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Gneezy, U.; Potters, J.J.M.

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AN EXPERIMENT ON RISK TAKING AND EVALUATION PERIODS*

URI GNEEZY AND JAN POTTERS

Does the period over which individuals evaluate outcomes influence their investment in risky assets? Results from this study show that the more frequently returns are evaluated, the more risk averse investors will be. The results are in line with the behavioral hypothesis of "myopic loss aversion," which assumes that people are myopic in evaluating outcomes over time, and are more sensitive to losses than to gains. The results have relevance for the equity premium puzzle, and also for the marketing strategies of fund managers.

I. INTRODUCTION

Recently, Benartzi and Thaler [1995] put forward an explanation for the equity premium puzzle. This puzzle refers to the fact that over the last century the risk-return relationship has been so much more favorable for stocks than for bonds, that unreasonably high levels of risk aversion would be needed to explain why investors are willing to hold bonds at all [Mehra and Prescott 1985]. The explanation for this puzzle, advanced by Benartzi and Thaler, is called myopic loss aversion (MLA), and rests on the combination of two behavioral concepts. The first concept is *loss aversion* [Kahneman and Tversky 1979; Tversky and Kahneman 1992], which refers to the tendency of individuals to weigh losses more heavily than gains. The second concept is *mental accounting* [Kahneman and Tversky 1984; Thaler 1985], which refers to the implicit methods people employ to code and evaluate financial outcomes.

The effect of combining these two concepts is perhaps best illustrated by means of a well-known problem devised by Samuelson [1963]. He asked a colleague whether he would be willing to accept a gamble in which there are equal chances to win $200 and to lose $100. The colleague declined this single gamble, but at the same time expressed a willingness to accept multiple plays of the gamble. Although such a preference may have much intuitive appeal, Samuelson proved a theorem, saying that if the

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single gamble is rejected at every relevant wealth position, then accepting the multiple gamble is inconsistent with expected utility maximization (see Tversky and Bar-Hillel [1983] for further discussion).

Benartzi and Thaler show that rejecting each single gamble, but accepting a sequence of such gambles is consistent with MLA (see Kahneman and Lovallo [1993] for a similar argument). If returns are evaluated over a longer period of time, multiple gambles become more attractive due to the lower probability that a loss will be experienced. To illustrate, suppose that the individual is characterized by loss aversion and has a utility function $u(z) = z$ for $z \geq 0$ and $u(z) = 2.5z$ for $z < 0$, where z is the change in wealth due to the gamble. Then, the expected utility of one gamble is negative: $\frac{1}{2}(200) + \frac{1}{2}(-250) < 0$. Hence, the individual will reject one gamble, and also two gambles—if each is evaluated separately. The same individual, however, accepts two gambles if (s)he evaluates them in combination: $\frac{1}{4}(400) + \frac{1}{2}(100) + \frac{1}{4}(-500) > 0$. Hence, rejecting a single gamble while accepting two gambles is quite easily explained by the combined hypotheses of individuals being more sensitive to losses than to gains *and* evaluating the outcomes of the sequence of gambles in combination.

As the example illustrates, MLA predicts that the dynamic aggregation rules that people employ influence their attitude toward risk. In particular, the period over which individuals evaluate financial outcomes influences their investments in risky assets. By means of theoretical simulations, Benartzi and Thaler show that MLA could thus provide an explanation for the equity premium puzzle. In particular, they show that the size of the equity premium is consistent with investors evaluating their portfolios annually and weighing losses about twice as heavily as gains.

However, Benartzi and Thaler do not present direct (experimental) evidence for the presence of MLA. The evidence presented in Benartzi and Thaler is only circumstantial. Hence, we seem to have a choice anomaly—a choice rule that departs from standard theory—that could potentially explain an important phenomenon. Yet, there are no direct and controlled tests that indicate that the anomaly is real. Designing such a test is the purpose of this paper.[1]

We have experimental subjects making a sequence of risky choices. To analyze the presence of MLA, we do not try to esti-

1. Independently, Thaler, Tversky, Kahneman, and Schwartz [1997] conducted a similar experiment.

mate the period over which subjects evaluate financial outcomes, but rather we try to manipulate this evaluation period. In our setup, two groups of participants are subjected to the same sequence of choices. Subjects in the first (high frequency) group are supplied with feedback information after each round of the sequence, and can change their choice after each round. The subjects in the second (low frequency) group, however, get feedback information only after three rounds, and can only adapt their choices after three rounds. If our design is successful in manipulating subjects' evaluation period, MLA would predict that the low-frequency subjects make more risky choices. If subjects use a longer horizon to evaluate outcomes, the trade-off between losses and gains becomes more favorable for the risky option. At the same time, subjective expected utility (SEU) theory does not predict a systematic difference in risk taking between the two treatments in our setup.

The remainder of this paper is organized as follows. The next section explains and motivates the design of the experimental test, and spells out the hypothesis. Section III presents the results, and Section IV concludes.

II. Design and Procedure

Consider an individual who is confronted with a sequence of three independent but identical lotteries, in which there is a probability of 2/3 to lose \$1 and a probability of 1/3 to win \$2.50. If, as is hypothesized by MLA, the individual weighs losses more heavily than gains, then the attractiveness of the lotteries may depend on whether the financial consequences of the gambles are evaluated separately or in combination. For illustration, suppose that the individual weighs losses relative to gains at a rate of $\lambda > 1$. Then the expected utility of a single lottery is $(2/3)\lambda(-1) + (1/3)(2.5)$, which is positive only if $\lambda < 1.25$. However, if a subject evaluates the three lotteries in combination, then the expected utility is $(1/27)(7.5) + (6/27)(4) + (12/27)(0.5) + (8/27)\lambda(-3)$, which is positive if $\lambda < 1.56$. This is because the probability of a loss decreases from 0.67 for a single lottery, to $(0.67)^3 = 0.30$ for three consecutive lotteries. If the financial consequences of the three lotteries are evaluated in combination rather than separately, then the lotteries should become more attractive.[2] It is this

2. This prediction only depends on losses weighing more heavily than gains, and not on the utility function being piecewise linear.

basic prediction of MLA that we tested in our experiment, by manipulating the evaluation period of subjects.

In the experiment, subjects were confronted with a sequence of twelve identical but independent rounds of a lottery (betting game). In each of the first nine rounds ("part 1" of the experiment), subjects were endowed with 200 cents.[3] They had to decide which part (X_t) of this endowment they wanted to bet in the lottery ($0 \leq X_t \leq 200$, $t = 1, \ldots, 9$). In the lottery there was a probability of 2/3 of losing the amount bet and a probability of 1/3 of winning two and a half times the amount bet. Subjects were fully informed about the objective probabilities of winning and losing, and about the corresponding size of gains and losses. It is important to stress that subjects could not bet any money accumulated in previous rounds. Hence, the maximum bet in each round is 200 cents, independently of the outcome of the bet in any of the previous rounds. In rounds 10 through 12 ("part 2" of the experiment) subjects were no longer endowed with any additional money from the experimenters. Rather, they had to make bets from the money earned in part 1. To that purpose, a subject's earnings in the nine rounds of part 1 were first totaled and then divided by three. The resulting amount was a subject's endowment (S) for each of the three rounds of part 2. Again, for each round a subject had to decide which part (X_t) of the endowment S to bet in the lottery ($0 \leq X_t \leq S$, $t = 10, 11, 12$).

The crucial feature of the design is that there were two different treatments: Treatment H (high frequency) and Treatment L (low frequency). In Treatment H the subjects played the rounds one by one. At the beginning of round 1 they had to choose how much of their endowment of 200 cents to bet in the lottery. Then they were informed about the realization of the lottery in round 1. Only then could they decide how much of their new endowment of 200 cents to bet for round 2, and so on. Hence, in this treatment subjects made nine betting decisions in part 1 and three decisions in part 2. In Treatment L, however, subjects played the rounds in blocks of three. At the beginning of round 1, subjects had to decide how much of their endowment of 200 cents to bet in the lotteries of rounds 1, 2, and 3. In addition, these bets were restricted to be equal. If a subject bet X in round 1, (s)he also bet X in rounds 2 and 3 (that is, $X_1 = X_2 = X_3$, with $0 \leq X_t \leq 200$). After subjects

3. At the time of the experiment, 1 guilder (100 cents) exchanged for about US$0.60.

decided on their bets, they were informed about the combined realization for rounds 1, 2, and 3. That is, they could not assign a gain or loss to any particular round, but only knew the aggregate result. Subsequently, subjects decided how much to bet in rounds 4, 5, 6, and so on. Hence, in Treatment L subjects make three decisions in part 1, and one decision in part 2.

In Treatment L subjects chose their bet for the next three rounds; they had, therefore, less freedom because they could not change their decision after every round. In particular, by the design of Treatment L we have $X_t = X_{t+1} = X_{t+2}$, for $t = 1, 4, 7, 10$. In Treatment H these equalities need not hold. Furthermore, the subjects in Treatment H were supplied with more information than were the subjects in Treatment L. When deciding on X_t, a subject in Treatment H was always fully informed about the realizations and corresponding earnings of the previous rounds. A subject in Treatment L, however, simultaneously decided about X_t, X_{t+1}, and X_{t+2} ($t = 1, 4, 7, 10$). A subject had to decide about X_{t+1} (X_{t+2}) without knowing the realization for round t (rounds t and $t+1$). Hence, subjects in Treatment L were supplied with less freedom and less information than those in Treatment H.

The basic idea behind the two treatments of our design is to manipulate the evaluation period. In Treatment L the frequency of choice and information feedback was lower than in Treatment H. As a result, the subjects in Treatment L can be expected to evaluate the financial consequences of betting in a more aggregated way. If the subjects are characterized by MLA, this should make them more apt to bet money in the lotteries.[4]

According to subjective expected utility (SEU) theory, there may be a difference between a subject's behavior in Treatment H and Treatment L. This is so because, within each block of three rounds, a subject in Treatment H has more information about the current wealth level in the second and third round than does a subject in Treatment L. A subject in Treatment H observes gains and losses along the way, and, contrary to a subject in Treatment H, can adjust bets accordingly. The effect of this additional infor-

4. In principle, it would be possible to draw conclusions from only part 1 of the experiment. However, since the subjects receive the 200 cents endowment from us, it is possible that they do not experience a lost bet as a "real" loss. In part 2 of the experiment subjects bet their own money, "earned" in part 1. Therefore, we expected that the impact of loss aversion (if at all) would be amplified in part 2. On the other hand, in part 2 subjects' wealth positions and experiences are more diverse. Hence, in part 2 we may also expect to find larger individual differences.

mation cannot be unambiguously signed in general.[5] In view of the small stakes involved in the experiment, however, the effect is likely to be small indeed. Hence, with the assumption that wealth effects within each block of three rounds on subjects' risk aversion are negligible, the natural hypothesis under SEU is that there are no systematic differences between average bets of the subjects in Treatment H and Treatment L. This we use as our null hypothesis.

Procedure

We had fourteen experimental sessions, seven for each of the two treatments. The experiment was administrated by pen and paper, and held in a seminar room with subjects seated far apart. Six different subjects participated in each session (84 subjects in total).[6] Students were recruited from Tilburg University. An announcement in the university bulletin solicited participants for a decision-making experiment of about 40 minutes, with a reward that would depend on their decisions, but which was likely to be somewhere between 5 and 35 Dutch guilders. For each session eight subjects were invited; six would participate in the betting games, one would act as an assistant, and one would serve as a spare in case of a no show.

Upon entering the room, a short standard-type introduction was read to the subjects by the experimenter. Subjects were informed that the experiment would consist of three parts, but that they would be informed about the instructions of part 2 only after part 1 was finished. After the introduction, each subject drew an envelope out of a stack. Six envelopes contained numbered registration forms for part 1 of the experiment; one envelope contained a note with "assistant," and one had an empty note (the latter envelope was removed when only seven subjects showed up). The assistant was told that he would receive a payment equal to the average earnings of the other participants. The subject who drew the empty note was paid *f*10 for showing up and was asked to leave the room.

5. Gollier, Lindsey, and Zeckhauser [1997] derive sufficient conditions on the utility function for this information effect to have an unambiguous sign. Translated to our setting, their results indicate that constant relative risk aversion less than 1 would induce *more* risk taking in Treatment H than in Treatment L. Under constant absolute risk aversion there should be no treatment effect.

6. As it turned out, we had one subject who was in the experiment twice. We delete his second set of choices from the data, leaving us with 41 observations in Treatment H.

Instructions (in Dutch) for part 1 were distributed and read aloud. After that, subjects could examine the instructions for a few additional minutes, and (privately) ask questions.

Subjects were then asked to record their first bets. The lottery was conducted by the assistant. To determine whether a subject gained or lost in a round's lottery, we used private "win letters" which were indicated on the Registration Form. For subjects 1 and 2 the win letter was A, for subjects 3 and 4 it was B, and for subjects 5 and 6 the win letter was C. We used different win letters to introduce more variation in the realization of gains and losses within each session. The assistant used a box containing three disks marked, respectively, A, B, and C. After the subjects had recorded their bets for the round, the assistant first showed the contents of the box to the subjects (to show that the box, in fact, contained an A, B, and C); (s)he then shook the box and randomly took one disk out of the box. The letter on the disk was the so-called round letter for the round. If a subject's private win letter matched the round letter, (s)he won in the lottery; if the letters did not match, (s)he lost. Since there were three letters in the box, only one of which matched a subject's win letter, the probability of winning in any round's lottery was 1/3, and the probability of losing was 2/3.

In Treatment L the subjects fixed bets for three rounds, and three lotteries were conducted by the assistant. For that purpose, the assistant used three boxes, each containing three disks labeled A, B, and C. The assistant first showed the contents of each box to the subjects (to show that each box, in fact, contained an A, B, and C); (s)he then shook the boxes and randomly took one disk out of each box. The three disks drawn (one for each round) were then shown *simultaneously* to the subjects.[7] The letters on the three disks drawn were the round letters for the present three rounds.

After each round (three rounds in Treatment L), subjects calculated and recorded their own earnings on their registration form. We checked these calculations to make sure that they understood the procedure, and that they did not cheat. Then sub-

7. The main purpose of our design is to manipulate the evaluation period of the subjects in Treatment L. We wanted them to evaluate three consecutive lotteries in an aggregated way, without experiencing the losses and gains of each separate lottery. Therefore, the outcomes of the three lotteries were shown to them simultaneously. In this way it was not possible for them to attribute a gain or a loss to any particular round in the block of three.

jects recorded their bets for the next round (next three rounds in Treatment L).

At the end of the nine rounds, total earnings were calculated, and forms were collected. The experimenter divided these total earnings by three to determine the starting endowment (maximum bet) for each of the three rounds of part 2. This starting endowment (S) was indicated on top of the Registration Form for part 2. These forms were distributed together with the instructions for part 2. The instructions were read aloud, and then the three betting rounds for part 2 were held. Again, subjects calculated their own earnings. After it was finished, all subjects were paid.[8] The assistant was paid the average earnings of the other subjects. That concluded the experiment.

III. Results

Analyzing the results of part 1 is a straightforward exercise. We simply compare the average percentage of the endowment (of 200 cents) bet in the lottery for the two treatments. To ease comparison, we take the average percentage of endowment bet in blocks of three rounds. These averages and the corresponding standard deviations (across individuals) are presented in Table I. The final row of Table I gives the average percentage of endowment bet over all rounds.

The results display a clear treatment effect. In each round average bets are larger for treatment L than for treatment H. To determine the significance of the differences, we use the nonparametric Mann-Whitney test.[9] The final column reports z-values, which are a transformation of the Mann-Whitney U-value corrected for the presence of ties. These z-values are asymptotically normally distributed. The corresponding one-tailed significance levels are also reported.[10] The results indicate that the difference in average bets is highly significant.

8. In fact, after part 2 was finished, there was a short supplementary part in the experiment. In this part we tried to obtain additional information about subjects' risk preferences. This part, however, is not directly relevant to the present test.

9. We cannot use the parametric t-test. This test assumes that the observations come from a normal distribution, which is not possible, given the lower- and upper-bound of 0 and 100, respectively. Also, a Kolmogorov-Smirnov test rejects the hypothesis that the observations are from a normal distribution.

10. We report one-tailed significance levels because the null hypothesis (SEU) predicts no systematic difference, whereas the alternative hypothesis (MLA) predicts that the bets in Treatment L will be larger.

TABLE I
AVERAGE PERCENTAGE OF ENDOWMENT BET (PART 1)

	Treatment H[a]	Treatment L[a]	Mann-Whitney z[b]
Rounds 1–3	52.0 (30.2)	66.7 (29.5)	−2.08 [0.018]
Rounds 4–6	44.8 (30.0)	63.7 (30.3)	−2.78 [0.003]
Rounds 7–9	54.7 (28.9)	71.9 (29.4)	−2.51 [0.006]
Rounds 1–9	50.5 (26.7)	67.4 (27.3)	−2.86 [0.002]

a. # obs. = 41 (42) for treatment H (L). Standard deviations are in parentheses.
b. One-tailed significance levels (p-values) are in brackets.

It appears, moreover, that the average levels of bets are fairly stable over the rounds. Although for both treatments bets are somewhat lower in the three middle rounds, there is no clear or significant pattern in the data. It is particularly noticeable that the difference between the two treatments is significant already in the very first round (X_1). Here, on average, the subjects in Treatment H bet 50.1 percent of their endowment, whereas the subjects in Treatment L bet 66.7 percent (the Mann-Whitney z-value is -2.35 with a p-value of 0.009). It seems that the design is effective in changing subjects' attitude toward risk right from the start of the experiment. This would suggest that subjects are, at least to a substantial extent, forward looking when they evaluate ("mentally account") risky decisions. This seems to be in line with Benartzi and Thaler, who formulate MLA in terms of "prospective" utility. An additional hypothesis could be that *experiencing* (not just *anticipating*) gains and losses affects subjects' risk behavior. For such a backward looking hypothesis we find no support. In the course of the experiment, the subjects in Treatment H experience losses more frequently than do the subjects in Treatment L. If this were a driving force behind the difference between the two treatments, then we would expect this difference to be stronger in the final round(s) than in the first round(s). No support for this is found in the data. Moreover, we find no effect of different experiences with gains and losses between subjects.[11] The fraction of endowment bet is not significantly affected by sub-

11. For example, within each treatment we compared the bets of the subjects who had just experienced a gain with those who had just experienced a loss. If subjects were backward looking, we would expect the bets to be higher for the former than for the latter group. The effect is in the other direction, however. Although this finding is statistically insignificant, bets are larger after a loss than after a gain.

jects' experiences with the occurrence of gains and losses in the preceding round(s).

In part 2, subjects' endowments were again identical across rounds, but contrary to part 1, they differed across individuals. In each of the three rounds, a subject's endowment was equal to 1/3 of his or her earnings (W) from part 1 of the experiment ($S = W/3$). As a consequence, for each subject we have two variables of interest: first, the absolute amount bet, $Y := \sum_{t=10}^{12} X_t (\leq W)$, where for Treatment L we have $X_{10} = X_{11} = X_{12}$, and, second, the percentage of the endowment bet in the lottery, $F := 100Y/W$. The averages of both variables are presented in the first two rows of Table II.

It appears that the treatment effect is in the same direction as in part 1. On average, subjects in Treatment L bet more in the risky lottery than do their counterparts in Treatment H. Both in absolute and relative terms, bets were larger if subjects were supplied with less information feedback and less freedom of choice. For the amount bet (Y), the difference is again highly significant. For the percentage of endowment bet (Y), the difference between the two treatments is less pronounced but still (marginally) significant. As the final row of Table II indicates, the increased willingness to take risks also pays off. Average total earnings (parts 1 and 2) in Treatment L are significantly larger than those in Treatment H.

IV. Conclusion

This paper presents a direct experimental test of the prediction of myopic loss aversion (MLA), that a longer evaluation period makes a risky option with positive expected return look more attractive. Our results strongly support this prediction. We ma-

TABLE II
AVERAGE AMOUNT BET, AVERAGE PERCENTAGE BET, AND AVERAGE TOTAL EARNINGS

	Treatment H[a]	Treatment L[a]	Mann-Whitney z[b]
Amount bet (Y)	707.3 (614.5)	887.1 (662.1)	−2.14 [0.016]
Percentage bet (F)	39.0 (30.0)	48.9 (32.1)	−1.62 [0.053]
Total earnings (parts 1 and 2)	1822 (1015)	2134 (745)	−1.78 [0.038]

a. # obs. = 41 (42) for treatment H (L). Standard deviations are in parentheses.
b. One-tailed significance levels (p-values) are in brackets.

nipulated the evaluation period of one group of experimental subjects by giving them less information feedback and less freedom of adjustment than a control group. This manipulation was intended to make subjects evaluate risky financial investments in a more aggregated way. As a consequence, they are less likely to be deterred by the occurrence of losses. In particular, we observe higher earnings for the subjects who evaluate their investment in a more aggregate way. The results provide support for Benartzi and Thaler's [1995] explanation of the equity premium puzzle.

The results may also have practical relevance. Manipulating the evaluation period of prospective clients could be a useful marketing strategy for fund managers. Our results suggest that providing investors with less frequent information feedback about how a particular risky fund is doing might make the fund appear more attractive by decreasing the likelihood that a loss will be experienced. Similarly, if investors are given less freedom of adjustment ("tying their hands"), this may induce them to evaluate financial outcomes in a more aggregated way, and help them to resist the temptation to drop out after the occasional setback.

Of course, our experiment is highly stylized. For example, the subjects in the experiment only face risk (known probabilities of possible outcomes), whereas real-life investors mainly deal with uncertainty (unknown probabilities). Another issue is that our experiment took less than an hour, whereas the time elapsing between real investment decisions is usually much longer. Furthermore, the financial stakes for the experimental subjects are low compared with those of most real-world decision-makers. These features are a cause for caution in extrapolating of the results. They also suggest lines along which to pursue further experimental work.

APPENDIX: EXCERPT OF INSTRUCTIONS

(Translated from Dutch; full instructions are available upon request.)

Introduction [Read aloud only]

Welcome to our experimental study of decision-making. The experiment will last about 40 minutes. The instructions for the experiment are simple, and if you follow them carefully, you can earn a considerable amount of money. All the money you earn is yours to keep, and will be paid to you, privately and in cash, immediately after the experiment.

The experiment will consist of three parts. The instructions for the second part will be distributed to you after the first part has been finished. The instructions for part 3 will be announced at the completion of part 2. Before we start the experiment, however, you will be asked to pick one envelope from this pile. In the envelope you will find your so-called Registration Form. This form will be used to register your decisions and earnings. One of you, however, will find the announcement "assistant" in the envelope. This person will assist us during the experiment, and will receive a payment that is equal to the average earnings of the other participants in the experiment.

On top of your Registration Form you will find your registration *number.* This number indicates behind which table you are to take a seat. A separate table is reserved for the assistant. When everyone is seated, we will go through the instructions of part 1 of the experiment. After that, you will have the opportunity to study the instructions on your own, and to ask questions. If you have a question, please raise your hand, and I will come to your table. Please do not talk or communicate with the other participants during the experiment.

Are there any questions about what has been said until now? If not, then will the person on my left please be the first to pick an envelope, open it, and take the corresponding seat.

Instructions for part 1 [Treatment H; Read aloud and distributed]

Part 1 of the experiment consists of 9 successive rounds. In each round you will start with an amount of 200 cents ($f2$). You must decide which part of this amount (between 0 cents and 200 cents) you wish to bet in the following lottery.

> You have a chance of 2/3 (67%) to lose the amount you bet and a chance of 1/3 (33%) to win two and a half times the amount you bet.

You are requested to record your choice on your Registration Form. Suppose that you decide to bet an amount of X cents ($0 \leq X \leq 200$) in the lottery. Then you must fill in the amount X in the column headed *Amount in lottery,* in the row with the number of the present round.

Whether you win or lose in the lottery partly depends on your personal *win letter.* This letter is indicated on the top of your Registration Form. Your win letter can be A, B, or C, and is the same for all 9 rounds. In any round you win in the lottery if your win letter matches the *round letter* that will be drawn by the assistant, and you lose if your win letter does not match the round letter.

The round letter is determined as follows. After you have recorded your bet in the lottery for the round, the assistant will, in a random manner, pick one letter from a box containing three letters: A, B, and C. The letter drawn is the round letter for that round. If the round letter matches your win letter you win in the lottery; otherwise you lose. Since there are three letters, one of which matches your win letter, the chance of winning in the lottery is 1/3 (33%) and the chance of losing is 2/3 (67%).

Hence, your earnings in the lottery are determined as follows. If you have decided to put an amount of X cents in the lottery, then your earnings in the lottery for the round are equal to $-X$ if the round letter does not match your win letter (you lose the amount bet) and equal to $+2.5X$ if the round letter matches your win letter (you win two and a half times the amount bet).

The round letter will be shown to you by the assistant. You need to record this letter in the column *Round letters,* under *win* or *lose,* depending on whether the round letter does or does not match your win letter. Also you need to record your earnings in the lottery in the column *Earnings in lottery.* Your total earnings for the round are equal to 200 cents (your starting amount) plus your earnings in the lottery. These earnings are recorded in the column *Total earnings,* in the row of the corresponding round. Each time we will come by to check your Registration Form.

After that, you are requested to record your choice for the next round. Again you start with an amount of 200 cents, a part of which you can bet in the lottery. The same procedure as described above determines your earnings for this round. It is noted that your private win letter remains the same, but that for each round a new round letter is drawn by the assistant. All subsequent rounds will also proceed in the same manner. After the last round has been completed, your earnings in all rounds will be totaled. This amount determines your total earnings for part 1 of the experiment. Then the instructions for part 2 of the experiment will be announced.

Instructions for part 1 [Treatment L; Read aloud and distributed]

Part 1 of the experiment consists of 9 successive rounds. In each round you will start with an amount of 200 cents (f2). You must decide which part of this amount (between 0 cents and 200 cents) you wish to bet in the following lottery.

> You have a chance of 2/3 (67%) to lose the amount you bet and a chance of 1/3 (33%) to win two and a half times the amount you bet.

You are requested to record your choice on your Registration Form. Suppose that you decide to bet an amount of X cents ($0 \leq X \leq 200$) in the lottery. Then you must fill in the amount X in the column headed *Amount in lottery.* Please note that you fix your choice for the next three rounds. Thus, if you decide to bet an amount X in the lottery for round 1, then you also bet an amount X in the lottery for rounds 2 and 3. Therefore, three consecutive rounds are joined together on the Registration Form.

Whether you win or lose in the lottery partly depends on your personal *win letter.* This letter is indicated on the top of your Registration Form. Your win letter can be A, B, or C, and is the same for all 9 rounds. In any round you win in the lottery if your win letter matches the *round letter* that will be drawn by the assistant, and you lose if your win letter does not match the round letter.

The round letter is determined as follows. After you have recorded your bet in the lottery for the next three rounds, the assistant will, in a random manner, for each of the next three rounds pick one letter from a box containing three letters: A, B, and C. For each of the three rounds a letter is drawn from a different box. The three letters drawn are the round letters for the present three rounds. If the round letter matches your win letter, you win in the lottery; otherwise you lose. Since each box contains three letters, one of which matches your win letter, the chance of winning in the lottery in a given round is 1/3 (33%) and the chance of losing is 2/3 (67%).

Hence, your earnings in the lottery for the three rounds are determined as follows. If you have decided to put an amount of X cents in the lottery, then your earnings in the lottery are equal to $-X$ for each round letter that does not match your win letter (you lose the amount bet for the round) and equal to $+2.5X$ for each round letter that matches your win letter (you win two and a half times the amount bet for the round).

The three round letters will be shown to you by the assistant. You need to record these letters in the column *Round letters,* under *win* or *lose,* depending on whether the round letter does or does not match your win letter. You also need to record your earnings in the lottery in the column *Earnings in lottery.* Your total earnings for the three rounds are equal to 600 cents (three times your starting amount of 200 cents) plus your earnings in the lottery. These earnings are recorded in the column *Total earnings,* in the row of the corresponding rounds. Each time we will come by to check your Registration Form.

After that, you are requested to record your choice for the next three rounds (4–6). For each of the three rounds you again start with an amount of 200 cents, a part of which you can bet in the lottery. The same procedure as described above determines your earnings for these three rounds. It is noted that your private win letter remains the same, but that for each round a new round letter is drawn by the assistant. The subsequent three rounds (7–9) will also proceed in the same manner. After the last round has been completed, your earnings in all rounds will be totaled. This amount determines your total earnings for part 1 of the experiment. Then the instructions for part 2 of the experiment will be announced.

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REFERENCES

Benartzi, Shlomo, and Richard Thaler, "Myopic Loss Aversion and the Equity Premium Puzzle," *Quarterly Journal of Economics,* CX (1995), 73–92.
Gollier, Christian, John Lindsey, and Richard Zeckhauser, "Investment Flexibility and the Acceptance of Risk," working paper, Gremaq, University of Toulouse, 1996.
Kahneman, Daniel, and Dan Lovallo, "Timid Choices and Bold Forecasts: A Cognitive Perspective on Risk Taking," *Management Science,* XXXIX (1993), 17–31.
Kahneman, Daniel, and Amos Tversky, "Prospect Theory: An Analysis of Decision under Risk," *Econometrica,* XLVII (1979), 263–91.
Kahneman, Daniel, and Amos Tversky, "Choices Values and Frames," *American Psychologist,* XXXIX (1984), 341–50.
Mehra, Rajnish, and Edward Prescott, "The Equity Premium: A Puzzle," *Journal of Monetary Economics,* XV (1985), 145–61.
Samuelson, Paul, "Risk and Uncertainty: A Fallacy of Large Numbers," *Scientia,* XCVIII (1963), 108–13.
Thaler, Richard, "Mental Accounting and Consumer Choice," *Marketing Science,* IV (1985), 199–214.
Thaler, Richard, Amos Tversky, Daniel Kahneman, and Alan Schwartz, "The Effect of Myopia and Loss Aversion on Risk Taking: An Experimental Test," *Quarterly Journal of Economics,* CXII (1997), 647–661.
Tversky, Amos, and Maya Bar-Hillel, "Risk: The Long and the Short," *Journal of Experimental Psychology: Learning, Memory, and Cognition,* IX (1983), 713–17.
Tversky, Amos, and Daniel Kahneman, "Advances in Prospect Theory: Cumulative Representation of Uncertainty," *Journal of Risk and Uncertainty,* V (1992), 297–323.