted O'Donoghue. "Animal spirits: Affective and deliberative processes in economic behavior." working paper 2005.

Machina, Mark. "Choice Under Uncertainty: Problems Solved and Unsolved," *Journal of Economic Perspectives,* 1987, 1, 121-154.

Ozdenoren, Emre, Steve Salant, and Dan Silverman. "Willpower and the Optimal Control of Visceral Urges." Working paper 2006.

Prelec, Drazen. "The Probability Weighting Function." *Econometrica*, 1998, 66, no. 3, 497-527.

Schmidt, Ulrich, Chris Starmer and Robert Sugden. "Explaining preference reversal with third-generation prospect theory." CeDEx discussion paper 2005-19,. www.nottingham.ac.uk/economics/cedex/papers/2005-19.pdf

Schoemaker, Paul. "The Expected Utility Model: Its Variants, Purposes, Evidence and Limitations," *Journal of Economic Literature,* 1982*,* 20, 529-563.

Slovic, Paul, and Sarah Lichtenstein. "Relative Importance of Probabilities and Payoffs in Risk Taking." *Journal of Experimental Psychology Monograph,* 1968, 78, 1-18.

Starmer, Chris. "Developments in Non-Expected Utility Theory Developments in Non-Expected Utility Theory: The Hunt for a Descriptive Theory of Choice under Risk." *Journal of Economic Literature*, 2000, XXXVIII, 332-382.

Starmer, Chris, Robert Sugden, and Robin Cubitt. "On the Validity of the Random Lottery Incentive System," *Experimental Economics*, 1998, Vol. 1, pp. 115-31.

Tversky, Amos, and Daniel Kahneman. "Rational choice and the framing of decisions," *Journal of Business*, 1986, 59, S251-0S278.

Tversky, Amos, and Daniel Kahneman. "Advances in Prospect Theory: Cumulative Representation of Uncertainty." *Journal of Risk and Uncertainty*, 1992, 5, 297-323.

Tversky, Amos, and Craig Fox. "Weighing Risk and Uncertainty," *Psychological Review*, 1995, 102, 269-283.

Wu, George and Richard Gonzalez.. "Curvature of the Probability Weighting Function," *Management Science*, 1996, 42, 1676-1690.

Appendix:

Original Choice/Price Protocol:

Have participants 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 participant to one partition. The participant sits behind the partition; an experimenter sits on the other side. The partition allows the participant 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 participant'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 participant'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 participant in the order presented originally. Ask him to place his response slip below the same-numbered spinner. Give participant 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.]*

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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 participant 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 participant'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 participant'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 participant in the order presented originally. Ask him to place his response slip below the same-numbered spinner. Give participant 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

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 participant **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?

$ _____

#_____

<u>Treatment Chart:</u>

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

1 – 16: Choice then WTP, Gains then Losses, SmallLow then LargeHigh (Order 1)

17 – 32: Choice then WTP, Losses then Gains, SmallLow then LargeHigh (Order 2)

33 – 48: Choice then WTP, Gains then Losses, LargeHigh then SmallLow (Order 3)

49 – 64: Choice then WTP, Losses then Gains, LargeHigh then SmallLow (Order 4)

65 – 72: WTP then Choice, Gains then Losses, SmallLow then LargeHigh (Order 1)

73 – 80: WTP then Choice, Losses then Gains, SmallLow then LargeHigh (Order 2)

81 – 88: WTP then Choice, Gains then Losses, LargeHigh then SmallLow (Order 3)

89 – 96: WTP then Choice, Losses then Gains, LargeHigh then SmallLow (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