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Measurement of Preferences and the Economic Importance of Preference Reversals

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Abstract

The empirical observation of preference reversals has been viewed as a fundamental challenge to economic theory, though exactly what the implications for economic theory are has not been investigated in depth. We argue in two ways that the implications for economics are not so serious as has been claimed. First, we present experimental evidence showing that the frequency of preference reversals decrease over time when subjects are given feedback concerning the monetary consequences to them of committing a reversal. This reduction in preference reversals is a result of convergence over time of two measures of preferences: the *choice rankings* and the *price rankings* of subjects for a set of six lotteries. Second, we argue that, even if there is some irreducible level of irrationality in the population (i.e., if some people consistently commit preference reversals), the partial equilibrium analysis of individual markets is not jeopardized. Specifically, there is no reason to believe that the essential elements of Marshallian demand analysis are affected. On the other hand, the welfare implications of general equilibrium analysis are jeopardized by the existence of preference reversals. One cannot claim that reactions of agents to a price change necessarily result in an efficient allocation, in the sense of Pareto.

This is a revised and extended version of a paper originally presented at the Economic Science Association Meeting, 20 October 1991, in Tucson, AZ.

1. Introduction

A preference reversal occurs when an individual prefers lottery B to lottery A, but states a higher selling price for lottery A than for lottery B. Past studies indicate that preference reversals are most likely to occur when lottery A is a high-payoff, low-probability lottery (called a "\$-Bet"), and lottery B is a low-payoff, high-probability lottery (called a "P-Bet"). We will refer to this as a Type 1 Preference Reversal. The case where A is preferred to B, and B is priced above A, will be referred to as a Type 2 Preference Reversal.

We expand upon previous studies of preference reversals by analyzing choice and price ranking behavior of subjects over a set of lotteries that were chosen so as to allow us to make inferences about the risk attitudes implied by choice and price ranking, as well as providing a check for violations of stochastic dominance. Specifically, we consider a *range* of \$-bets, with expected values varying above and below that of a single P-bet, and ask subjects to provide both a *choice ranking* of the lotteries, as well as a set of minimum selling prices for the lotteries. The point at which a subject's preferences shift from preferring the P-bet to preferring a \$-bet, as the expected value of the \$-bets is varied, provides us with a measure of risk attitude. Similarly, the rank order of assigned selling prices provides another ranking of the lotteries. Since our design makes use of \$-bets that fall into a natural dominance ordering, violations of stochastic dominance in both the choice and pricing task may be easily identified, as well.

In previous studies, most preference reversals for the sort of lotteries we consider (i.e., one positive and one zero prize) occurred when (a) the P-bet and \$-bet are close in expected value and (b) the expected value of the \$-bet was at least as great as the expected value of the P-bet. In the first experiment we conducted, the distribution of risk attitudes implied by the choice ranking task in our subject population has a mode in the region of risk aversion, and the distribution of risk attitudes implied by the price ranking task has a mode at risk neutrality (i.e., expected-value pricing). We believe that the use of expected values for prices is, to some degree, a special feature of our experiment, since the expected values of the lotteries we chose were particularly easy to calculate. Overall, our results are unique in the literature on preference reversals in that we have analyzed the *distribution* of choice and pricing behavior, and found them to be different.

Since the measured distributions of preferences implied by the choice and pricing tasks are different, two questions arise: Which distribution, if any, is the more accurate indicator of individuals' true preferences? Do these distributions ever converge (say, over time), or are they stable, implying some irreducible level of inconsistency in the two methods of eliciting preferences? The first question, we believe, is virtually impossible to answer: Scientifically,

we have little basis for claiming that one measured distribution is more correct than another. We address the second question by conducting a second experiment, in which subjects answer identical sets of lottery choice and pricing questions in two sessions separated by a week. Half of these subjects, as well, receive additional instructions in the second session, which explain to them, in essence, the consequences of committing a preference reversal (this group is referred to as the Treatment Group). The other half of the subjects (the Control Group) did not receive these additional instructions. We find that the distributions of preferences implied by the choice and pricing tasks converge for the treatment group, but not for the control group. More specifically, the distribution of preferences implied by the choice task changes, but the distribution implied by the pricing task does not change. We find that, as a result, the frequency of preference reversals drops for the treatment group. So the answer to the second question is, yes, at least sometimes. But the answer to the first question remains elusive. We consider the implications of the second question for market efficiency and welfare economics in the last part of the paper.

The rest of the paper is organized as follows. In Section 2 we outline the design of the experiment and its relationship to previous preference reversal experiments. In Section 3 we present the results of the first experiment, including analysis of stochastic dominance violations, the distributions of choice behavior and price ranking behavior, and the resulting distribution of preference reversals. The design and conduct of Experiment 2 is outlined in Section 4, and Section 5 contains results of the second experiment. Section 6 contains discussion and conclusions. An appendix contains a description of the conduct of the experiments, and a sample of the forms used in the experiment. Data will be provided to researchers for purposes of confirming our analysis on request.

2. Design and Conduct of Experiment 1

The relationship between the distribution of risk preferences and the distribution of price ranking behavior has not, as far as we know, been studied before in the context of preference reversals. The usual approach (e.g., Grether and Plott (1979), Reilly (1982), Goldstein and Einhorn (1987), Cox and Epstein (1989), Tversky, Slovic and Kahneman (1990)) has been simply to select a number of (\$-bet, P-bet) pairs, collect subjects' responses to choice and pricing questions, and then analyze the gross frequency of preference reversals of Type 1 and Type 2.

We designed our first experiment to allow us to make inferences beyond the frequency of preference reversals by using a set of six lotteries, all but one of which fall into a natural stochastic-dominance ordering. We asked the

subjects to *rank* the lotteries, rather than make pairwise choices, and then to state a minimum *selling price* for each of the lotteries (only the ordering of prices was important, as in Tversky, et al. (1990)). For both the choice ranking and the price ranking tasks, we are able to make inferences about subjects' rationality, independent of preference reversals, by observing violations of stochastic dominance.¹ For those subjects who do not violate stochastic dominance, we can then make inferences about the nature and causes of preference reversals.

The lotteries the subjects faced were designed as 3-outcome lotteries, so that they can be displayed on a Marshak-Machina probability triangle diagram. The lotteries, written in the form $L: \{p_h, M_h; p_m, M_m; p_l, M_l\}$, $p_h + p_m + p_l = 1$, $M_h > M_m > M_l$, are defined below, and displayed in Figure 1².

L1: {0,\$10;0.75,\$4;0.25,\$0} $EV[L1] = \$3$

L2: {0.5,\$10;0,\$4;0.5,\$0} $EV[L2] = \$5$

L3: {0.4,\$10;0,\$4;0.6,\$0} $EV[L3] = \$4$

L4: {0.3,\$10;0,\$4;0.7,\$0} $EV[L4] = \$3$

L5: {0.2,\$10;0,\$4;0.8,\$0} $EV[L5] = \$2$

L6: {0.1,\$10;0,\$4;0.9,\$0} $EV[L6] = \$1$

We use the symbol $>_c$ to represent preferences implied by the choice ranking of lotteries, and the symbol $>_p$ to represent preferences implied by the price ranking of lotteries. A subject obeying stochastic dominance should rank lotteries L2 through L6 as $L2 >_c L3 >_c L4 >_c L5 >_c L6$, and should price so that $L2 >_p L3 >_p L4 >_p L5 >_p L6$. But, there is no correct position, based on stochastic dominance, within these rankings for L1. Our purpose in using this design was to make obvious to the subjects that there was a natural dominance ranking for most of the lotteries, and that their real task was to place L1 in an appropriate position among the rest of the lotteries. We also felt that this design might make the price ranking task easier. That is, a subject should find it easier to state a higher minimum selling price for L2 than for L3, and so on, since it is so obvious that L2 is "a little bit better" than L3, etc. To check whether ranking lotteries by choice, in itself, made a difference, we used two treatments, one in which the choice ranking task was done first, and

¹Alternatively, one can interpret violations of stochastic dominance as reflecting the "seriousness" with which subjects approach the tasks, rather than lack of rationality. This point has been made by Lindman (1971).

²The probability of M_h and M_l are measured on the vertical and horizontal axis, respectively. See Machina (1987) for details.

the other in which the price ranking task was done first.

The first experiment was conducted in two trials, one at Rutgers University (RU), with undergraduate economics students as subjects, and one at the Indian Statistical Institute (ISI), with graduate students in economics, statistics and mathematics as subjects. In the Rutgers trial, there were four treatments. In Treatment 1, the subjects were asked to rank the lotteries first, and then price them. Treatment 2 was the reverse. Treatments 1 and 2 are further divided into treatments 1a, 1b, and 2a, 2b, as follows. The "a" treatments had the lottery $\{0, \$10; 0.75, \$4; 0.25, \$0\}$ given as L1, and the "b" treatments had it as L6. None of these treatments had any effect on either the distribution of choice ranking patterns or price ranking patterns in the RU trial, so we used only Treatment 1a in the trial at ISI.

3. Results of Experiment 1

Throughout the discussion of our results, we refer to the lotteries using the names in Figure 1. We first investigate violations of stochastic dominance in the choice ranking and price ranking tasks. The preference patterns implied by the choice ranking task, on the one hand, and by the price ranking task, on the other, are shown in Table 1 for the RU trial and the ISI trial. We did not give our subjects the opportunity to report indifference in the choice ranking task, so no risk neutral patterns, nor any other patterns with indifference, are observed. There was no restriction on stating equal prices for lottery 1 and one of the other lotteries, so such patterns are observable for the price ranking task. Especially significant is the "risk neutral" pattern (implied by setting $p_1=p_4$), and we present this pattern in a separate category. Other "equal price" patterns are subsumed within the various categories. For example, those patterns with $p_1=p_2$ are contained in pattern 1, those with $p_1=p_3$ are in pattern 2, etc.

As seen in Table 1, among the Rutgers undergraduate subjects, there were a few violations of dominance in the choice ranking task: 15 subjects out of 207, or 7%. There were no violations of dominance in choice ranking by the ISI students. The frequencies of the patterns implied by choice ranking decisions show that the Rutgers subjects were more risk averse than the ISI subjects, on average. The mode of this distribution is on the "risk averse" pattern for the RU group, and on the "somewhat risk averse" pattern for the ISI group.

For both groups of subjects, there were substantial violations of stochastic dominance in the price ranking task; that is, the prices set for the lotteries L2, L3, L4, L5, L6 did not satisfy $p_2 > p_3 > p_4 > p_5 > p_6$. The difference in the level of violations of dominance between Rutgers and ISI students is probably explained by their relative knowledge and

experience. The ISI graduate students (the majority of whom were statistics students) would be more facile with statistical concepts and would seem to be less likely to rank or price the lotteries in a manner inconsistent with stochastic dominance. What is important, however, is the relatively higher level of violations of dominance in the price ranking task for *both* groups. It appears that the price ranking task is inherently more difficult than the choice ranking task or, at any rate, the task of expressing one's preferences by way of stating selling prices is much less obvious than expressing one's preferences by way of directly stating preferences through ranking. One reason for this might be that people have less experience with pricing than with choosing (see Lindman (1971), for example). This seems to us to be *prima facie* evidence for taking rankings more seriously than prices as a reflection of preferences.

Finally, note the most important fact in Table 1, the difference in the distribution of preferences implied by the choice ranking task and the distribution of preferences implied by the price ranking task. This is especially marked for the RU group, since (ignoring those who violated stochastic dominance) the mode of the price ranking distribution is different from the choice ranking distribution (at the "risk neutral pattern", pattern 3.5, instead of pattern 2), and the tails of the distribution are skewed in the opposite directions. A Wilcoxon matched-pairs signed ranks test rejects the hypothesis that the choice ranking and price ranking tasks imply the same distribution of preferences for both the RU and the ISI groups.³

Preference Reversals

Type 1 preference reversals were most prevalent in our experiment between L1 and L4, and L1 and L3: approximately 65% and 50%, respectively. The L1 and L2, L1 and L5, and L1 and L6 comparisons, had many fewer Type 1 preference reversals: approximately 25%, on average. Type 2 preference reversals account for less than 5% of responses.

Table 2 shows the frequency of preference reversals for L1 versus each of the other lotteries. Four types of preference reversals have been defined: Type 1, as already noted, are the preference reversals usually found in the

³The test makes use of the ranks of the differences between the preference patterns implied by the ranking and pricing tasks for individuals. The data are the pattern numbers. Pricing patterns with $p_1 = p_i$, $i=2, 3, 4, 5, 6$ are assigned pattern numbers 1.5, 2.5, 3.5, 4.5 and 5.5, respectively. Thus, equal-price patterns are assumed to lie midway between the adjacent strict preference patterns. This way of coding the data eliminates potential bias arising from the fact that subjects could not state strict indifference in the ranking task.

experimental literature; P-bet chosen over \$-bet, but the price of the P-bet is less than the price of the \$-bet. Type 2 reversals are the obverse, and found much less frequently; \$-bet chosen over the P-bet, but the price of the \$-bet is less than the price of the P-bet. Type 3 and Type 4 reversals are special cases of Type 1 and Type 2, respectively, in which the prices of the two lotteries are equal. Since we did not allow subjects to express indifference in the choice ranking task, we have to consider the possibility that Type 3 and Type 4 reversals are really expressions of indifference; that is, if we had allowed subjects to express indifference in the choice ranking task so that the risk neutral pattern was possible, then all Type 3 and Type 4 reversals would be equal rankings and equal prices.⁴

An analysis of the data shows that it is unlikely that all Type 3 and Type 4 reversals really represent indifference. In the vast majority of cases, the lotteries involved in Type 3 reversals, for example, were not listed next to each other in the subject's ordinal ranking. Another lottery was "in between" them, though their prices were set equal. For example, only 68/192 (36%) of subjects obeying dominance in the Rutgers trial ranked L1 and L4 next to each other. For the ISI trial, 20/32 (63%) of subjects, all of whom obeyed stochastic dominance, ranked L1 and L4 next to each other. This places an upper bound on the number of subjects committing Type 3 or 4 reversals who are potentially indifferent between L1 and L4. Since, in fact, it is only on a set of zero probability that true indifference would occur, we treat the Type 3 and Type 4 reversals as true preference reversals.

Rutgers Trial:

In Table 2, we see that Type 1 reversals are most prevalent in the comparisons of responses for L1 vs. L3, and L1 vs. L4, whether or not dominance is violated in choice ranking or price ranking. In both comparisons, L1 is the P-bet, and its expected value is near but below that of L3, and equal to that of L4. Observation (ii), from the introduction, implies that we should find the most Type 1 reversals in the L1 vs. L4 comparison.

The L1 vs. L3 comparison shows Type 1 reversals to be 43% of the responses when dominance is not considered, and 46.62% of the responses when all violations of dominance are excluded. Type 3 reversals in this case are 4.83% and 3.38%, respectively. The L1 vs. L4 comparison shows Type 1 reversals to be 30.43% of total subject's responses when no screen for dominance is applied, and 29.95% when dominance violations are screened out. This is somewhat

⁴Goldstein and Einhorn (1987) also considered lotteries with one positive and one zero prize, but excluded all "ties" from analysis.

less than the comparable figures for the L1 vs. L3 comparison. But Type 3 reversals account for 35.27% of responses when dominance violations are not removed, and 42.57% when dominance violations are filtered out. Added together, Type 1 and Type 3 reversals account for 65.7% (dominance violations included) and 72.52% (dominance violations excluded.) of responses.

ISI Trial:

Though the frequency of preference reversals was lower in the ISI trial than the Rutgers trial, the same pattern of reversals was observed, with Type 1 reversals most frequent in the L1 vs. L3 comparison and the L1 vs. L4 comparison. The frequency of reversals fell as the expected values of the P-bet and \$-bet diverged.

In the L1 vs. L3 comparison, the frequency for Type 1 reversals was 21.88% (with dominance violations) and 22.22% (dominance violations excluded.) Type 3 reversals were 3.13% and 0%, respectively. The Type 1 violations in the L1 vs. L4 comparisons were 15.63% (with dominance violations) and 14.88% (dominance violations excluded.) These values are considerably lower than the corresponding values for the Rutgers trial. But the Type 3 reversals in the L1 vs. L4 comparison in the ISI trials, 34.38% (with dominance violations) and 37.04% (dominance violations excluded), are quite similar to the results found in the Rutgers trials.

4. Design and Conduct of Experiment 2

The second experiment was designed to test the hypothesis that subjects commit preference reversals because they do not fully understand the nature of the problem they are faced with. Specifically, we investigate the possibility that subjects do not realize that it is in their best interest to be certain that both the *choice decisions* and the *pricing decisions* that they make imply the same *preference ordering* of the lotteries they are faced with, and that this preference ordering is their true preference ordering. Thus, we suspect that individuals who commit preference reversals may simply not *understand* that there are some actions that will maximize expected utility and others that will not. This is to be differentiated from the alternative view that there may be *strategic misrepresentation* of preferences by subjects in the experiment.

Grether and Plott (1979) listed a number of potential explanations for preference reversal, and their experiment addressed each of these explanations in one way or another. They concluded that none of the explanations they listed

could account for the preference reversals they observed. The evidence leading to this conclusion was the simple fact that there were still "a lot" of preference reversals, even though the new design incorporated the potential explanations. Since these potential explanations were not built into the design *as treatment variables*, however, it is not clear (to us) that such a conclusion is warranted. We have chosen to focus on what Grether and Plott termed "Theory 10, Confusion and Misunderstanding," since we believe it is one of the more plausible candidates. Other candidates surely warrant further careful study as well.

In this second experiment, subjects responded to a set of lottery choice and pricing questions, as in the first experiment, and a randomly selected subset of subjects was then given the an opportunity to earn money based on their decisions and the outcome of lotteries. The experiment was conducted in 2 separate trials, 1 week apart. In the first trial, all subjects received the same instructions and questions to answer, and some of the subjects played out lotteries at the end of the session. In the second trial, the same set of subject were again given the same set of instructions and questions to answer, and at the end another randomly selected set of subjects played out lotteries. In the second trial, however, one-half of the subjects received, in addition to the standard set of instructions, an additional sheet, labeled "Additional Instructions," which explained in detail why it would be in their best interest to be sure that, essentially, their choice and price rankings matched. Otherwise, there was no difference between the first and second trial. Whether such additional instructions matter, then, comes down to an analysis of the difference, if any, between the two groups, in terms of the relationship between the choice-induced and the price-induced preference patterns.

The lotteries considered in Experiment 2 are a subset of those from Experiment 1. Of the lotteries displayed in Figure 1, only L1, L3 and L4:

L1: {0,\$10;0.75,\$4;0.25,\$0} $EV[L1] = \$3$

L3: {0.4,\$10;0,\$4;0.6,\$0} $EV[L3] = \$4$

L4: {0.3,\$10;0,\$4;0.7,\$0} $EV[L4] = \$3$

Unlike Experiment 1, in Experiment 2 subjects were given the opportunity to state indifference between lotteries in the choice ranking task. Otherwise, the conduct of the experiment was the same as that for Experiment 1.

5. Results of Experiment 2

Table 3 shows the distribution of preference patterns for the two trials of Experiment 2, with the Control and

Treatment Groups pooled. The sample is restricted to those subjects who were present at both the first and the second trial (held one week apart), and who did not violate stochastic dominance in either the choice ranking or the price ranking tasks. A total of 37 subjects participated in at least one of the trials. Application of the above rules reduced the sample size to 25. All analysis reported below concerns only these 25 subjects. Of the 25 subjects, 9 were in the control group and 16 were in the treatment group.

Table 4 shows results of Wilcoxon matched-pairs signed-ranks tests for differences in distributions. The top part of the table reports results of Wilcoxon tests of the null hypothesis that the choice ranking and price ranking tasks generate the same distribution of preferences patterns within each trial. In each trial, there is a significant difference in these distributions overall (combining the two groups). When the two groups are analyzed separately, this difference holds up for the control group, but for the treatment group the hypothesis cannot be rejected in Trial 2. We interpret this as indicating that the two distributions converged; i.e., the frequency of preference reversals was reduced in the group that received additional instructions in the second trial.

The bottom part of Table 4 reports results of tests of the null hypothesis that a given ranking task (choice or price) generates the same distribution in Trial 1 and Trial 2. Overall, one cannot reject this hypothesis for either ranking task. When the two groups are analyzed separately, there is some evidence that the distribution for the choice ranking task changed from Trial 1 to Trial 2 for the treatment group (rejection at the 17% level). We interpret this as indicating that the convergence found in the choice and price distributions is probably due to changes in choice ranking behavior, and not to changes in price ranking behavior.⁵

Table 5 shows the changes in Preference Reversal patterns between Trial 1 and Trial 2 for the two relevant lottery comparisons: L1 vs. L3 and L1 vs. L4. The preference reversal patterns, listed at the bottom of the table, are defined in the same way as for Experiment 1, except that patterns 3 and 4 now could arise from statements of indifference in the choice task combined with a statement of strict preference in the price ranking task. In fact, all occurrences of patterns 3 and 4 arise from the converse: strict preference in choice combined with indifference (i.e., equal prices) in pricing. As can be seen, there is only a small reduction, overall, in the frequency of preference reversals in the L1 vs. L3 comparison, but there is a substantial reduction in preference reversals in the L1 vs. L4 comparison.

⁵Lindman (1971) also found a reduction in preference reversals, but apparently from changes in pricing behavior, not choice behavior.

In fact, of the 9 subjects who committed a reversal in Trial 1 but did not commit a reversal in Trial 2 for the L1 vs. L4 comparison, 8 were in the treatment group. It appears that the additional instructions led many subjects in the treatment group to modify their behavior so as not to commit a preference reversal.

6. Discussion and Conclusions

The preference reversal phenomenon is of interest to economists for a simple reason. We assume that if an individual prefers A to B, he is willing to pay more for A than for B. The experimental discovery of preference reversals shows that this is not the case for all individuals in all situations. The existence of preference reversals undermines the conclusions drawn about economic welfare in various circumstances. As noted by Grether and Plott (1979, p. 624), "How are we to regard cost-benefit measures once we have accepted the fact that the sign of the benefit-minus-cost figure can be *reversed* by simply measuring preference in terms of "most preferred" options rather than in terms of a limit selling or purchase price?" But, it is not clear that the existence of preference reversals undermines the partial equilibrium analysis often used to study market processes.

Consider the market demand curve for Lottery A. It represents the quantity of Lottery A a group of buyers are willing and able to buy at a set of prices of Lottery A, over a specified time span, other things the same. The demand curve slopes down because, it is assumed, as the price declines, buyers in the market are willing and able to purchase more units of the good, and new buyers decide to enter the market. For a market in lotteries, this basic relationship is not threatened by the PR phenomenon. We still expect that a falling price for Lottery A, everything else the same, will lead to a larger quantity demanded.

The preference reversal phenomenon does have implications for welfare economics and cross-demand effects; if the price of Lottery B changes, what will happen to the demand curve of Lottery A? Suppose that all of the buyers of Lottery B participated in a PR experiment, and that 40% of them committed a preference reversal, in that they chose B over A but priced A above B. How will they react when the price of B changes in the market, everything else the same? Are they better-off if they follow their choices, or their price statements?

Without having an answer to this question, we really have no reason to say that a price decline has led to an increase in *the welfare of an individual who commits a preference reversal*. Since not all subjects commit reversals, we may still claim the welfare of consumers in a market does increase as price falls, but some effort must be expended to justify this

claim.

Typically, researchers assume that the *choices* individuals make in a PR experiment are expressions of their preferences, the primitive concept, and the pricing task is the derivative concept. But, we have little evidence of this. From our experiment, all we know is that individuals have given two rankings for the same set of lotteries, and these two rankings are not compatible for a significant proportion of the subjects. We have little evidence that either one of the two stated rankings is the "correct" expression of an individual's preference. We do have some evidence that the choice ranking task was less difficult for our subjects than the pricing task, since fewer dominance violations were recorded in the choice ranking task than the pricing task.

One way to determine which ranking is the "correct" one, the one that more accurately reflects the individuals preferences, is to repeat the experiment with the same subjects and lotteries, giving feedback and instructions about the previous results to reduce confusion and misunderstanding. For example, if the pricing ranking is altered in repeated trials to be compatible with the unchanged choice ranking, then it seems likely that the choice ranking more accurately reflects preferences than the price ranking.

If the rankings do not converge in any way, then one could argue that choice or rankings in an ordinal fashion and pricing are simply different and cannot be made compatible for some individuals. This latter results would support the approach of some psychologists, such as the expression theory of Goldstein and Einhorn (1987). These theories imply that, for some individuals, their economic activities simply have no clear relationship to their economic welfare; that is, there is some irreducible amount of inconsistency in human behavior.

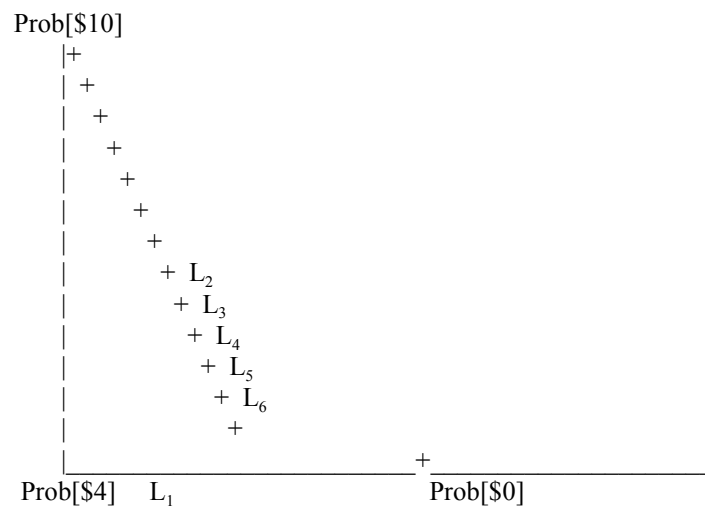
The results of our second experiment show that there is a tendency for choice rankings and price rankings to approach each other, and for preference reversals to be reduced. We found that subjects who were given feedback about their earlier choice and price rankings changed their choice rankings to conform more closely to their price rankings. Our conjecture is that, in general, preference reversals will be reduced through experience; that is, subjects will report fewer and fewer preference reversals as they eliminate confusion about the process in which they are engaged. In a market for insurance, for example, we expect that individuals will act more consistently as they become more familiar with the product and with the process of choosing and pricing the product. [E.g., see Lindman (1971, p. 396)] Thus, at any given time in any given market, some consumers will be "unsophisticated" and will behave differently than more experienced or "sophisticated" traders. This does not imply that markets will not operate effectively. It does imply that

some traders may take advantage of less sophisticated traders and lead them to a lower level of welfare than they would have reached had they been more experienced. Instead of "asymmetric information" in markets, we have "asymmetric market skills."⁶

We assume that demand data represents preferences as the appropriate welfare concept for many economic decisions. A smoker, for example, may wish he or she did not have a taste for cigarettes, and may even purchase goods and services to help himself or herself "kick the habit". But, no matter how contradictory the smoker's inner motivations, once he or she acts to purchase a pack of cigarettes, he or she has expressed an "effectual demand" [as noted by A. Smith (1985, p.57)] in that market, and the psychological motivations that lie behind that expression are not relevant for the operation of the market. But, the "optimum" a market equilibrium may reach in such a case is a limited one.

Finally, we note three other results of our experiments. First, reversals were much more frequent between the lotteries that were close in expected value. For example, preference reversals occurred about three times as often in the (L1,L3) and (L1,L4) comparisons than in the (L1,L2), (L1,L5) and (L1,L6) comparisons in Experiment 1. Second, many subjects (over 30% in Experiment 1) set prices according to the expected value of the lotteries. This may not be unusual for simple one-positive-outcome lotteries like the ones we used. Third, the more "statistically sophisticated" subjects, the ISI students, committed half as many dominance violations in choice or pricing, and had fewer preference reversals than the Rutgers students. We suggest the reason for this is that the ISI students experienced less "confusion and misunderstanding" than the Rutgers students.

⁶See, e.g., Halmi and Waldman (1985) for an investigation of the dynamics of markets and other decision processes when some agents are "naive" and others are "sophisticated".

Figure 1

L1: {0,\$10;0.75,\$4;0.25,\$0} EV[L1] = \$3
L2: {0.5,\$10;0,\$4;0.5,\$0} EV[L2] = \$5
L3: {0.4,\$10;0,\$4;0.6,\$0} EV[L3] = \$4
L4: {0.3,\$10;0,\$4;0.7,\$0} EV[L4] = \$3
L5: {0.2,\$10;0,\$4;0.8,\$0} EV[L5] = \$2
L6: {0.1,\$10;0,\$4;0.9,\$0} EV[L6] = \$1

Table 1
Preference Patterns implied by Choice Ranking

<u>Pattern</u>	<u>Risk Attitude</u>	<u>Rutgers Trial</u>	<u>ISI Trial</u>
0. Violated stoch. dom.		15	0
	(7%)	(0%)	
1. $L1 >_c L2 >_c L3 >_c L4 >_c L5 >_c L6$		38	5
(Highly risk averse)		(18%)	(16%)
2. $L2 >_c L1 >_c L3 >_c L4 >_c L5 >_c L6$		72	6
(Risk averse)		(35%)	(19%)
3. $L2 >_c L3 >_c L1 >_c L4 >_c L5 >_c L6$		52	14
(Somewhat risk averse)		(25%)	(44%)
4. $L2 >_c L3 >_c L4 >_c L1 >_c L5 >_c L6$		16	6
(Somewhat risk seeking)		(8%)	(19%)
5. $L2 >_c L3 >_c L4 >_c L5 >_c L1 >_c L6$		2	0
(Risk seeking)		(1%)	(0%)
6. $L2 >_c L3 >_c L4 >_c L5 >_c L6 >_c L1$		12	1
(Highly risk seeking)		(6%)	(3%)
TOTAL		207	32

Preferences Patterns Implied by Price ranking

<u>Pattern</u>	<u>Risk Attitude</u>	<u>Rutgers Trial</u>	<u>ISI Trial</u>
0. Violated stoch. dom.		55	5
	(27%)	(16%)	
1. $L1 >_p L2 >_p L3 >_p L4 >_p L5 >_p L6$		9	1
(Highly risk averse)		(4%)	(3%)
2. $L2 >_p L1 >_p L3 >_p L4 >_p L5 >_p L6$		8	2
(Risk averse)		(4%)	(6%)
3. $L2 >_p L3 >_p L1 >_p L4 >_p L5 >_p L6$		4	5
(Somewhat risk averse)		(2%)	(16%)
** $L2 >_p L3 >_p L1 =_p L4 >_p L5 >_p L6$		72	13
(Risk neutral)		(35%)	(41%)
4. $L2 >_p L3 >_p L4 >_p L1 >_p L5 >_p L6$		28	2
(Somewhat risk seeking)		(14%)	(6%)
5. $L2 >_p L3 >_p L4 >_p L5 >_p L1 >_p L6$		18	3
(Risk seeking)		(9%)	(9%)
6. $L2 >_p L3 >_p L4 >_p L5 >_p L6 >_p L1$		13	1
(Highly risk seeking)		(6%)	(3%)
TOTAL		207	32

Wilcoxon matched-pairs signed ranks test*

Wilcoxon Statistic	Probability (2-tailed)
RU Group: -8.52	.00
ISI Group: -3.05	.00

* Tests the null hypothesis that the choice ranking and price ranking tasks generate the same distribution of preferences patterns. Pattern 0 excluded.

Table 2
Preference Reversals
(% of Subjects)

Rutgers Undergraduate Students

	All Subjects					Only those Subjects				
	(N=207)					Consistent with Dominance				
	Type of PR*					Type of PR*				
Lottery Pair	None	1	2	3	4	None	1	2	3	4
L1 v. L2	78.26	16.43	1.93	0.97	2.42	82.43	14.19	1.35	1.35	0.68
L1 v. L3	47.83	43.00	0.48	4.83	3.86	47.97	46.62	0.68	3.38	1.35
L1 v. L4	27.05	30.43	1.45	35.27	5.80	20.95	29.73	1.35	42.57	5.41
L1 v. L5	64.25	19.32	0.97	12.56	2.90	71.62	15.54	1.35	10.14	1.35
L1 v. L6	75.85	10.14	1.93	9.18	2.90	84.46	5.41	2.70	6.76	0.68

ISI Graduate Students

	All Subjects					Only those Subjects				
	(N=32)					Consistent with Dominance				
	Type of PR*					Type of PR*				
Lottery Pair	0	1	2	3	4	0	1	2	3	4
L1 v. L2	81.25	12.50	3.13	3.13	0.00	85.19	11.11	3.70	0.00	0.00
L1 v. L3	71.88	21.88	3.13	3.13	0.00	77.78	22.22	0.00	0.00	0.00
L1 v. L4	37.50	15.63	3.13	34.38	9.38	37.04	14.81	0.00	37.04	11.11
L1 v. L5	81.25	15.63	0.00	3.13	0.00	85.19	14.81	0.00	0.00	0.00
L1 v. L6	84.38	6.25	0.00	9.38	0.00	88.89	3.70	0.00	0.00	7.41

* Reversal Patterns are defined as follows (for L1 vs. X)

Pattern Observation

0 No reversal

1 $L1 >_c X$ and $X >_p L1$

2 $X >_c L1$ and $L1 >_p X$

3 $L1 >_c X$ and $X =_p L1$

4 $X >_c L1$ and $L1 =_p X$

Note: $>_c$ refers to preference in the choice ranking task, $>_p$ refers to preference in the price ranking task.

Table 3
Preference Patterns implied by Choice Ranking

<u>Pattern</u>	<u>Risk Attitude</u>	<u>Trial 1</u>	<u>Trial 2</u>
1.	$L1 >_c L2 >_c L3$ (Risk averse)	7 (28%)	7 (28%)
1.5	$L1 =_c L2 >_c L3$ (Less risk averse)	0 (0%)	0 (0%)
2.	$L2 >_c L1 >_c L3$ (Slightly risk averse)	12 (48%)	9 (36%)
2.5	$L2 >_c L1 =_c L3$ (Risk neutral)	3 (9%)	2 (6%)
3.	$L2 >_c L3 >_c L1$ (Risk seeking)	3 (13%)	7 (28%)
TOTAL		25	25

Preferences Patterns Implied by Price Ranking

<u>Pattern</u>	<u>Risk Attitude</u>	<u>Trial 1</u>	<u>Trial 2</u>
1.	$L1 >_p L2 >_p L3$ (Risk averse)	3 (12%)	3 (12%)
1.5	$L1 =_p L2 >_p L3$ (Less risk averse)	1 (4%)	2 (8%)
2.	$L2 >_p L1 >_p L3$ (Slightly risk averse)	0 (0%)	4 (16%)
2.5	$L2 >_p L1 =_p L3$ (Risk neutral)	8 (32%)	5 (20%)
3.	$L2 >_p L3 >_p L1$ (Risk seeking)	13 (52%)	11 (44%)
TOTAL		25	25

Table 4: Statistical Tests**Tests for Differences in Choice and Pricing Distributions***

	Trial 1		Trial 2	
	<u>z-Stat.</u>	<u>Prob.</u>	<u>z-Stat.</u>	<u>Prob.</u>
Overall:	-2.87	.00	-1.95	.05

Control Group: -1.90 .06 -1.78 .08

Treatment Group: -2.17 .03 -0.96 .34

* Wilcoxon matched-pairs signed ranks test of the null hypothesis that the choice ranking and price ranking tasks generate the same distribution of preferences patterns within each trial.

Tests for Changes in Choice and Pricing Distributions over Time**

	Choice		Pricing	
	<u>z-Stat.</u>	<u>Prob.</u>	<u>z-Stat.</u>	<u>Prob.</u>
Overall:	-1.13	.26	1.05	.29

Control Group: 0.00 1.00 0.53 .59

Treatment Group: -1.37 .17 0.85 .39

** Wilcoxon matched-pairs signed ranks tests of the null hypothesis that the choice ranking in each trial or the price ranking task in each trial generate the same distribution of preferences patterns.

Table 5: Changes in Preference Reversal Patterns over Time***Reversal Patterns for L1 vs. L3**

		Trial 2 Patterns							
		0	1	2	3	4	Total	%	
-----+-----+-----									
		0	14	1	0	0	1	16	64.00
Trial	1	2	3	0	1	0	0	6	24.00
1	2	1	0	1	0	0	0	2	8.00
Patterns	3	0	0	0	0	0	0	0	0.00
	4	1	0	0	0	0	1	4.00	Distributon
-----+-----+-----									
		Total	18	4	1	1	1	25	
		%	72.00	16.00	4.00	4.00	4.00	4.00	
Trial 2 Distribution									

Reversal Patterns for L1 vs. L4

		Trial 2 Patterns							
		0	1	2	3	4	Total	%	
-----+-----+-----									
		0	6	2	0	0	0	8	32.00
Trial	1	6	3	1	0	0	0	10	40.00
1	2	1	0	0	0	0	0	1	4.00
Patterns	3	2	0	0	4	0	6	24.00	Distribution
	4	0	0	0	0	0	0	0.00	
-----+-----+-----									
		Total	15	5	1	4	0	25	
		%	60.00	20.00	4.00	16.00	0.00	0.00	
Trial 2 Distribution									

* Reversal Patterns are defined as follows (for L1 vs. X)

Pattern Observation

0 No reversal

1 $L1 >_c X$ and $X >_p L1$

2 $X >_c L1$ and $L1 >_p X$

3 $L1 = >_c X$ and $X = >_p L1$ (with strict preference in one case,

4 $X = >_c L1$ and $L1 = >_p X$ and strict indifference in the other)

Note: $>_c$ refers to preference in the choice ranking task, $>_p$ refers to preference in the price ranking task.

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Appendix: Conduct, Instructions and Forms

Conduct of Experiment 1

At Rutgers, the forms were distributed in an introductory economics class for sophomore engineering students. The students were given approximately 1/2 hour to answer the questions, and then the forms were collected. The collected forms were shuffled, and then a student volunteer drew 40 forms, roughly 20% of the total, from the pile. The students whose names were on these forms were the ones who played out randomly selected lotteries.

The selected subjects were called to the front of the lecture hall in pairs. When a pair reached the front of the room, each of them rolled a die to randomly pick a pair of lotteries. The experimenter picked one of the subjects to play the lottery in the selected pair that he or she had ranked higher, and picked the other to play the lottery he or she had priced higher. The lotteries were played by allowing each subject to choose a numbered poker chip from a bowl of chips numbered 1 to 100. If the lottery to be played was $\{\$4, 0.75; 0, 0.25\}$, then a drawn chip numbered between 1 and 75 was a winner. If the subject won the lottery, he or she was paid cash immediately after filling out a receipt. Then, the process was repeated with the rest of the 40 randomly selected subjects.

At ISI, All subjects played out one lottery. Each subject rolled a pair of dice to randomly select two lotteries. Half of the subjects played the one in the pair they ranked higher, half played the one they priced higher. The chosen lottery was played by drawing a numbered chip from a box. The prizes in the ISI experiment were 100 rupees instead of \$10, and 40 rupees instead of \$4. The exchange rate at the time of the experiment was approximately 21 rupees for 1 dollar. In terms of purchasing power, though, the prizes at ISI were probably higher⁷

⁷For example, at the time of the experiment, the price of a good seat at the movie theater was about 8 Rupees, the price of a liter bottle of beer in a restaurant was about 35 Rupees (20 Rupees in a liquor store), and the price of deluxe meal at a 5-star hotel in New Delhi was about 100 Rupees.

Instructions for Experiment 1

You are about to participate in an experiment in the economics of decision-making. The purpose of the experiment is to gain a better understanding of how people make decisions in situations involving uncertainty. At the end of the experiment, approximately 10% of you will be randomly selected and given the opportunity to earn money by participating in a lottery drawing. Please read the following instructions and answer all of the questions.

The experiment consists of a number of questions concerning the following six *lotteries*, each of which provides some *chance* of winning a monetary prize.

))))))))))))), +))))))))))))), +))))))))))))),
 * **Lottery A:** * * **Lottery B:** * * **Lottery C:** *
 * * * * *
 *A 75/100 chance * *A 50/100 chance * *A 40/100 chance *
 *to win \$4.00. * *to win \$10.00. * *to win \$10.00. *
 .))))))))))))- .))))))))))))- .))))))))))))-
 +))))))))))))), +))))))))))))), +))))))))))))),
 * **Lottery D:** * * **Lottery E:** * * **Lottery F:** *
 * * * * *
 *A 30/100 chance * *A 20/100 chance * *A 10/100 chance *
 *to win \$10.00. * *to win \$10.00. * *to win \$10.00. *
 .))))))))))))- .))))))))))))- .))))))))))))-

For each lottery, the chance of winning the prize is stated as a ratio, or relative frequency. For example, one of the lotteries consists of a 75/100 chance to win \$4.00. In a single play of the lottery, you would, of course, either win the \$4.00 or win \$0, but if you played the lottery many times you could expect to win the \$4.00 prize about three-fourths of the time. For example, you could expect to win about 75 times if you played the lottery 100 different times. The stated chances of winning the other lotteries can, similarly, be interpreted as the relative frequency with which you could expect to win the stated prize over many plays of the lottery.

At the front of the room we have a box containing 100 poker chips, numbered from 1 to 100. The lottery discussed in the last paragraph could be conducted in the following manner: A single chip is to be drawn from the box. If the number on the chip is *any number from 1 to 75*, then the player wins \$4. If the number on the chip is *any number from 76 to 100*, then the player wins \$0. Similarly, the other 5 lotteries could be conducted by appropriately defining which numbered chips are "winners," and which numbered chips are "losers."

Questions

Please consider the following two questions.

1. If you were given the opportunity to play one of the six lotteries, in the manner described above, free of charge, which lottery would you choose to play? More generally, in what order would you place the six lotteries, from the one you would most prefer to play, to the one you would least prefer to play? Please examine the six lotteries carefully before making your decision. Indicate on the Decision Sheet on the next page the way in which you would order the lotteries by placing a "1" in the first column (labelled "Order") beside the lottery that you would most like to play, a "2" beside the lottery that is the second best to you, and so on, finally placing a "6" beside the lottery that you would least like to play.

In order to give you an incentive to consider your choices carefully, several of you will be given the opportunity to play a lottery at the end of the experiment. For each person who is randomly selected, two of the six lotteries will be randomly selected. Of these two, the one that you ranked higher will be the lottery that you will play. Approximately 10% of you will be given this opportunity.

2. Imagine that you have a ticket giving you the right to play Lottery A. What is the *lowest price* at which you would be willing to *sell* this ticket to another person, thus giving up your right to play the lottery? Imagine now that you have a ticket for Lottery B. What is the lowest price at which you would be willing to sell this ticket? Imagine the same situation, in turn, for each of the other lotteries, and try to determine the lowest price at which you would still be willing to sell each of these tickets. Indicate these minimum selling prices of tickets to each lottery on the Decision Sheet on the next page by writing the appropriate price in the second column (labelled "Price") beside each of the lotteries.

In order to give you an incentive to consider your choices carefully, several of you will be given the opportunity to play a lottery at the end of the experiment. For each person who is randomly selected, two of the six lotteries will be randomly selected. Of these two, the one that you placed the higher minimum selling price on will be the lottery that you will play. Approximately 10% of you will be given this opportunity.

Name: _____ (this will be used in the random selection of people to play lotteries at the end of the experiment.)

Decision Sheet

1. Indicate the way in which you would order the lotteries by placing a "1" in the first column (labelled "Order") beside the lottery that you would most like to play, a "2" beside the lottery that is the second best to you, and so on, finally placing a "6" beside the lottery that you would least like to play.

2. Indicate your minimum selling price for a ticket to each of the lotteries by writing the appropriate price in the second column (labelled "Price") beside each of the lotteries.

The lotteries are listed here again for easy reference.

+)))))))))))))) , +)))))))))))))) , +)))))))))))))) ,
 * **Lottery A:** * * **Lottery B:** * * **Lottery C:** *
 * * * * *
 * A 75/100 chance * * A 50/100 chance * * A 40/100 chance *
 * to win \$4.00. * * to win \$10.00. * * to win \$10.00. *
 .))))))))))))))- .))))))))))))))- .))))))))))))))-
 +)))))))))))))) , +)))))))))))))) , +)))))))))))))) ,
 * **Lottery D:** * * **Lottery E:** * * **Lottery F:** *
 * * * * *
 * A 30/100 chance * * A 20/100 chance * * A 10/100 chance *
 * to win \$10.00. * * to win \$10.00. * * to win \$10.00. *
 .))))))))))))))- .))))))))))))))- .))))))))))))))-

Order	Price
Lottery A: _____	_____
Lottery B: _____	_____
Lottery C: _____	_____
Lottery D: _____	_____
Lottery E: _____	_____
Lottery F: _____	_____

Conduct of Experiment 2

The forms were distributed in an intermediate microeconomics classes at Rutgers University. The students were given approximately 1/2 hour to answer the questions, and then the forms were collected. The collected forms were shuffled, and then a student volunteer drew 10 forms, roughly 20% of the total, from the pile. The students whose names were on these forms were the ones who played out randomly selected lotteries. The experiment was repeated one week later, under the same conditions, the only change being that half of the students received an additional page of instructions (see instructions below). The payoff procedure was as for Experiment 1.

Instructions for Experiment 2

Name: _____

Instructions

You are about to participate in an experiment in the economics of decision-making. The purpose of the experiment is to gain a better understanding of how people make decisions in situations involving uncertainty. At the end of the experiment, approximately 20% of you will be randomly selected and given the opportunity to earn money by participating in a lottery drawing. Please read the following instructions and answer all of the questions.

The experiment consists of a number of questions concerning the following three *lotteries*, each of which provides some *chance* of winning a monetary prize.

+))))))))))))), +))))))))))))), +))))))))))))),

* **Lottery A:** * * **Lottery B:** * * **Lottery C:** *

* * * * *

*A 75/100 chance * *A 40/100 chance * *A 30/100 chance *

*to win \$4.00. * *to win \$10.00. * *to win \$10.00. *

.)))))))))))))- .)))))))))))))- .)))))))))))))-

For each lottery, the chance of winning the prize is stated as a ratio, or relative frequency. For example, one of the lotteries consists of a 75/100 chance to win \$4.00. In a single play of the lottery, you would, of course, either win the \$4.00 or win \$0, but if you played the lottery many times you could expect to win the \$4.00 prize about three-fourths of the time. For example, you could expect to win about 75 times if you played the lottery 100 different times. The stated chances of winning the other lotteries can, similarly, be interpreted as the relative frequency with which you could expect to win the stated prize over many plays of the lottery.

At the front of the room we have a box containing 100 poker chips, numbered from 1 to 100. The lottery discussed in the last paragraph could be conducted in the following manner: A single chip is to be drawn from the box. If the number on the chip is *any number from 1 to 75*, then the player wins \$4. If the number on the chip is *any number from 76 to 100*, then the player wins \$0. Similarly, the other 2 lotteries could be conducted by appropriately defining which numbered chips are "winners," and which numbered chips are "losers."

Questions

Please consider the following two questions.

1. If you were given the opportunity to play one of the three lotteries, in the manner described above, free of charge, which lottery would you choose to play? More generally, in what order would you place the three lotteries, from the one you would most prefer to play, to the one you would least prefer to play? Please examine the three lotteries carefully before making your decision. Indicate on the Decision Sheet on the next page the way in which you would rank the lotteries by placing a "1" in the first column (labelled "Rank") beside the lottery that you would most like to play, a "2" beside the lottery that is the second best to you, finally placing a "3" beside the lottery that you would least like to play. If there are two lotteries that you equally prefer to play, then you should assign to these lotteries the same rank. If, however, you have even the slightest preference for one lottery over another, then you should assign different ranks to the lotteries.

In order to give you an incentive to consider your choices carefully, several of you will be given the opportunity to play a lottery in the **First Payoff Round** at the end of the experiment. For each person who is randomly selected, two of the three lotteries will be randomly selected. Of these two, the one that you ranked higher will be the lottery that you will play. If you assigned the same rank to the two lotteries selected, then one of the lotteries will be randomly chosen for you to play. Approximately 10% of you will play a lottery in the First Payoff Round.

2. Imagine that you have a ticket giving you the right to play Lottery A. What is the *lowest price* at which you would be willing to *sell* this ticket to another person, thus giving up your right to play the lottery? Imagine now that you have a ticket for Lottery B. What is the lowest price at which you would be willing to sell this ticket? Imagine the same situation for all three lotteries, and try to determine the lowest price at which you would still be willing to sell each of these tickets. Indicate these minimum selling prices of tickets to each lottery on the Decision Sheet on the next page by writing the appropriate price in the second column (labelled "Price") beside each of the lotteries.

In order to give you an incentive to consider your choices carefully, several of you will be given the opportunity to earn money, either by playing a lottery, or by selling your right to play a lottery, in the **Second Payoff Round** at the end of the experiment. For each person who is randomly selected, two of the three lotteries will be randomly selected. Of these two, we will consider the one that you placed the higher minimum selling price on. If you assigned the same minimum selling price to the two lotteries selected, then one of the lotteries will be randomly chosen for consideration. The minimum selling price that you assigned to this lottery will be noted, and then a price between \$0.00 and \$9.99 will be randomly selected. Each possible price, in 1-cent increments, between \$0.00 and \$9.99 is equally likely to be selected. If the randomly selected price is **greater than or equal to** the minimum selling price you assigned to the lottery, then you will be paid that price, and you will be done. If the randomly selected price is **less** than the minimum selling price that you assigned to the lottery, then you will, instead, play out that lottery, in the manner described on the first page of the instructions. Approximately 10% of you will be given this opportunity.

Additional instructions(Given to the treatment group in Trial 2 of Experiment 2)

1. You may find the following observations useful in making your **ranking** decisions. Note that the same prize is available in both Lottery B and Lottery C. The only difference between these lotteries is that the chances of winning the prize in Lottery B are bigger than the chances of winning the prize in Lottery C. Thus, it seems that Lottery B is clearly a better bet than Lottery C, and it would be sensible to rank Lottery B higher than Lottery C, so that if these 2 lotteries are the ones selected in the first payoff round, you will have the chance of playing the better bet. Lottery A, however, is not so easy to compare to either Lottery B or C. Whether you rank Lottery A highest, lowest, or between Lotteries B and C will depend on exactly what your preferences are.

Note that if you assign the same ranking to two lotteries and, moreover, these two lotteries are the ones randomly selected in the first payoff round, then the choice of which lottery you will play will be determined randomly. Thus, if you have even the slightest preference for one lottery over another, you should be sure to assign it a higher rank.

2. You may find the following observations useful in making your **pricing** decisions. Note that the same prize is available in both Lottery B and Lottery C. The only difference between these lotteries is that the chances of winning the prize in Lottery B are bigger than the chances of winning the prize in Lottery C. Thus, it seems that Lottery B is clearly a better bet than Lottery C, and it would be sensible to state a higher minimum selling price for Lottery B than for Lottery C so that if these 2 lotteries are the ones selected in the second payoff round, you will have the chance of either selling the right to play, or actually playing out, the better bet. Lottery A, however, is not so easy to compare to either Lottery B or C. Whether you assign Lottery A a higher price, a lower price, or a price between those assigned to Lotteries B and C will depend on exactly what your preferences are. In general, the lottery that you would **most prefer** to play should have the **highest** minimum selling price assigned to it, and the lottery you would **least prefer** to play should have the **lowest** minimum selling price assigned to it.

Note that if you assign the same price to two lotteries and, moreover, these two lotteries are the ones randomly selected in the second payoff round, then the choice of which lottery you will either sell or play will be determined randomly. Thus, if you have even the slightest preference for one lottery over another, you should be sure to assign it a higher minimum selling price.

Also note that it is important that you assign a minimum selling price to each lottery at too low or too high a price. In general, the minimum selling price you assign to a given lottery should be an amount that you would be just as satisfied to receive for certain, as you would be having the chance to play the lottery. If the price you assign is lower than this amount, then you may end up selling your right to play the lottery when you would actually prefer to play it. If the price you assign is higher than this amount, then you may end up playing the lottery when you would actually prefer to sell your right to play at the randomly selected price.

Decision Sheet

1. Indicate the way in which you would *rank* the lotteries by placing a "1" in the first column (labelled "Rank") beside the lottery that you would most like to play, a "2" beside the lottery that is the second best to you, and so on, finally placing a "3" beside the lottery that you would least like to play.
2. Indicate your *minimum selling price* for a ticket to each of the lotteries by writing the appropriate price in the second column (labelled "Price") beside each of the lotteries.

The lotteries are listed here again for easy reference.

+))))))))))))) , +))))))))))))) , +))))))))))))) ,
 * **Lottery A:** * * **Lottery B:** * * **Lottery C:** *
 * * * * *
 *A 75/100 chance * *A 40/100 chance * *A 30/100 chance *
 *to win \$4.00. * *to win \$10.00. * *to win \$10.00. *
 .))))))))))))) - .))))))))))))) - .))))))))))))) -

Rank Price

Lottery A: _____

Lottery B: _____

Lottery C: _____