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Diminishing Preference Reversals by Inducing Risk Preferences

Abstract

Since its first use, risk preferences induction using binary lotteries (Roth and Malouf, 1979) has been debated intensely. Selten, Sadrieh and Abbink (1999) argue that inducing risk neutral preferences at best has no effect and can even make behavior appear less rational. Among the evidence they cite is an increase in reversal rates in preference reversal experiments where risk neutral preferences are induced. In stark contrast, we show that inducing risk averse or risk loving preferences dramatically reduces reversal rates and inverts the typical pattern of reversals observed in previous research. Both results can be explained if inducing risk neutrality has little effect on mean behavior but increases response variance while inducing other preferences affects both mean behavior and variance. Thus, in the context of inducing preferences, our results extend those of Camerer and Hogarth (1999), who show that simple monetary incentives frequently affect mean behavior and variance differently.
Diminishing Preference Reversals by Inducing Risk Preferences

We study risk preference induction in a preference reversal task and generate results that prove interesting for both areas of study. Under some conditions, inducing risk preferences appears to have no effect of reversal rates (or increase them slightly), under others, such incentives mitigate reversals. The perspective on incentives provided by Camerer and Hogarth (1999) provides a useful framework for understanding these results. In fact, the work here suggests their results can be extended from simple monetary payoffs to the binary lottery payoffs used to induce risk preferences.¹

Camerer and Hogarth (1999) argue that complex relationships exist between incentives and behavior in economics experiments and that polar views on incentives (that incentives never have an effect or that incentives always promote more rational behavior) are too simplistic. They show that when one looks for incentive effects by measuring mean behavior, one frequently reaches a different conclusion than when one looks for incentive effects by measuring the variance in behavior. Why? Incentives can affect both, possibly in different manners and to different degrees.

One question Camerer and Hogarth (1999) do not address is the efficacy of the binary lottery form of incentives used for risk preference induction. However, one might suspect that similar complex relationships exist. Here, using risk preference induction in preference reversal experiments and comparing our results to previous work by Selten, Sadrieh and Abbink (1999), we show that this indeed must be the case.

¹ The binary lottery risk preference induction mechanism was introduced by Roth and Malouf (1979) and extended by Berg, Daley, Dickhaut and O'Brien (1986). As we will discuss later, the mechanism can be used to induce expected utility maximizing subjects to behave as if they have arbitrary “induced” utility functions that reflect particular risk preferences induced by the experimenter.
Induction may affect mean behavior and response variance, but not necessarily both. Thus, our results provide a first step in integrating the study of preference induction into the framework developed by Camerer and Hogarth.

In analyzing our results, we first use the same metrics as Selten, Sadrieh and Abbink and find that the proportion of subjects exhibiting predicted reversals is significantly reduced in our data. We next use the metric most frequently used to study preference reversals by psychologists and demonstrate that it is possible to reverse the most typical finding. Finally we show that the data in our experiments are consistent with the assumption that choices are driven by expected utility maximization where elicitation of preferences is subject to measurement error.

In the next section, we describe risk preference induction, preference reversals and their joint study. Then, we describe our experimental methods and procedures. We then present our results. We end with conclusions and discussion.

I. Risk Preference Induction and Preference Reversals

We start with the conclusions of Selten, Sadrieh and Abbink (1999) who study risk preference induction in settings where behavioral anomalies such as preference reversals are commonly observed. They conclude:

"Our studies seem to indicate that the subjects' attitudes towards binary lottery tickets are not fundamentally different from those towards money. Both kinds of stimuli seem to be processed in a similar way. This results in similar patterns of behavior. In as far as there is a difference, it goes in the opposite direction from what would be expected on the basis of vonNeumann-Morgenstern utility theory."
They draw this conclusion by demonstrating that, when they induce risk neutrality, they observe no change in traditional behavioral biases including “the reference point effect,” “the preference reversal effect,” and “violations of stochastic dominance.”

We will focus on the preference reversal effect here. A preference reversal arises when a subject’s choice between two gambles in a direct comparison differs from the preference ranking implied by the prices the same subject assigns to the same gambles in pricing tasks. One explanation for reversals is that subjects make errors in either the choice task, the pricing task or both. Presumably even small errors could produce reversals if subjects are nearly indifferent between the gambles. And, for a given propensity for error, the closer subjects are to indifference, the greater the reversal rate. Alternatively, psychologists (e.g., see Bostic, Herrnstein, and Luce, 1990, and Tversky, Slovic and Kahneman, 1990) have argued that reversals result from a tendency for the unit of assessment to influence the outcome of judgment tasks. In pricing tasks, subjects are instructed to convert gambles to a common unit, money, but in choice tasks, no such common unit is suggested.\(^2\)

One reason risk preference induction may decrease reversal rates is that it creates a clear preference for one gamble over the other, moving subjects away from indifference and, therefore, decreasing the probability that small errors will result in reversals. In theory, all subjects with the same induced preferences should prefer the same gamble in a pair and price them identically. Alternatively, risk preference induction could reduce reversals by providing a common measuring stick across tasks. Induction frames both the pricing decision and the choice decision similarly by

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\(^2\) Bostic, Herrnstein and Luce (1990) demonstrate that by making the pricing task more like a choice task (using the PEST procedure), they can reduce the number of observed reversals.
emphasizing the common consequence of the payoffs, the probability of winning a prize.

Induction could also increase reversals because it depends on the reduction of compound lotteries. Among others, Luce (2000, pp 46-47) argues that subject behavior does not conform to the compound lottery axiom. If so, or if subjects find the increased complexity of induction burdensome, the frequency of errors may rise. When subjects are nearly indifferent between gambles, this increase in error rate would result in increased reversals. We hypothesize that Selten, Sadrieh and Abbink (1999) induction technique results in near indifference between gambles and, because of increased errors, results in increased reversal rates.

To study our hypothesis, we do the following. First, we induce risk averse and risk loving preferences rather than risk neutral preferences. Inducing risk neutrality may produce no observable effects except an increase in noise because the subjects are already largely risk neutral. Inducing risk averse and risk loving preferences should shift the population’s mean risk preference in a predictable direction and produce observable effects beyond the increased noise. Second, we make the costs of erroneously reporting true preferences higher. After accounting for the effect of the induction lottery, Selten, Sadrieh and Abbink’s payoff levels are quite small. At the exchange rates quoted in their paper, the average preference reversal gamble pair differed in ultimate expected value (after accounting for the induction lottery) by about $0.07. In contrast, the average gamble pair in our experiments differs in ultimate expected value by $0.22 to $1.20 depending on the treatment. Thus, incorrect statements in the choice task cost roughly 3 to 17 times what they did in the Selten, Sadrieh and Abbink study. Similarly,
the costs of error in the pricing tasks differ significantly with our cost roughly 8 to 52 times higher.

A. Inducing Risk Preferences

In theory, inducing risk preferences (Berg, Daley, Dickhaut and O’Brien, 1986, and Roth and Malouf, 1979) lets experimenters test virtually any prediction that is derived from expected utility theory. The experimenter does not need to know each subject’s native utility function. Instead, the experimenter pays off subjects using an artificial commodity that is converted to the probability of winning a prize. If subjects make choices consistent with those of someone who maximizes expected utility and prefers more money to less, then this payoff scheme induces subjects to behave as if they have particular risk preferences. The type of preferences that are induced depends on how the artificial commodity is converted to probability. If the conversion is concave (convex, linear), then risk aversion (loving, neutrality) is induced in the artificial commodity.

Early studies on induction (e.g., Berg, Daley, Dickhaut and O’Brien, 1986, and Roth and Malouf, 1979) demonstrate reasonably successful performance of the technique in bargaining games, individual choices and value elicitation. In first price sealed bid auctions, the technique predicts well only if the bids predicted using risk induction are adjusted to capture subjects’ desires to win the auction (Rietz, 1993). At the same time the technique when applied to auction prices has more predictive power than at the individual level (Cox and Oaxaca, 1995). In a recent review article, Berg, Dickhaut and Rietz (2001) suggest that the performance of the technique is sensitive to the prior experience of subjects in the task as well as the magnitude of payoffs. As the
opportunity cost of error increases, the performance of the technique improves. This fact is fully studied in Prasnikar (2001), who demonstrates a strong relationship between level of monetary payoffs and performance of induction.

B. The Preference Reversal Task

Grether and Plott (1979) modified the original preference reversal task of Lichtenstein and Slovic (1971) to accommodate typical economic concerns about the nature of subject incentives, wealth effects, order effects and potential other confounds. The timeline for the typical subject in an experiment is:

- The subject chooses between pairs of gambles. (3 pairs)
- The subject states selling prices for each gamble. (12 gambles)
- The subject chooses between pairs of gambles. (3 pairs)

Thus, there are six pairs of gambles. First, three pairs are presented to the subject who must state which gamble in each pair is preferred. Indifference is admissible. Then, prices for each gamble in all six pairs are elicited. Finally, the last three pairs are presented to the subject. The gambles in each pair have approximately the same expected value as one another. One gamble, the “p-bet,” has a high probability of winning a low amount while the other, the “$-bet,” has a low probability of winning a large amount. Reversals, or inconsistencies in the ranking of gambles across these two types of measurement, are typically classified as “predicted” or “unpredicted” reversals. If, within a pair, a subject chooses the p-bet over the $-bet, but prices the $-bet higher, it is called a “predicted” reversal. If the $-bet is chosen over the p-bet while the p-bet is priced higher, it is called an “unpredicted” reversal. Lichtenstein and Slovic
(1971) first reported that predicted reversals significantly outnumber unpredicted reversals. Others confirmed this finding (e.g., Hamm, 1979; Lichtenstein and Slovic, 1971; and Schkade and Johnson, 1989). Economists added real dollar payoffs to the gambles and found that reversals still occurred in the same patterns and at approximately the same levels. (e.g., Grether and Plott, 1979; Reilly, 1982; Berg, Dickhaut and O'Brien, 1985). Numerous studies have sought an explanation of the phenomenon (e.g., Goldstein and Einhorn, 1987; Kahneman and Tversky, 1979; Karni and Safra, 1987; Loomes, Starmer and Sugden, 1989; Loomes and Sugden, 1983; and Segal, 1988). In addition to replicating and finding the preference reversal result, several authors have tried to eliminate it by instituting a market-like mechanism, such as arbitraging subjects (Berg, Dickhaut and O'Brien, 1985) or employing an auction structure (Cox and Grether, 1996). Such attempts have met with some success.

Selten, Sadrieh and Abbink (1999) and our study, unlike market based studies, are designed to examine whether preference reversal phenomena can be mitigated by attempting to reduce within and between subject variability by adopting the preference induction technique.

C. The Preference Reversal Task with Induced Preferences

In the traditional preference reversal task, subjects both choose between and price gambles that pay off in monetary units (e.g., dollars). In this study, preferences are induced. Hence, our subjects choose between and price gambles which payoff in probabilities of winning yet another binary lottery. The second lottery (the induction lottery) pays off in dollars. Induction lotteries can be designed so that all subjects should choose the same gamble in each pair during the choice task. Further, each
subject should place the same value on each gamble in the pricing task. Given some success in inducing preferences, we might expect to see reversals disappear or at least be mitigated when induction is employed in the preference reversal task. However, to induce preferences, complexity is increased in the experiment: a preference induction lottery is imbedded in each task. Given the historical concerns about performance of the compound lottery axiom (Lewis and Bell, 1985; and Moser, Birnberg and Do, 1994), the induction technique may not work at all and could even add noise to the apparently already noisy choices that occur in traditional preference reversal experiments.

II. Methods and Procedures

A. Task Description

In our study, like traditional preference reversal experiments, subjects make 18 decisions: 3 paired choice decisions, followed by 12 pricing decisions, followed by the 3 remaining paired choice decisions. Traditionally, one of the eighteen decisions is picked randomly and payoffs are determined by the outcome of that gamble or pair. Selten, Sadrieh and Abbink (1999) reward subjects after each decision in points that may lead to payoffs in an induction lottery that occurs after every other decision. We reward subjects in points that may lead to payoffs in an induction lottery that occurs after each decision.

The payoffs for gambles in our study are stated in units of an artificial commodity, points, which have no value outside the experiment. The gambles are generated so that the expectation in points is approximately the same for each member of a pair of gambles. These gambles are shown in Table I. Value is induced on points via a
transformation function (call this G) that converts points to the probability of winning the monetary prize. The transformation function is used to construct the “prize wheel” that subjects will use to determine whether they win the monetary prize. In this way, all subjects see the transformation function before they make any decisions. The induced certainty equivalents for each gamble are also shown in Table I.

The time line for a paired choice decision is as follows:

Subject chooses one of two gambles. ➔ Subject plays the selected gamble for points. ➔ Points converted via G to a lottery that pays $0 or monetary prize ➔ Subject plays lottery for monetary prize and receives payoff

Berg, Dickhaut, Daley and O'Brien (1986) have shown that, when this reward mechanism is used, a subject who is an expected utility maximizer will act as if he has a utility function specified by G for experimental points. The inducing technique is derived with no assumption about the wealth level of the subject playing the lottery. As long as outcomes from choices are independent, the inducing technique can be applied to each choice in a sequence.

In the paired choice task, the subject is predicted to choose the gamble that maximizes the probability of winning the monetary prize given the transformation function specified by the experimenter. If the transformation function converting points to the probability of winning the preferred prize is concave, then the subject will behave as if risk averse in experimental points. If the transformation function is convex, then the subject will behave as if risk loving in experimental points. Thus, the technique should induce a utility function, G, on experimental points.

A similar modification of the traditional preference reversal task is made in the pricing decision. A typical pricing decision is described in the following diagram.

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3 The set assumptions needed are actually a subset of those required for expected utility maximization. Only the monotonicity and compound lottery axioms are required.
Subject States a value, V, in points for gamble. → Random number, RN, drawn from [0,40]

If RN > V → Subject receives RN points → Points converted via G to a lottery that pays $0 or monetary prize → Subject plays lottery for monetary prize and receives payoff

If RN < V → Subject plays gamble for points → Points converted via G to a lottery that pays $0 or monetary prize → Subject plays lottery for monetary prize and receives payoff

As in the paired comparison, subjects are predicted to state a point value to maximize the probability of winning the monetary prize. In theory, this stated value is the certainty equivalent of the gamble under the utility function induced by G. Because we restrict subjects to state an integer value, subjects in our experiment are predicted to round prices to the highest integer less than the certainty equivalent of the gamble.

B. Risk Preferences Induced

Our design varied both the risk preferences induced and the amount of the monetary prize. Subjects were induced to be either risk averse with $G(w) = -e^{-0.11w}$ or risk loving with $G(w) = e^{0.11w}$ where w represents the number of points earned in the task. Within the risk averse group, prizes were either $1 (low incentives) or $2 (high incentives)

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4 The functions used to map points into the 360 degrees of the prize wheel were:
Risk Averse: Degrees = 364.4784 – 364.4784*e^{-0.11W}
Risk Loving: Degrees = -4.47478 + 4.47478*e^{0.11W}
incentives); within the risk loving group, prizes were either $3 (low incentives) or $6 (high incentives).\footnote{The monetary reward differed for the risk averse and risk loving groups so that the expected winnings in the two groups were equal. However, the variance in winnings is greater for the risk-loving group.}

Subjects in these experiments consisted of primarily sophomores and junior enrolled in business school classes at the University of Minnesota. The experiments were run in two groups. Forty-seven students were randomly assigned between the risk-averse/low-incentive group and the risk-loving/low-incentive group. Forty-six students were randomly assigned between the risk-averse/high-incentive group and the risk-loving/high-incentive group.

III. Predictions and Results

We find that inducing risk averse preferences reduces the preference reversal rate relative to Selten, Sadrieh and Abbink, 1999 and reduces rates relative to other studies from the economics and psychology literature. Inducing risk loving preferences reverses the most commonly found pattern of reversals.

A. Predictions

Since there are no wealth effects in experimental points associated with a reward structure that transforms points to lotteries, whenever the same transformation function is used in the paired choice task and the pricing task, choices in the paired choice and stated values in the pricing task should be consistent. That is, choices will reflect the induced preference ordering on points and stated values will reflect the same preference ordering through the certainty equivalent of the gamble in points. Therefore,
subjects who strictly conform to the monotonicity, transitivity and compound lottery axioms should exhibit no preference reversals.

B. Reversal Rates

First, for comparison, we present our reversal rates summarized across subject (as in Selten, Sadrieh and Abbink, 1999) and averaged across decisions (as in Lichtenstein and Slovic, 1971, and Grether and Plott, 1979).

1. Subject by Subject Data

Table II shows the comparison between the Selten, Sadrieh and Abbink (1999) data and our data when the subject is the unit of analysis. Selten, Sadrieh and Abbink classify subjects into one of 4 categories: (1) no reversals, (2) more predicted reversals than unpredicted, (3) more unpredicted reversals, (4) equal number of types of reversals. We present our data summarized in the same way. This results in two data sets under induced risk neutrality (the Selten, Sadrieh, and Abbink data), two under induced risk aversion and two under induced risk loving.

Several differences are striking between the sets of data. First, inducing risk aversion significantly increases the number of subjects who display no reversals at all (43% of subjects overall under risk aversion versus 13% under risk neutrality and 14% under risk loving preferences). Second, inducing either risk aversion or risk loving reduces the number of subjects who display more predicted reversals (state a preference for the p-bet, but price the $-bet higher) relative to inducing risk neutrality (36% overall under risk aversion and 16% under risk loving versus 75% under risk

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6 We have excluded observations with reported indifference across pairs in choices but reported different valuations in the pricing task because it is unclear whether these are predicted or unpredicted reversals according to Selten, Sadrieh and Abbink’s (1999) classification scheme.
neutrality). Third, inducing risk loving preferences significantly increases the number of subjects who display more unpredicted reversals (state a preference for $-bet, but price the p-bet higher) than risk neutrality or risk aversion (57% overall under risk loving versus 17% percent under risk neutrality and 7% under risk aversion). The $\chi^2$ tests in Panel B always show significant differences across induction treatments (risk neutral versus risk aversion versus risk loving) and show no significant differences across the type of information presented to subjects (Selten, Sadrieh and Abbink, 1999) or the level of incentives alone in our experiments. Thus, inducing different preferences has a decided effect on the patterns of choice. Most striking is the reversal of the normal pattern of reversals (from mostly predicted to mostly unpredicted) as one moves from inducing risk aversion to inducing risk loving preferences.

2. Grouped data

Traditionally, psychologists and economists (e.g., Lichtenstein and Slovic, 1971, and Grether and Plott, 1979) have reported overall average response rates. Specifically, using individual decisions for gamble pairs as the unit of measure, they present the percentages of non-reversals, predicted reversals and unpredicted reversals.

Table III, Panel A contrasts results from the Lichtenstein and Slovic (1971) experiment with incentives, the Grether and Plott (1979) experiments with incentives, Selten, Sadrieh and Abbink’s (1999) experiments and ours. Again, there are striking results. First, the overall reversal rate across the Lichtenstein and Slovic and Grether and Plott treatments remains remarkably constant (ranging from 32% to 37%) across differences in value elicitation methods. This rate is similar to our risk loving treatments
(30% and 36%). However, notice that the pattern of reversals is reversed with significantly more “unpredicted” reversals in our treatment. The Selten, Sadrieh and Abbink treatments result in slightly lower reversal rates (from 21% to 33%). Most of this is from a reduction in unpredicted reversals. Our risk averse treatments result in significantly lower reversal rates (16% and 16%).

Table III, Panel B presents $\chi^2$ tests for differences in reversal rates across all the treatments in these studies with incentives. The italicized cells show comparisons between treatments in a study. Within a study, these show no significant differences as a result of changing from no incentives to monetary incentives (Grether and Plott, Experiment 1), changing the means of eliciting values (Grether and Plott, Experiment 2), monetary incentives and induced risk neutrality (Selten, Sadrieh and Abbink monetary versus binary treatments) or information structure (Selten, Sadrieh and Abbink summary statistics versus none). In addition, Lichtenstein and Slovic’s results do not differ from any of the Grether and Plott treatments nor three of the four Selten, Sadrieh and Abbink treatments. Finally, in our data, there is no significant difference between high and low incentive levels. The only within study effect is the clear significance of changing from induced risk aversion to induced risk loving preferences in our data. The data show frequent differences across studies. Some of these differences are expected. For example, we expect other treatments to differ significantly from our induced risk aversion and induced risk loving preferences. However, some are unexpected. We cannot explain why Selten, Sadrieh and Abbink’s monetary treatments differ significantly from Grether and Plott’s monetary treatments while their induced risk preference treatments do not.
C. The Two Error Rate Model

Perfect performance of the induction technique in the preference reversal task would imply that there would be no reversals in the data. Table II shows this is not the case. One potential explanation is that individuals generally follow an expected utility model but the methods used to elicit choices and values have error. Lichtenstein and Slovic (1971) first introduced this “two error rate” formulation. However, the model failed to fit their data, leading them to conclude that the reversals they saw were systematic rather than random deviations from expected utility theory.

To develop the model, let “q” represent the percentage of subjects who prefer the p-bet according to their underlying preference ordering for gambles, “r” represent the error rate in the choice task and “s” represent the error rate in the pricing task. If we assume that errors in the choice task and the pricing task are random (that is, error rates do not differ across bets or subjects) and independent (that is, making an error in the choice task does not affect the probability of making an error in the pricing task), then the pattern of observations generated in a preference reversal experiment should conform to Figure 1, where a, b, c and d represent the percentage of observations that fall in each cell. The four cells represent all combinations of preferences indicated by the choice and the pricing tasks for a particular pair of gambles: (a) the proportion of comparisons where the p-bet was both chosen and priced higher than the $-bet, (b) the proportion where the p-bet was chosen but the $-bet was priced higher (c) the proportion where $-bet was preferred but the p- bet was priced higher and (d) the proportion where the $-bet was preferred and priced higher.
These proportions are also functions of q, r and s if behavior conforms to the two-error-rate model according to the functions given in Figure 1. Solving for q, r and s gives the following equations.

\[
q(1 - q) = \frac{ad - bc}{(a + d) - (b + c)} .
\]  
\[
r = \frac{(a + b - q)/(1 - 2q)}
\]  
and

\[
s = \frac{(a + c - q)/(1 - 2q)}
\]  
There are at most two sets of parameters that satisfy these equations. In one set, the estimated percentage of subjects that prefer the P-bet is consistent with risk aversion (that is, \(q > .5\)). The other set is consistent with risk loving (\(q < .5\)). In our analysis, we assume when we induce risk aversion (loving) q will be greater (less) than 0.5.

Table IV shows the overall reversal rates for each data set along with estimates or q, r and s. The Selten, Sadrieh and Abbink (1999) data differs a bit from the rest of the data because half of their p-bets have a significantly higher expected value than the $-bets and half have a significantly lower expected value. So, we would hypothesize q's close to 0.5 for this data. The estimates accord with this hypothesis. The estimate of q is 0.5 when \(q(1-q) = (ad-bc)/(a-b-c+d) = 0.25\). In Selten, Sadrieh and Abbink's binary

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7. We will be unable to calculate q whenever the denominator in equation (1) is zero. This occurs only when \(r = 1/2\) or \(s = 1/2\). Similarly, when \(q = 1/2\), the denominators in equation (2) and equation (3) are zero, so r and s cannot be calculated. As long as \(q \neq 1/2\), \(r \neq 1/2\), and \(s \neq 1/2\), then all three parameters can be calculated from a, b, c, and d.

8. These sets of parameters are related as follows. Let \(\{q_1, r_1, s_1\}\) represent the parameter set obtained when we choose the solution to equation (1) that is consistent with risk aversion (that is, \(q_1 > .5\)). Then the second set of parameters, \(\{q_2, r_2, s_2\}\), satisfies:

\[
q_2 = 1 - q_1
\]

\[
r_2 = 1 - r_1
\]

and

\[
s_2 = 1 - s_1 .
\]

If \(q = .5\), then there is no second solution to equation (1). In this case, we cannot estimate error rates since the denominators in equations (2) and (3) are zero.
treatment with feedback on statistics, \( q \) cannot be estimated because \( q(1-q) = 0.28 \). In their other treatments \( q \) is estimated to be 0.68, 0.69 and 0.50 exactly. In the rest of the data, the estimated model suggests subjects have a strong preference for one type of bet or another (all the estimates of \( q \) are near 0 or 1). If the induction technique worked perfectly, \( q \) should be 1 for risk averse preferences (in our data it is estimated at 0.99 and 0.99) and \( q \) should be 0 for risk loving preferences (in our data it is estimated at -0.10 and 0.07). The results on the error rates implied by the data are striking.\(^9\) In the data without induction or with risk neutrality induced, the needed choice task error rate (\( r \)), the pricing task error rate (\( s \)) or both need to exceed 50%. In stark contrast, when risk aversion or risk loving preferences are induced, both error rates are relatively small; the average of the error rates always fall below 27%.

IV. Conclusions

Preference Reversal tasks have traditionally been used to demonstrate the failure of expected utility theory. We show it is possible to alter the preference reversal phenomenon and produce observations that are consistent with the assumption that the observed behaviors of subjects maximize expected utility (with some error). This is accomplished by using the risk preference induction technique, which itself depends on expected utility maximization (or at least the ability to reduce compound lotteries).

Our results differ dramatically from those of Selten, Sadrieh and Abbink (1999). We induce different risk preferences (risk loving and risk averse preferences instead of risk neutral) and increase the cost of errors (by 2 to 50 times the level in the Selten,

\(^9\) As noted earlier, no real root exists for the Lichtenstein and Slovic experiment. In related work (Berg, Dickhaut and Rietz, 1998), we attribute this to the nature of incentives used in this experiment.
Sadrieh, and Abbink study). We observe fewer reversals in both our risk averse condition, a change in the pattern of reversals for subjects induced to be risk loving and, apparently, less noise in the choices made by and valuations given by subjects.

Thus, we reach an apparent paradoxical conclusion. Using the same (preference reversal) task it is possible to generate data that supports the notion of cognitive biases (e.g., Lichtenstein and Slovic, 1971; Grether and Plott, 1979; and Selten, Sadrieh and Abbink, 1999) and data consistent with expected utility maximization (our current study). Selten, Sadrieh and Abbink argue that changing the incentives by inducing risk neutrality should change the nature of the task and result in more rational behavior. However, they observe that it does little to change the reversal rate, possibly decreasing it slightly, but with higher implied error rates. In contrast, we find that reversal rates are decreased when we induce risk averse preferences and implied error rates fall with either risk averse or risk loving induced preferences.

Can these apparently conflicting results be explained? We believe that extending Camerer and Hogarth’s (1999) ideas to inducing preferences provides an explanation. Camerer and Hogarth differentiate the effects of incentives on mean behavior and on its variance. A similar distinction in the potential effects of induction helps here. The intended effect of induction is to create uniformly risk neutral, risk averse or risk loving preferences. Hopefully, this produces choices and data more consistent with these preferences. That is, induction can change mean behavior. A second effect is to increase the number of steps subjects must undertake to perform the task and, hence, to increase the task difficulty. With induction, subjects must reduce compound lotteries as well as make choices in the economic context under study. This
can add noise to responses. Selten, Sadrieh and Abbink (1999) argue that “background risk” (the increased variance of ultimate payoffs resulting from using a lottery) increases the number of violations. Again, the argument is that the lottery mechanism can add noise. In other words, induction can also change the response variance in the data.

If subjects are already approximately risk neutral, then the observable effects of inducing risk neutrality could all lie in the increase in response variance. In context, this should increase the noise rate. Hence, Selten, Sadrieh and Abbink (1999) observe no fundamental difference in mean behavior and, if anything, an increase in variance. However, if one induces risk aversion or risk loving preferences in subjects who are largely risk neutral, then one should observe a change in the typical responses (i.e., a change in mean behavior) that, in our data, appears to swamp any increase in variance.

Far from dismissing preference induction, as Selten, Sadrieh and Abbink (1999) would have us do, the evidence calls for much more research to fully understand the tradeoffs and expected effects of using risk preference induction in experiments. Further study on incentive levels, types of induced risk preferences and other variations of the risk preference technique will be useful in understanding the tradeoffs involved in using the technique.
References


Figures

Figure 1: Two Error Rate Model

<table>
<thead>
<tr>
<th>P-Bet Chosen</th>
<th>P-Bet Priced Higher</th>
<th>$-Bet Priced Higher</th>
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<td>$+(1-q)(1-r)(1-s)$</td>
</tr>
</tbody>
</table>

where:

$q =$ percentage of subjects whose underlying preference ordering ranks the P-Bet higher
$r =$ error rate in the paired-choice task
$s =$ error rate in the pricing task
### Table I: Pairs of Gambles Used in the Experiment

<table>
<thead>
<tr>
<th>Pairs</th>
<th>Type</th>
<th>Probability of Winning</th>
<th>Points if Win</th>
<th>Points If Lose</th>
<th>Expected Points</th>
<th>Risk Averse Certainty Equivalent</th>
<th>Risk Loving Certainty Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P</td>
<td>35/36</td>
<td>9</td>
<td>2</td>
<td>8.81</td>
<td>8.71</td>
<td>8.86</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>11/36</td>
<td>27</td>
<td>1</td>
<td>8.94</td>
<td>4.09</td>
<td>17.33</td>
</tr>
<tr>
<td>2</td>
<td>P</td>
<td>33/36</td>
<td>14</td>
<td>2</td>
<td>13.00</td>
<td>12.13</td>
<td>13.43</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>9/36</td>
<td>40</td>
<td>4</td>
<td>13.00</td>
<td>6.56</td>
<td>27.90</td>
</tr>
<tr>
<td>3</td>
<td>P</td>
<td>32/36</td>
<td>15</td>
<td>14</td>
<td>14.89</td>
<td>14.88</td>
<td>14.89</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>12/36</td>
<td>36</td>
<td>4</td>
<td>14.67</td>
<td>7.55</td>
<td>26.54</td>
</tr>
<tr>
<td>4</td>
<td>P</td>
<td>30/36</td>
<td>23</td>
<td>5</td>
<td>20.00</td>
<td>16.52</td>
<td>21.59</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>18/36</td>
<td>40</td>
<td>0</td>
<td>20.00</td>
<td>6.19</td>
<td>33.81</td>
</tr>
<tr>
<td>5</td>
<td>P</td>
<td>27/36</td>
<td>26</td>
<td>22</td>
<td>25.00</td>
<td>24.82</td>
<td>25.15</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>18/36</td>
<td>39</td>
<td>11</td>
<td>25.00</td>
<td>16.89</td>
<td>33.11</td>
</tr>
<tr>
<td>6</td>
<td>P</td>
<td>29/36</td>
<td>13</td>
<td>3</td>
<td>11.06</td>
<td>10.01</td>
<td>11.74</td>
</tr>
<tr>
<td></td>
<td>$</td>
<td>7/36</td>
<td>37</td>
<td>5</td>
<td>11.22</td>
<td>6.90</td>
<td>23.16</td>
</tr>
</tbody>
</table>
Table II: Reversal Occurrences by Subject Across Preference Induction Treatments

Panel A: Percent Of Subjects With No Reversals, More Predicted Than Unpredicted Reversals, More Unpredicted Than Predicted Reversal And Equal Numbers Of Types Of Reversals Across Treatments

<table>
<thead>
<tr>
<th>Number of subjects</th>
<th>Selten, Sadrieh Abbink's (1999) Risk Neutral Treatment</th>
<th>Our Risk Averse Treatment</th>
<th>Our Risk Loving Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Without summary statistics</td>
<td>With summary statistics</td>
<td>High Incentives</td>
</tr>
<tr>
<td>No reversals</td>
<td>4 (8%)</td>
<td>5 (21%)</td>
<td>10 (42%)</td>
</tr>
<tr>
<td>More predicted reversals</td>
<td>36 (75%)</td>
<td>16 (67%)</td>
<td>8 (33%)</td>
</tr>
<tr>
<td>More unpredicted reversals</td>
<td>3 (6%)</td>
<td>2 (8%)</td>
<td>4 (17%)</td>
</tr>
<tr>
<td>Equal numbers of reversals</td>
<td>5 (10%)</td>
<td>1 (4%)</td>
<td>2 (8%)</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>24</td>
<td>24**</td>
</tr>
</tbody>
</table>

Panel B: $\chi^2$ Tests for Significant Differences Across Treatments

<table>
<thead>
<tr>
<th>Selten, Sadrieh Abbink's (1999) Risk Neutral Treatment</th>
<th>Our Risk Averse Treatment</th>
<th>Our Risk Loving Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>With summary statistics</td>
<td>High Incentives</td>
<td>Low Incentives</td>
</tr>
<tr>
<td>Selten, Sadrieh Abbink's (1999) Risk Neutral Treatment</td>
<td>3.00</td>
<td>15.55*</td>
</tr>
<tr>
<td>With summary statistics</td>
<td>--</td>
<td>5.33</td>
</tr>
<tr>
<td>High Incentives</td>
<td>2.035</td>
<td>13.71*</td>
</tr>
<tr>
<td>Low Incentives</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

* Significant at the 95% level of confidence.

**Observations with indifference in choices but different dollar prices for pairs excluded.
### Table III, Panel A: Reversal Rates Across Risk Treatments

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Percentage of Choices</th>
<th></th>
<th></th>
<th></th>
<th>Total No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Reversal</td>
<td>Predicted Reversals</td>
<td>Unpredicted Reversals</td>
<td>Indifference</td>
<td>No.</td>
</tr>
<tr>
<td>Lichtenstein and Slovic (1971)</td>
<td>Exp. 3 (Incentives)</td>
<td>63%</td>
<td>32%</td>
<td>5%</td>
<td>NA</td>
</tr>
<tr>
<td></td>
<td>Exp. 1 (Incentives)</td>
<td>62%</td>
<td>25%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Grether and Plott (1979)</td>
<td>Exp. 2 (Selling Prices)</td>
<td>58%</td>
<td>23%</td>
<td>11%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Exp. 2 (Equivalents)</td>
<td>58%</td>
<td>27%</td>
<td>9%</td>
<td>6%</td>
</tr>
<tr>
<td>Selten, Sadrieh Abbink (1999) Monetary Incentives</td>
<td>Without Summary Statistics</td>
<td>76%</td>
<td>15%</td>
<td>6%</td>
<td>3%</td>
</tr>
<tr>
<td></td>
<td>With Summary Statistics</td>
<td>75%</td>
<td>19%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Selten, Sadrieh Abbink (1999) Binary Incentives</td>
<td>Without Summary Statistics</td>
<td>66%</td>
<td>21%</td>
<td>6%</td>
<td>7%</td>
</tr>
<tr>
<td></td>
<td>With Summary Statistics</td>
<td>66%</td>
<td>27%</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td>Our Risk Averse Treatment</td>
<td>High Incentives</td>
<td>83%</td>
<td>10%</td>
<td>6%</td>
<td>1%</td>
</tr>
<tr>
<td></td>
<td>Low Incentives</td>
<td>80%</td>
<td>11%</td>
<td>5%</td>
<td>4%</td>
</tr>
<tr>
<td>Our Risk Loving Treatment</td>
<td>High Incentives</td>
<td>61%</td>
<td>8%</td>
<td>22%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>Low Incentives</td>
<td>51%</td>
<td>9%</td>
<td>27%</td>
<td>13%</td>
</tr>
</tbody>
</table>
Table III, Panel B: $\chi^2$-Tests For Differences Between Data Sets

<table>
<thead>
<tr>
<th>Study</th>
<th>Data Set Description</th>
<th>Data Set Number</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lichtenstein And Slovic</td>
<td>Exp. 3 Incentives</td>
<td>1**</td>
<td>1.94</td>
<td>4.31</td>
<td>1.85</td>
<td>9.64*</td>
<td>4.31</td>
<td>2.69</td>
<td>0.607</td>
<td>17.65*</td>
<td>14.43*</td>
<td>25.69*</td>
<td>29.65*</td>
</tr>
<tr>
<td>(1971)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grether and Plott (1979)</td>
<td>Exp. 1 Incentives</td>
<td>2</td>
<td>--</td>
<td>3.82</td>
<td>0.77</td>
<td>10.42*</td>
<td>8.19*</td>
<td>1.91</td>
<td>3.42</td>
<td>20.79*</td>
<td>15.19*</td>
<td>28.20*</td>
<td>44.83*</td>
</tr>
<tr>
<td></td>
<td>Exp. 2 Selling Prices</td>
<td>3</td>
<td>--</td>
<td>--</td>
<td>2.03</td>
<td>16.48*</td>
<td>13.22*</td>
<td>4.08</td>
<td>8.57*</td>
<td>26.21*</td>
<td>19.59*</td>
<td>16.93*</td>
<td>25.13*</td>
</tr>
<tr>
<td></td>
<td>Exp. 2 Equivalents</td>
<td>4</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>14.81*</td>
<td>11.17*</td>
<td>3.08</td>
<td>4.93</td>
<td>25.75*</td>
<td>19.39*</td>
<td>25.59*</td>
<td>37.52*</td>
</tr>
<tr>
<td></td>
<td>Risk Neutral with Summary Statistics</td>
<td>6</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>7.53</td>
<td>3.05</td>
<td>5.28</td>
<td>6.32</td>
<td>23.23*</td>
<td>34.83*</td>
</tr>
<tr>
<td></td>
<td>Risk Neutral with Summary Statistics</td>
<td>7</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>5.22</td>
<td>15.41*</td>
<td>9.30*</td>
<td>24.02*</td>
<td>37.04*</td>
</tr>
<tr>
<td>Berg Dickhaut and Rietz</td>
<td>Risk Averse High Incentives</td>
<td>9</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>1.72</td>
<td>23.86*</td>
<td>42.08*</td>
</tr>
<tr>
<td></td>
<td>Risk Averse Low Incentives</td>
<td>10</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>20.87*</td>
<td>37.04*</td>
</tr>
<tr>
<td></td>
<td>Risk Loving High Incentives</td>
<td>11</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>3.13</td>
</tr>
<tr>
<td></td>
<td>Risk Seeing Low Incentives</td>
<td>12</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

*Significant at the 95% level of confidence.

**2 Degrees of freedom for comparisons to Lichtenstein and Slovic and 3 degrees of freedom for all other comparisons.
Table IV: Reversal Rates, Estimated Preference Rates and Estimated Error Rates from the Two-Error Rate Model*

<table>
<thead>
<tr>
<th>Study</th>
<th>Data Set Description</th>
<th>Reversal Rate*</th>
<th>Estimated q (Preference for p-bet)</th>
<th>Estimated r (Error rate in choice task)</th>
<th>Estimated s (Error rate in pricing task)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lichtenstein and Slovic (1971)</td>
<td>Exp. 3 Indeterminate Incentives</td>
<td>37%</td>
<td>No Real Root</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>Exp. 1 Incentives</td>
<td>35%</td>
<td>0.88</td>
<td>0.68</td>
<td>0.92</td>
<td></td>
</tr>
<tr>
<td>Exp. 2 Selling Prices</td>
<td>37%</td>
<td>0.84</td>
<td>0.68</td>
<td>0.87</td>
<td></td>
</tr>
<tr>
<td>Exp. 2 Equivalents</td>
<td>38%</td>
<td>0.90</td>
<td>0.65</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>Grether and Plott (1979)</td>
<td>Monetary with Summary Statistics</td>
<td>22%</td>
<td>0.68</td>
<td>0.77</td>
<td>1.03</td>
</tr>
<tr>
<td>Selten, Sadrieh and Abbink (1999)</td>
<td>Risk Neutral with Summary Statistics</td>
<td>25%</td>
<td>0.50</td>
<td>NA**</td>
<td>NA**</td>
</tr>
<tr>
<td>Risk Neutral</td>
<td>30%</td>
<td>0.69</td>
<td>0.67</td>
<td>1.10</td>
<td></td>
</tr>
<tr>
<td>Berg Dickhaut and Rietz</td>
<td>Risk Averse High Incentives</td>
<td>16%</td>
<td>0.99</td>
<td>0.08</td>
<td>0.11</td>
</tr>
<tr>
<td>Risk Averse Low Incentives</td>
<td>17%</td>
<td>0.99</td>
<td>0.06</td>
<td>0.12</td>
<td></td>
</tr>
<tr>
<td>Risk Loving High Incentives</td>
<td>33%</td>
<td>0.07</td>
<td>0.11</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Risk Seeing Low Incentives</td>
<td>41%</td>
<td>-0.10**</td>
<td>0.19</td>
<td>0.36</td>
<td></td>
</tr>
</tbody>
</table>

*For experiments in which subjects were permitted to respond "indifferent," percentage reversals is calculated using only non-indifference responses.

**Estimates for r and s are undefined when the estimated q is 0.50.

***Sampling error can produce negative estimated probability values outside of the valid zero to one range when the true q is close to the limits.
Appendix: Instructions

The experimenters are trying to determine how people make decisions. We have designed a simple choice experiment and we will ask you to make one decision in each of several items. After each decision (which results in your receiving points), you will have an opportunity of winning a $3.00 prize. This opportunity is influenced by the points you have received.

Each decision you make will involve one or more bets. Bets will be indicated by pie charts as shown below. If a bet is played, then one ball will be drawn from a bingo cage that contains 36 red balls numbered 1, 2,..., 36. Depending upon the nature of the bet, the number drawn will determine the number of points which you will receive. For example, if you play the following bet then you will win 30 points if the number drawn is less than or equal to 10, and you will win 5 points if the number drawn is greater than 10.

The experiment will be run as follows. You will be asked to make decisions for each of 18 items. Following each decision, you will have the opportunity of winning a $3.00 prize in a simple, two-step procedure. In Step 1, you will play a bet determined by your decision. Based on the outcome of this bet, you will be awarded points. In Step 2, you will play a second bet which is determined using the points which you were awarded in Step 1. This second bet will be determined in the following fashion. The points you have been awarded in Step 1 will define the “WIN” area on your prize wheel. You will spin the spinner on the wheel to determine whether you win $3.00 or win nothing. If the spinner stops in the area of the wheel less than or equal to your points from Step 1, you win the $3.00 prize. If the spinner stops on a number greater than your points, you win nothing. The experiment will continue until each of the 18 items has been completed.
Part 1:

In this part you will consider several pairs of bets. For each pair you must indicate which bet you prefer to play or indicate that you are indifferent between them. You will then have an opportunity of winning a $3.00 prize determined by the following 2-step procedure:

**Step 1:** The bet you indicate as preferred will be played and you will be awarded points based on its outcome. If you check "Indifferent" the bet you play will be determined by a coin toss.

**Step 2:** The points you receive in Step 1 will determine the “WIN” area on your prize wheel. You will spin the spinner to determine whether you win the $3.00 prize.

(The first three paired choice tasks follow.)

Part 2:

Instructions: In this part you will consider several bets. For each bet you must indicate the smallest number of points for which you would give up the opportunity to play the bet. As each item is completed, you will have an opportunity of winning a $3.00 prize determined by the following two-step procedure:

**Step 1:** A ball will be drawn from a bingo cage containing 41 green balls numbered 0,1,2,...40. If the number on this green ball is greater than or equal to the number you have specified you will receive points equal to the number on the ball. Otherwise you will play the bet and receive the points indicated by the outcome of the bet.

**Step 2:** The points you receive in Step 1 will determine the “WIN” area on your prize wheel. You will then spin the spinner to determine whether you win the $3.00 prize.

It is in your best interest to be accurate; that is, the best thing you can do is be honest. If the number of points you state is too high or too low, then you are passing up opportunities that you prefer. For example, suppose you would be willing to give up the bet for 20 points but instead you say that the lowest amount for which you would give it up is 30 points. If the ball drawn at random is between the two (for example 25) you would be forced to play the bet even though you would rather have given it up for 25 points.

On the other hand, suppose that you would give it up for 20 points but not for less, but instead you state your amount as 10 points. If the ball drawn at random is between the
two (for example 15) you would be forced to give up the bet for 15 points even though at
that amount you would prefer to play it.

**Practice Item 1:** Consider the bet shown below. What is the smallest number of points
for which you would give up the opportunity to play this bet? Remember that the points
you receive as a result of this decision will determine the “WIN” area on your prize
wheel for the $3.00 prize.

```
5 points
30 points
18
9
```

My amount is _____ points.

**Example 1:** Suppose the green ball drawn at random is 2.

**Step 1:**

**Question 1:** The number on the green ball is

a) greater than or equal to my indicated amount.
b) less than my indicated amount.

**Question 2:** Therefore, I would

a) receive points equal to the number on the ball and not play the bet.
b) play the bet and receive points according to its outcome.

So, at this point I would have (circle the correct words) the bet/_____ points.

**Question 3a:** Will you be playing the bet? _____ (yes/no) If your answer is no, skip
Question 3b and go to Step 2.
Question 3b: Suppose the red ball drawn to determine the outcome of the bet was 18. If I was actually playing this item, the amount of points I would have after playing the bet would be _____.

Step 2:

Question 1: This means that the “WIN” area of my prize wheel would cover the numbers 0 through _____.

Question 2: If the spinner stopped on the number 5, I would (circle the correct words) win/not win the $3.00 prize.

Question 3: If the spinner stopped on the number 40, I would (circle the correct words) win/not win the $3.00 prize.

If your answer to Step 1 Question 3a was "no," STOP here and wait until the experimenter tells you to go on to Example 2. Otherwise, continue to the next page.

{Page break.}

Step 1:

Question 3b: Now suppose the red ball drawn to determine the outcome of the bet was 10 instead of 18. If I was actually playing this item, the amount of points I would have after playing the bet would be _____.

Step 2:

Question 1: This means that the “WIN” area of my prize wheel would cover the numbers 0 through _____.

Question 2: If the spinner stopped on the number 5, I would (circle the correct words) win/not win the $3.00 prize.

Question 3: If the spinner stopped on the number 40, I would (circle the correct words) win/not win the $3.00 prize.

Stop here and wait for the experimenter to tell you to go on to Example 2.

{Page break.}

Example 2: Suppose the green ball drawn at random is 38.

Step 1:
Question 1: The number on the green ball is a) greater than or equal to my indicated amount.  
               b) less than my indicated amount.

Question 2: Therefore, I would a) receive points equal to the number on the ball and not play the bet.  
               b) play the bet and receive points according to its outcome.

So, at this point I would have (circle the correct words) the bet/points.

Question 3a: Will you be playing the bet? (yes/no) If your answer is no, skip Question 3b and go to Step 2.

Question 3b: Suppose the red ball drawn to determine the outcome of the bet was 18.  
If I was actually playing this item, the amount of points I would have after playing the bet would be _____.

Step 2:

Question 1: This means that the “WIN” area of my prize wheel would cover the numbers 0 through _____.

Question 2: If the spinner stopped on the number 5, I would (circle the correct words) win/not win the $3.00 prize.

Question 3: If the spinner stopped on the number 40, I would (circle the correct words) win/not win the $3.00 prize.

If your answer to Step 1 Question 3a was "no," STOP here and wait until the experimenter tells you to go on to the next practice item. Otherwise, continue to the next page.

{Page break.}

Step 1:

Question 3b: Now suppose the red ball drawn to determine the outcome of the bet was 10 instead of 18.  
If I was actually playing this item, the amount of points I would have after playing the bet would be _____.

Step 2:

Question 1: This means that the “WIN” area of my prize wheel would cover the numbers 0 through _____.
Question 2: If the spinner stopped on the number 5, I would (circle the correct words) win/not win the $3.00 prize.

Question 3: If the spinner stopped on the number 40, I would (circle the correct words) win/not win the $3.00 prize.

Stop here and wait for the experimenter to tell you to go on to the next practice item.

(Page break.)

Practice Item 2: Consider the bet shown below. What is the smallest number of points for which you would give up the opportunity to play this bet? Remember that the points you receive as a result of this decision will determine the “WIN” area on your prize wheel for the $3.00 prize.

My amount is ____ points.

The green ball drawn at random is ____.

The number on this green ball is a) greater or equal to my indicated amount.
   b) less than my indicated amount.

Therefore, I would a) receive points equal to the number on the ball and not play the bet.
   b) play the bet and receive points according to the outcome.
The red ball drawn to determine the outcome of the bet was ____.

If this were one of the actual decision items in this experiment, the amount of points I would have as a result of my decision would be ____ points.

This means that the “WIN” area of my prize wheel would cover the numbers 0 through ____.

My spinner stopped on the number ____.

Therefore I would have (circle the correct words) won/not won the $3.00 prize.

Practice Item 3: Consider the bet shown below. What is the smallest number of points for which you would give up the opportunity to play this bet? Remember that the points you receive as a result of this decision will determine the “WIN” area on your prize wheel for the $3.00 prize.

My amount is ____ points.

The green ball drawn at random is ____.

The number on this green ball is a) greater or equal to my indicated amount. b) less than my indicated amount.

Therefore, I would a) receive points equal to the number on the ball and not play the bet.
b) play the bet and receive points according to the outcome.

The red ball drawn to determine the outcome of the bet was _____.

If this were one of the actual decision items in this experiment, the amount of points I would have as a result of my decision would be ____ points.

This means that the “WIN” area of my prize wheel would cover the numbers 0 through _____.

My spinner stopped on the number _____.

Therefore I would have (circle the correct words) won/not won the $3.00 prize.

{The twelve pricing tasks follow.}

Part 3:

This part is exactly like Part 1. You will consider several pairs of bets, and for each pair you must indicate which bet you prefer to play or indicate that you are indifferent between them. You will then have an opportunity of winning a $3.00 prize determined by the following two-step procedure:

Step 1: The bet you indicate as preferred will be played and you will be awarded points based on its outcome. If you check “Indifferent” the bet you play will be determined by a coin toss.

Step 2: The points you receive in Step 1 will determine the boundary of the “WIN” area on your prize wheel. You will spin the spinner to determine whether you win the $3.00 prize.

{The other three paired choice tasks follow.}