Pay One or Pay All: Random Selection of One Choice for Payment

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Abstract: It has become increasingly common in economics experiments to elicit a series of choices from participants, and then pay for only one, selected at random, after all have been made. This allows the researcher to observe a large number of individual decisions, and to increase payoffs for each decision since only one of them will be used for payment. It has not been demonstrated, however, whether subjects behave as if each of these choices involves the stated payoffs, or if subjects scale-down payoffs to account for the random selection that is made. This paper reports an experiment that tests this directly. In an environment where payoff scale effects have been demonstrated to matter, three treatments are conducted: pay for one of 10 choices under low payoffs, pay for all 10 choices under low payoffs, and pay for 1 of 10 choices under 10x the low payoff level. Increasing payoff scale has a significant effect on choices compared with the low payoff treatments where all 10 decisions are paid, or where one decision is paid. However, there is no significant difference in choices between paying for one or all 10 decisions at the low payoff level. This supports the validity of using the random-choice payment method.

Keywords: Experiments, Risk Aversion, Salience

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1. Introduction

A common technique used to conduct economics experiments is to give subjects a series of choices, each with substantial earnings, and then determine final earnings based on just one of these choices selected at random after all have been completed. Recent examples of this include Andreoni and Miller (2002), Goeree, Holt, and Laury (2002), Harbaugh, Krause, and Versterlund (2002), Holt and Laury (2002), Laury (2002), Laury and Holt (2002), Shupp and Williams (2002), Laury and McInnes (2001), and Myagkov and Plott (1997). This random-payment technique allows the researcher to obtain a large amount of data without the high cost that would be associated with paying for all choices, and without scaling down earnings to a level that subjects may not take seriously. The assumption behind this technique is that subjects will consider each choice at its stated value, and consider all carefully because any one of them could be used in the end to determine payoffs for the entire experiment.

However, given that payoff scale may affect behavior in some environments, one might legitimately question the validity of the random-choice payment technique. Subjects might reasonably view the payoffs from any individual decision in terms of its expected value – the outcome from the decision multiplied by the probability that any given decision will be used in the end. Davis and Holt (1993) address this issue when they discuss a paper by Starmer and Sugden (1991) in which only one of two decisions are paid ex post. They write:

> The problem with the random-selection procedure as implemented here may be nothing more than that incentives for each choice are diluted. … Since only one of the two decisions made … is relevant, expected payoffs per decision fell by one-half. If this conjecture is correct, more consistent behavior would be generated by doubling the … payoffs for each lottery. (Davis and Holt, 1993, page 455).

If subjects do, in fact, scale down payoffs to account for the fact that only one decision is paid in the end, the resulting payoffs may be quite small, especially if the number of decisions made is large.

This paper addresses the question of whether subjects whose payments will be determined by a single decision determined ex post make choices as they would when they are paid for all decisions. I consider this question in an environment where payoff scale has been shown to affect decisions. Few studies have specifically addressed how the scale of payoffs affects decisions.[1] However, in some contexts increasing real payoffs has been found to have a significant effect on choice behavior in experiments. For examples see Kachelmeier and Shehata (1992), Smith and Walker (1993), Camerer and Hogarth (1999), Holt and Laury (2002), and Laury (2002). In a lottery choice experiment, Holt and Laury (2002) report that scaling up payoffs (by factors of 20, 50, and 90) causes a significant increase in risk aversion. Therefore, if paying for all choices (instead of one chosen at random) is interpreted by subjects as an increase in the expected payoff for each decision, one would expect to see more risk aversion among subjects who are paid for all choices instead of one choice selected at random.

In each of the three treatments reported here, subjects make 10 choices about which of two risky prospects they prefer. In the first treatment, these choices involve low payoffs (several dollars for each choice) and subjects are paid for one of these 10 decisions. In the second, payoffs are scaled up by a factor of 10 and subjects are still paid for one of 10 decisions. In the final treatment, payments for each choice are held constant at the original (low payoff) level, but subjects are paid for all 10 choices.

This paper focuses only on the payoff-scale effect of the random selection procedure. It does not address the "isolation effect": whether subjects view each decision separately or as part of a larger portfolio of decisions. This isolation effect is typically addressed by comparing choices when a subject faces a *single* decision with those made when he faces a series of decisions (with payment made for one randomly selected at the end). The isolation effect implies that subjects given a series of decisions consider each individually. As Davis and Holt point out, however, it does not directly address the issue of whether subjects scale down payoffs for every decision. Little difference between these procedures has been found in individual choice experiments (see Camerer, 1989, and Starmer and Sugden, 1991). However, whether subjects are given one decision or paid for one randomly selected decision may matter when others can benefit from one's decision, as in a dictator game (Stahl and Haruvy, 2002).

The experimental design is contained in the next section. Results are presented in Section 3, and the final section concludes.

[1] Many more studies have addressed the effect of using real (rather than hypothetical) payoffs.

2. Experimental Design

The first treatment (hereafter "1x Pay One") used the 10 decisions with their associated payoffs shown in Table 1.[2] In each decision, subjects were asked to choose between Option A and Option B. Probabilities were stated in terms of a throw of a 10-sided die. The instructions read:

> Option A pays $2.00 if the throw of the die is 1, and it pays $1.60 if the throw is 2-10. Option B yields $3.85 if the throw of the die is 1, and it pays $0.10 if the throw is 2-10. The other Decisions are similar, except that as you move down the table, the chances of the higher payoff for each Option increase. In fact, for Decision 10 in the bottom row, the die will not be needed since each Option pays the highest payoff for sure, so your choice here is between $2.00 and $3.85.

After everyone had submitted their choices for all 10 decisions, a 10-sided die was thrown twice. The first die throw determined which one of the 10 decisions was used for payment. The second die throw determined, according to the stated probabilities for the selected decision, whether earnings were $2.00 or $1.60 (if Option A was chosen) or $3.85 or $0.10 (if Option B was chosen). Subjects were told, "(e)ven though you will make ten decisions, only one of these will end up affecting your earnings, but you will not know in advance which decision will be used. Obviously, each decision has an equal chance of being used in the end."

Table 1. Paired Lottery Choice Decisions: Low Payoff Treatment

Decision	Option A ("Safe")		Option B ("Risky")
1	1/10 of $2.00, 9/10 of $1.60	or	1/10 of $3.85, 9/10 of $0.10
2	2/10 of $2.00, 8/10 of $1.60	or	2/10 of $3.85, 8/10 of $0.10
3	3/10 of $2.00, 7/10 of $1.60	or	3/10 of $3.85, 7/10 of $0.10
4	4/10 of $2.00, 6/10 of $1.60	or	4/10 of $3.85, 6/10 of $0.10
5	5/10 of $2.00, 5/10 of $1.60	or	5/10 of $3.85, 5/10 of $0.10
6	6/10 of $2.00, 4/10 of $1.60	or	6/10 of $3.85, 4/10 of $0.10
7	7/10 of $2.00, 3/10 of $1.60	or	7/10 of $3.85, 3/10 of $0.10
8	8/10 of $2.00, 2/10 of $1.60	or	8/10 of $3.85, 2/10 of $0.10
9	9/10 of $2.00, 1/10 of $1.60	or	9/10 of $3.85, 1/10 of $0.10
10	10/10 of $2.00, 0/10 of $1.60	or	10/10 of $3.85, 0/10 of $0.10

The payoffs from Option A are less variable than those for Option B, and so I refer to Option A as the "safe" lottery and Option B as the "risky" lottery. Starting from the top of the

[2] Each session began with a lottery choice experiment (with different payoffs) that was used to acquaint subjects with the procedures and 10-sided die used to determine payoffs. This was followed by a second experiment (an individual choice task or ultimatum game) conducted for different purposes. Earnings were quite similar between sessions, and no systematic effect on subsequent choices was observed.

table, most subjects will initially choose the safe lottery, and eventually switch to the riskier Option B when the chance of the higher-payoff outcome in each pair becomes large enough. For example, a risk neutral person will choose Option A for the first four decisions, and then switch to Option B at Decision 5 when the expected payoff for Option B exceeds that of Option A. A risk loving individual will make fewer than four safe choices, and a risk averse person will make more than four safe choices. The number of safe choices a person makes is therefore used to infer the degree of risk aversion (see Holt and Laury, 2002).

In the second treatment (hereafter, "10x Pay One"), all procedures were identical to those described above. Subjects made 10 choices. They were paid for one decision determined by the throw of a 10-sided die (after all choices had been made). However, earnings were 10-times the level shown in Table 1. Option A resulted in payoffs of $20 or $16, while the payoffs for Option B were $38.50 or $1.

In the final treatment ("1x Pay All"), payoffs were identical to those shown in Table 1. However, subjects were paid for all 10 decisions. They were told:

> You will have to choose A or B for each of these decisions. We will look at the choice that you made for the first decision, and then the die throw will determine your earnings. Then we will look at the choice you made for the second decision, then the second die throw will determine your earnings for this decision, and so on. The computer will then report your total earnings to you, from all 10 decisions.

Instructions were identical between treatments, except for the changes necessary to explain earnings and how the payoff decision was determined. Appendix A contains all instructions used in this experiment.

Table 2 summarizes each of these treatments. All sessions were conducted in the experimental economics laboratory at Georgia State University.[3] Subjects were seated at computer terminals, separated by privacy dividers. Most were students at Georgia State University. This urban campus is located in downtown Atlanta, and so the subject pool is more

[3] The 1x Pay One treatment was conducted as part of the experiment described in Holt and Laury (2002). These participants had the same experience as those in the new treatments: they started with the same risk aversion experiment, and then completed an individual choice experiment before taking part in the lottery choice experiment described here. A total of 212 subjects (from Georgia State University, University of Miami, and University of Central Florida) participated in this treatment. For greater comparability and control, I restrict attention to only those subjects who participated at Georgia State University. None of the results presented in Section 3 change when I use the entire 212-subject sample in this low-payoff treatment.

diverse than at many universities. Subjects ranged in age from 18 to 57. They were about equally divided between male and female, about 30 percent white, and many were raised outside of the United States or North America. No subject had participated in a previous lottery choice experiment, and no one participated in more than one of the treatments reported in this paper.

Table 2. Summary of Treatments

Treatment Label	# of Subjects	Description
1x Pay One	55	Payoffs shown in Table 1; paid for 1 of 10 choices
10x Pay One	30	Payoffs 10x those shown in Table 1; paid for 1 of 10 choices
1x Pay All	30	Payoffs shown in Table 1; paid for 10 of 10 choices

3. Results

As in Holt and Laury (2002) and Laury and Holt (2002), I use the total number of safe choices to classify the degree of risk aversion of each subject, with more safe choices associated with a higher degree of risk aversion. The majority of these subjects chose Option A for the first few choices, and then switched to Option B without ever going back to Option A. About 15 percent of the subjects switched back to Option A at least one time after choosing Option B. The analysis presented below considers both the full sample, and only those who exhibit a clean switch-point between Option A and Option B (that is, those who switch from Option A to Option B only once).

I first examine whether scaling up payoffs by a factor of 10 causes a significant increase in risk aversion. Figure 1 shows the cumulative distribution of the number of safe ("Option A") choices in the 1x Pay One treatment and the 10x Pay One treatment. Recall that the risk neutral prediction is to choose safe for the first four decisions; this is shown by the dashed line that goes from 0 to 1 at four safe choices. The actual choice distribution for both treatments lies to the right of this, indicating that most subjects are risk averse (they typically make more than four safe choices). The distribution in the 10x payoff treatment generally lies to the right of that for the low payoff treatment, demonstrating a higher degree of risk aversion as payoffs are scaled up by a factor of 10.

The average number of safe choices increases from 5.2 in the low payoff treatment to 5.7 in the high payoff treatment. This difference is significant, as seen using a one-tailed Mann-Whitney U-Test or Kolmogorov-Smirnov test (see Table 3). These results are even stronger when attention is restricted to those subjects who switch to Option B without ever going back to

Option A, as shown in the bottom half of Table 3. These data show that increasing payoffs by a factor of 10 is sufficient to result in a significant increase in risk aversion.[4]

Table 3. Treatment Effects

Comparison	Mann-Whitney Test[a]	Kolmogorov-Smirnov Test[b]
All Observations		
1x Pay One versus 10x Pay One	1.72 (.043)	6.71 (<.025)
1x Pay One versus 1x Pay All	0.02 (.492)	0.06 (<.50)
1x Pay All versus 10x Pay One	1.48 (.070)	4.28 (<.10)
Subjects who Switch from Safe to Risky Only Once		
1x Pay One versus 10x Pay One	2.34 (.010)	8.08 (.01)
1x Pay One versus 1x Pay All	0.24 (.405)	0.16(<.50)
1x Pay All versus 10x Pay One	1.84 (.033)	4.68 (<.05)

[a] z-statistic (p-value)
[b] Chi-square statistic (p-value)

Next, I consider whether paying for all 10 choices in the low payoff condition changes behavior relative to the case where only one decision is paid. Specifically, I look at whether this causes an increase in risk aversion similar to that observed when payoffs are scaled up by a factor of 10. If subjects view the random selection method as if each decision involves the stated payoffs, there will be little difference in choices between the 1x Pay One and 1x Pay All treatments. However, if they instead view the random selection method as a decrease in incentives, we will see similar behavior between the 10x Pay One and the 1x Pay All treatments.

Figure 2 shows the cumulative number of safe choices made in the 1x Pay One treatment and the 1x Pay All treatment. The distributions are quite close, and the null hypothesis of no difference in the number of safe choices between treatments cannot be rejected at any standard level of confidence. In fact, the average number of safe choices (5.2) is identical in these two treatments, and the median number of safe choices is slightly *lower* when subjects are paid for all 10 decisions (5.5 when all decisions are paid versus 6.0 when only one is paid).[5] Sometimes the larger scale used to create cumulative frequencies can mask differences in behavior that are more apparent in the frequency distribution data. Figure 3 shows that the choice frequencies for these

[4] There is no significant gender difference for either treatment, nor is there a gender difference in the 1x Pay All treatment.

[5] The medians are identical (6.0 safe choices) when attention is restricted to subjects who switch from “safe” to “risky” only once.

two treatments (1x Pay One or 1x Pay All) are almost identical for any number of safe choices.[6] However, the frequency distribution is shifted to the right (toward more risk averse choices) when payoffs are scaled up by a factor of 10 with one decision used for payment (10x Pay One). In this high payoff treatment the modal choice pattern is seven safe choices (compared with six safe choices in each of the other two treatments).

Given the similarity in distributions between the 1x Pay One and 1x Pay All treatments, it is not surprising that I find a significant difference between choices in the 1x Pay All and 10x Pay One treatments (see Table 3). This supports the hypothesis that subjects view payment for all 10 decisions more like paying for one of 10 at the same (low) payoff level than scaling up of payoffs by a factor of ten.

Taken together, these results provide evidence that subjects do not view random payment for one decision as a decrease in stakes for each decision that is presented.

4. Conclusions

Many researchers use the technique of eliciting a number of decisions from subjects, and then choosing just one of these decisions at the end of the experiment to determine earnings for the entire session. This raises the question of whether subjects consider the given payoffs at the stated value or whether they scale down these payoffs to account for the fact that not all decisions are actually going to be paid. If paying for one randomly chosen decision affects choice behavior by decreasing the salience of each decision, one is most likely to observe a behavioral difference in a setting where the scale of payoffs typically affects choice patterns.

This paper presents an experiment in which payoff scale has a significant effect on choices. Specifically, when subjects are paid for 1 of 10 lottery choice decisions (chosen at random after all have been made) scaling up by a factor of 10 causes a significant increase in risk aversion. I then compare the pattern of choices that are made when one of 10 choices are paid at the original (low) payoff level and when all 10 choices are paid at this level. Subjects make the

[6] This is the one way in which there is a difference in behavior when the entire (212-subject) sample is used for the 1x Pay One treatment. The frequency distribution is more dispersed when all 212 observations are used, with almost an equal number of subjects making 4, 5, or 6 safe choices. The median number of safe choices is 5.0, however the mode is unchanged at 6.0. A K-S test cannot reject the null hypothesis of identical distributions between the full sample and the Georgia State University sub-sample at any standard level of confidence.

same 10 decisions, with the same payoff for each decision, in both of these treatments. The only difference is whether subjects are paid for one or all of the 10 choices made.

If subjects effectively scale down earnings when they are to be paid based on a subset of their decisions, one would expect them to treat payoffs in the treatment where they are paid for all choices more like those with higher payoffs and random choice. However, if they do not scale down in this manner, choices (at a given stated payoff level) should be insensitive to whether they are paid for one or all of their decisions.

The evidence from this experiment points to the latter interpretation. There is no significant difference in the number of safe choices made under low payoffs when subjects are paid for 1 of 10 decisions, compared with being paid for all 10 decisions. However, a significant increase in risk aversion is observed when payoffs are scaled up by a factor of 10. This lends support to the notion that one can use the random selection method without decreasing the salience of payments.

Figure 1. Cumulative Distribution of Safe Choices: Low versus High Payoffs

Key: 1x Pay One (thin line with dots), 10x Pay One (thin line with squares), Risk Neutral Prediction (dashed line)

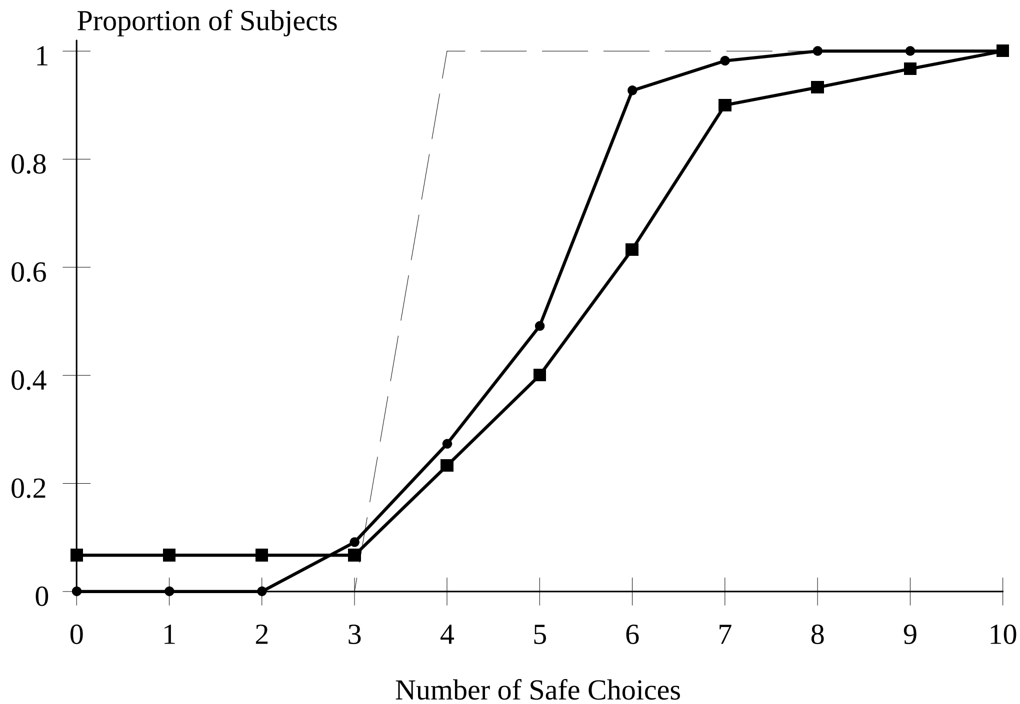

Figure 2. Cumulative Distribution of Safe Choices:
Paying for One Decision versus Paying for All Decisions

Key: 1x Pay One (thin line with dots), 1x Pay All (thin line with crosses), Risk Neutral Prediction (dashed line)

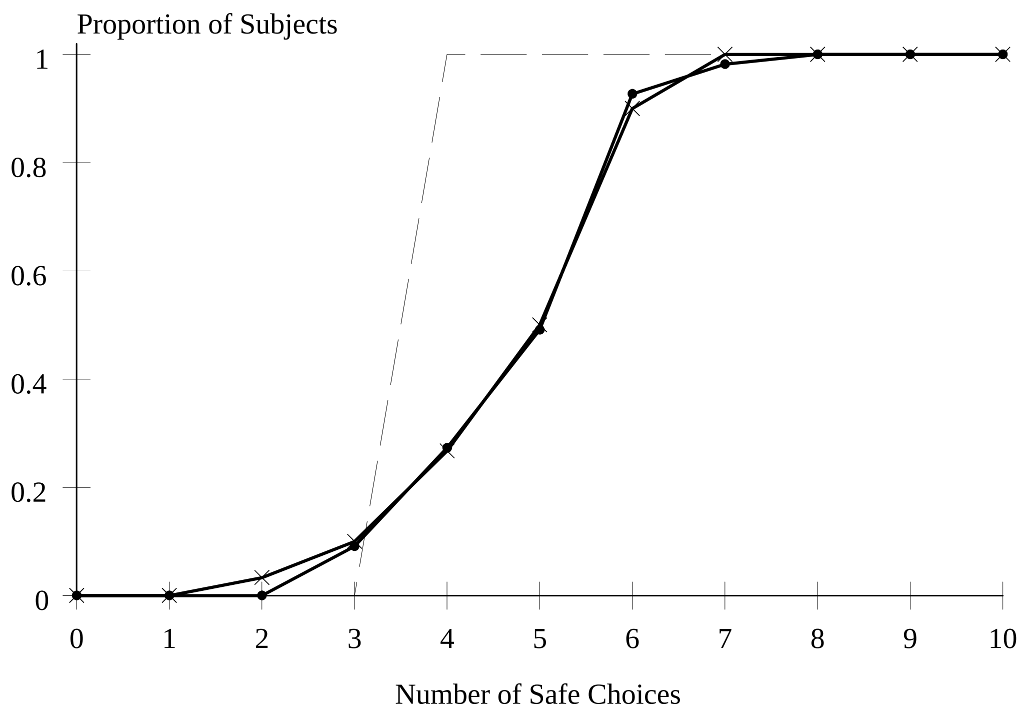

Figure 3. Frequency Distribution of Safe Choices

Key: 1x Pay One (thin line with dots), 1x Pay All (thin line with crosses), 10x Pay One (thin line with squares)

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Appendix A. Experiment Instructions

Control Treatment: 1x Pay One

Your computer screen shows ten decisions. Each decision is a paired choice between "Option A" and "Option B." You will make ten choices and record them using your mouse, but only one of them will be used in the end to determine your earnings. Before you start making your ten choices, please let me explain how these choices will affect your earnings for this part of the experiment.

Here is a ten-sided die that will be used to determine payoffs; the faces are numbered from 1 to 10 (the "0" face of the die will serve as 10.) After you have made all of your choices, we will throw this die twice, once to select one of the ten decisions to be used, and a second time to determine what your payoff is for the option you chose, A or B, for the particular decision selected. Even though you will make ten decisions, only one of these will end up affecting your earnings, but you will not know in advance which decision will be used. Obviously, each decision has an equal chance of being used in the end.

Now, please look at Decision 1 at the top. Option A pays $2.00 if the throw of the die is 1, and it pays $1.60 if the throw is 2-10. Option B yields $3.85 if the throw of the die is 1, and it pays $0.10 if the throw is 2-10. The other Decisions are similar, except that as you move down the table, the chances of the higher payoff for each Option increase. In fact, for Decision 10 in the bottom row, the die will not be needed since each Option pays the highest payoff for sure, so your choice here is between $2.00 and $3.85.

To summarize, you will make ten choices: for each decision row you will have to choose between Option A and Option B. You may choose A for some decision rows and B for other rows, and you may change your decisions and make them in any order. You make your choices by clicking in the circle next to the Option you wish to choose in each decision. To change your decision, you can simply click in the circle for the other Option. After you have made all 10 choices, click on the Submit button at the bottom of the page. Do not click on this button until you are sure about all 10 of your decisions. Once you have clicked this button you can not go back and change any of your decisions!

After everyone has submitted their decisions, we will throw the ten-sided die once to select which one of the ten Decisions will be used. Then we will throw the die a second time to determine your money earnings for the Option you chose for that Decision. Earnings for this choice will be added to your previous earnings, and you will be paid all earnings in cash when we finish.

So now please look at the decisions on your screen. You will have to choose A or B for each of these decisions, and then the die throw will determine which one is going to count. We will look at the decision that you made for the choice that counts, and then the second die throw will determine your earnings for this part. The computer will then report your earnings to you.

Are there any questions? Now you may begin making your choices. Please do not talk with anyone while we are doing this; raise your hand if you have a question.

Treatment 1: 10x Pay One

Your computer screen shows ten decisions. Each decision is a paired choice between "Option A" and "Option B." You will make ten choices and record them using your mouse, but only one of them will be used in the end to determine your earnings. Before you start making your ten choices, please let me explain how these choices will affect your earnings for this part of the experiment.

Here is a ten-sided die that will be used to determine payoffs; the faces are numbered from 1 to 10 (the "0" face of the die will serve as 10.) After you have made all of your choices, we will throw this die twice, once to select one of the ten decisions to be used, and a second time to determine what your payoff is for the option you chose, A or B, for the particular decision selected. Even though you will make ten decisions, only one of these will end up affecting your earnings, but you will not know in advance which decision will be used. Obviously, each decision has an equal chance of being used in the end.

Now, please look at Decision 1 at the top. Option A pays $20 if the throw of the die is 1, and it pays $16 if the throw is 2-10. Option B yields $38.50 if the throw of the die is 1, and it pays $1 if the throw is 2-10. The other Decisions are similar, except that as you move down the table, the chances of the higher payoff for each Option increase. In fact, for Decision 10 in the bottom row, the die will not be needed since each Option pays the highest payoff for sure, so your choice here is between $20 and $38.50.

To summarize, you will make ten choices: for each decision row you will have to choose between Option A and Option B. You may choose A for some decision rows and B for other rows, and you may change your decisions and make them in any order. You make your choices by clicking in the circle next to the Option you wish to choose in each decision. To change your decision, you can simply click in the circle for the other Option. After you have made all 10 choices, click on the Submit button at the bottom of the page. Do not click on this button until you are sure about all 10 of your decisions. Once you have clicked this button you can not go back and change any of your decisions!

After everyone has submitted their decisions, we will throw the ten-sided die once to select which one of the ten Decisions will be used. Then we will throw the die a second time to determine your money earnings for the Option you chose for that Decision. Earnings for this choice will be added to your previous earnings, and you will be paid all earnings in cash when we finish.

So now please look at the decisions on your screen. You will have to choose A or B for each of these decisions, and then the die throw will determine which one is going to count. We will look at the decision that you made for the choice that counts, and then the second die throw will determine your earnings for this part. The computer will then report your earnings to you.

Are there any questions? Now you may begin making your choices. Please do not talk with anyone while we are doing this; raise your hand if you have a question.

Treatment 2: 1x Pay All

Your computer screen shows ten decisions. Each decision is a paired choice between "Option A" and "Option B." All earnings that you see on your screen are in pennies. You will make ten choices and record them using your mouse. All 10 decisions will be used in the end to determine your earnings. Before you start making your ten choices, please let me explain how these choices will affect your earnings for this part of the experiment.

Here is a ten-sided die that will be used to determine payoffs; the faces are numbered from 1 to 10 (the "0" face of the die will serve as 10.) After you have made all of your choices, we will throw this die a total of 10 times to determine what your payoff is for the option you chose, A or B, for each of the 10 decisions. So the first die throw will determine your payoff for Decision 1. The second die throw will determine your payoff for decision 2, and so on.

Now, please look at Decision 1 at the top. Option A pays $2.00 (200 pennies) if the throw of the die is 1, and it pays $1.60 (160 pennies) if the throw is 2-10. Option B yields $3.85 (385 pennies) if the throw of the die is 1, and it pays $0.10 (10 pennies) if the throw is 2-10. The other Decisions are similar, except that as you move down the table, the chances of the higher payoff for each Option increase. In fact, for Decision 10 in the bottom row, the die will not be needed since each Option pays the highest payoff for sure, so your choice here is between $2.00 or $3.85.

To summarize, you will make ten choices: for each decision row you will have to choose between Option A and Option B. You may choose A for some decision rows and B for other rows, and you may change your decisions and make them in any order. You make your choices by clicking in the circle next to the Option you wish to choose in each decision. To change your decision, you can simply click in the circle for the other Option. After you have made all 10 choices, click on the Submit button at the bottom of the page. Do not click on this button until you are sure about all 10 of your decisions. Once you have clicked this button you can not go back and change any of your decisions!

After everyone has submitted their decisions, we will throw the ten-sided die 10 times to determine what your payoff for all 10 decisions (based on which Option you chose in each decision). Earnings from all 10 choices will be added to your previous earnings, and you will be paid all earnings in cash when we finish. Remember that the earnings that you see on your screen are in pennies.

So now please look at the decisions on your screen. You will have to choose A or B for each of these decisions. We will look at the choice that you made for the first decision, and then the die throw will determine your earnings. Then we will look at the choice that you made for the second decision, then the second die throw will determine your earnings for this decision, and so on. The computer will then report your total earnings to you, from all 10 decisions.

Are there any questions? Now you may begin making your choices. Please do not talk with anyone while we are doing this; raise your hand if you have a question.