Individual Sense of Fairness: An Experimental Study

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Abstract

Many prior studies have identified that subjects in experiments demonstrate preferences for fair allocations. We present an experimental study designed to test whether a similar concern for fairness manifests itself when the decision maker is choosing among differing probabilistic allocation mechanisms that will all generate an *ex post* unfair allocation by assigning an indivisible prize to one individual. This investigation is inspired by Karni and Safra (2002) in which a structure for preferences for fairness in such an environment was developed. Here we use this model to design experiments that allow us to test for the presence of concern for fairness in individual choice behavior and examine some factors that may affect the intensity of the concern for fairness.

1 Introduction

By and large, neoclassical economics is founded on a narrow notion of self-interest seeking behavior, where self-interest is defined in terms of *material well-being*. This stands in stark contrast to long held views, in philosophy and psychology, maintaining that human behavior is motivated in part by emotions and, in particular, by moral sentiments.[1] There is, however, growing interest among economists in the potential implications of broadening the psychological base of the model of individual behavior, by incorporating emotions into the theory of choice. (See, for example, a survey by Elster [1998] and discussions by Loewenstein [2000], Romer [2000].) This interest is partly due to experimental evidence showing that subjects do not always make choices consistent with narrow definitions of pure self-interest.[2]

In this paper we explore, via an experiment, some issues pertaining to the presence of an intrinsic sense of fairness as a motive force in individual choice behavior. Specifically, confronting subjects with choices among allocation procedures involving random selection of a winner of a predetermined prize, we look for evidence of willingness to sacrifice one's own chance of winning to attain what is perceived to be a fairer allocation procedure. Our subjects participate in a three-person dictator game in which one of the three players chooses a lottery that is used to determine who, among

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[1] See Hume (1740), Smith (1756), Rawls (1963, 1971) for philosophical discussions.

[2] A comprehensive list of such papers is too long to include, but a good introduction to this literature can be found in chapter 2 of Camerer (2003).

the three, wins a $15 prize. This work is inspired by two recent papers of Karni and Safra (2002, 2002a). The first paper presents an axiomatic model of choice among random allocation procedures of individual motivated, in part, by concern for fairness. The second paper introduces measures of the intensity of individual sense of fairness and derives their behavioral characterizations. Our experimental design is based on the analytical framework of Karni and Safra (2002) and is intended to test their contention, that inherent sense of fairness is manifested in individual choice among random allocation procedures.

Studies of three person ultimatum games include Güth and Van Damme (1998) and Bolton and Ockenfels (1998,1999). Typically these games involved one person proposing a split among all three players with one of the other two being designated to accept or reject the proposed split. In our experiments, there is no acceptance/rejection decision. Their proposal was that people care only about the average payoff to the other two and find that players seem relatively unconcerned with the distribution among the other players. Kagel and Wolfe (2001) examine three person ultimatum games allowing for a "consolation prize" to the third party if a proposal is rejected to examine some reciprocity issues.

Charness and Rabin (2002) investigate a wide variety of games including a few three person dictator games in an attempt to distinguish between models of fairness as resulting from "difference aversion" as proposed by Fehr and Schmidt (1999), or from what Charness and Rabin label as "social welfare" preferences as suggested by the results in Andreoni and Miller (2000). Individuals who possess "difference averse" preferences dislike having any individual's payoff too different from any others. Persons with "social welfare" preferences are less interested in any absolute differences in payoffs, but are more interested in helping out those players with low payoffs than those with higher payoffs.

The three person dictator games in Charness and Rabin (2002), however only allow dictators to make binary choices which restricts the potential richness of choices that more options along a line segment will allow. Their primary interest appears to be in investigating reciprocity issues and not necessarily fairness as such. Their results do show that subjects are willing to give up some potential for gain in an attempt to equalize the payoff to the other subjects, much as our results will show. Engelmann and Strobel (2004) present the results from similar experiments in three person dictator games in which the subjects choices are also limited to binary choices. They, however, designed the available choices to test between specific models of fairness. They find some evidence in favor of difference averse preferences but also find that there are substantial deviations from such a model that may be best explained through efficiency or "maximin" considerations.

Our method is similar to the experiments of Andreoni and Miller (2000). Andreoni and Miller have subjects allocate coins between themselves and another subject along particular exchange rates. This is equivalent to presenting the subjects with a choice from multiple possible budget sets. Their interest was in determining the degree to which subjects would violate the basic axioms of revealed preference theory. There is also a related series of papers in Fisman et al. (2005a-c) in which the authors use a similar approach for testing issues involved in preferences for fairness by constructing a graphical representation of 2 and 3 person dictator games in which the dictator gets to choose from a carefully constructed budget set in which the authors are essentially varying the price for trading off welfare for the dictator and the recipient. The key difference between the Andreoni and Miller approach are that Fisman et al. present the subjects with a much larger number of budget sets and present some budget sets with varying structures that allow the authors to test for a few specific notions of fair behavior.

Our design has a similar interpretation: the line segment, in the probability simplex, is the equivalent of a budget constraint and the dictator's choice represents the point in that budget constraint that intersects his "highest" indifference curve. Our purpose, however, is different from that of both the Andreoni and Miller and Fisman et al. Those authors were mainly interested in determining the consistency of choices in deterministic environments. Our main interest is to look for manifestation of a concern for procedural fairness as proposed in Karni and Safra (2002). This requires a new experimental design in which the choices involve uncertainty in a manner that was not studied previously. Many studies provide evidence suggesting the existence of preferences for fairness in deterministic allocations. This study examines the presence of a concern for fairness in individual choice among random allocation procedures. We note that, if one's sole concern is the fairness of the outcome, then any procedure such as ours that assigns a prize to one among equally deserving individuals is equally unfair. Even if a person is willing to compensate another person to make the ex-post allocation fairer, it does not necessarily follow that the same person would be willing to reduce his chance of winning a prize to improve the chances of others. Our study focuses on this issue.

Bolton, Brandts and Ockenfels (2005) also studied individual preferences over allocation mechanisms using experimental methods. In that paper, the authors have subjects choose between different discrete procedures for dividing an amount of money. One set of treatments involved the proposer's offer in an ultimatum game being determined by lottery. The lottery was defined by the experimenter and not chosen by the proposer. Other treatments allow the proposer to choose between having a lottery make an initial offer or making the offer themselves. The interest of that paper appears to be focused on the receiver's view of their treatment at the hands of the proposer in terms of "fairness," or more properly the "acceptability," of different offers depending on the mechanism through which the offer is made. Our interest is a more direct assessment of the preference structure of the individual making the offer. These are complementary lines of research aimed at different aspects of the broad question of how people view the fairness of different procedures.

The rest of the paper is organized as follows: In Section 2, we will provide a brief description of the theoretical environment from Karni and Safra (2002) and describe the experiments designed to test the theory. In Section 3, we present and analyze the findings. The main conclusions and issues raised by this work are summarized in Section 4.

2 Theory and the Design of the Experiments

2.1 Theory

To set the stage, we review briefly those elements of the theory of Karni and Safra that are relevant for the current study. We focus on aspects of the model that underlie the experimental design.

Let $N = \{1, ..., n\}, n > 2$, be a set of individuals who must decide on a procedure by which to allocate, among themselves, one unit of an indivisible good. Because only one individual is awarded the good, the ex-post allocation is necessarily unfair. The issue, therefore, is what allocation procedure may be implemented to attain a higher level of fairness ex-ante. Karni and Safra (2002) restrict attention to procedures that allocate the good by lot. Formally, let e^i, the unit vector in $\mathbb{R}^n$, denote the *ex-post* allocation that assigns the good to individual i. Let $X = \{e^i \mid 1 \leq i \leq n\}$ be the set of *ex-post* allocations and let P be the $n-1$ dimensional simplex representing the set of all probability distributions on X. In this context, P has the interpretation of the set of *random allocation procedures*, or allocations by lot.

An individual, in this model, is characterized by two binary relations, $\succcurlyeq$ and $\succcurlyeq_F$, on P. The preference relation $\succcurlyeq$ represents his actual choice behavior and the relation $\succcurlyeq_F$ represents his conception of fairness. The preference relation $\succcurlyeq$ has the usual interpretation, namely, for any pair of allocation procedures p and q in P, $p \succcurlyeq q$ means that, if he were to choose between p and q, the individual would either choose p or be indifferent between the two. The fairness relation, $\succcurlyeq_F$, has the interpretation of "fairer than," that is, $p \succcurlyeq_F q$ means that the allocation procedure p is regarded by the individual as being at least as fair as the allocation procedure q. The notion of fairness and how intense the sentiment for fairness is, are subjective, intrinsic and, together with concern for self-interest, governs the individual's behavior.

Taking the preference and the fairness relations as primitives, Karni and Safra (2002) derive a third binary relation, $\succcurlyeq_S$ representing the self-interest motive implicit in the individual behavior. Loosely speaking, an allocation procedure p is preferred over another allocation procedure q from a self-interest point of view if the two allocation procedures are equally fair and p is preferred over q. Moreover, Karni and Safra introduce axioms that are equivalent to the existence of an *affine* function $\kappa : P \to \mathbb{R}$ representing the relation $\succcurlyeq_S$, a strictly quasi-concave function $\sigma : P \to \mathbb{R}$ representing the fairness relation $\succcurlyeq_F$, and a utility function V representing the preference relation $\succcurlyeq$ as a function of its self-interest and fairness components, i.e., for all allocation procedures, $p, q \in P$,

$$p \succcurlyeq q \Leftrightarrow V\left(\left(\kappa \cdot p, \sigma\left(p\right)\right) \geq V\left(\left(\kappa \cdot q, \sigma\left(q\right)\right).$$

In addition, Karni and Safra (2002) examine the case in which the function V is additively separable in the self-interest and fairness components. Formally,

$$V\left(\left(\kappa \cdot p, \sigma\left(p\right)\right) = h\left(\kappa \cdot p\right) + \sigma\left(p\right),$$

where h is a monotonic increasing function.

The experimental design, used to test this theory, is a three person version of a dictator game in which the dictator must choose how to allocate the chances of winning the prize. The dictator is not given complete freedom to pick any allocation he desires, rather he must select the allocation from a predetermined set of such allocations represented by a line segment in the probability simplex. We will be testing whether the preference structures hypothesized in Karni and Safra (2002, 2002a) exist, or whether in such an environment people possess indifference curves that are curved or straight. A more specific description of these possible preference structures is contained below.

This experimental design is faithful to the theoretical model of Karni and Safra (2002). To develop their model, Karni and Safra used three agents and allowed one individual to express his preferences among (a subset of) lotteries that assign to himself the same probability of winning but traded off the probabilities of winning for the other two agents. This setup was used to neutralize the self-interest motive for the decision maker to focus on the fairness motive. Our experiment is designed to test whether individuals are willing to sacrifice their own chance of winning to improve the overall fairness of the allocation procedure based upon the nature of preferences proposed in Karni and Safra. Therefore, in the experiments, we have preserved the general structure which requires using three subjects as in the original theoretical work but we do not hold the decision maker's probability of winning fixed.

2.2 Experimental Design

The design of these experiments is a three person dictator game, which is executed using a modified version of the interface used in Sopher and Narramore (2000). The experiments involved bringing groups of subjects, in multiples of three, into a computer lab. The subjects were given a verbal introduction to the experiment, including an overview of the rules, and were then led through an interactive help program to make sure that they understood the interface and rules of the experiment. When the subjects had completed the instructions sequence, each subject was randomly assigned a type of either A, B or C. The subjects were then divided anonymously and randomly into three person groups with one subject of each type in each group. The subject A in each group, whose behavior is the main concern of this study, was asked to choose the allocation of the probabilities to the subjects in the group to be used in the actual lottery for a $15 prize. More specifically, the subjects of type A are asked to design a lottery $p = (p_A, p_B, p_C)$, where $p_i \geq 0$, $i = A, B, C$ and $\Sigma_{i=1}^{3} p_i = 1$, to be used to select the winner of the $15. In this context, p_i is the probability that subject i wins the prize. The question to A was phrased as follows: "Please choose the allocation of chances to be used in deciding who among A, B, and C wins the prize."

The subjects B and C in each group were asked to perform similar tasks, but their choices did not affect their own or the other players' payoffs. In particular, the B subjects were asked to respond to the question: "Please select the allocation that you would choose if you were the decision maker, subject A." The C subjects were asked to respond to the question: "Please select the allocation that you believe is fair." The main purpose of doing this was to give the other subjects a choice task such that no subject could identify who was A by observing some subjects making a choice and others not. As a secondary consideration, it is interesting to examine the preferences expressed by the other subjects in a hypothetical context, and to elicit their views on what the fair allocation procedure is. Note that it was important, in our design, that the choices made by subjects B and C should not be incentivized (e.g. we could not pay the B subjects using an incentive compatible scoring rule to induce them to make careful choices). The reason is, that if the B subjects were paid then A's choice would not be the sole determinant of the final payoff of B, which is key to the interpretation of their choices. With this qualification, it is nonetheless of interest to examine the responses of the B and C subjects.

The A subjects were informed that they were the only ones making a choice affecting the payoffs of everyone in their group, and the subjects B and C were fully informed that their choices would not affect their payoffs. The A subjects were further informed that the subjects B and C would be responding to other questions, but were not told what those other questions were. For precise information on what the subjects were told, there is a complete record of the help screens that the subjects were led through to explain the experiment contained in the Appendix.

The choice set, corresponding to this design, is a 2-dimensional simplex depicted in Figure 1. The top vertex of the triangle represents the allocation procedure according to which the subject A is the sure winner. Similarly, the lower left and right vertices are the allocation procedures that making subjects B and C, respectively, the sure winners. Supposing that the three subjects perceived themselves to be equally deserving of the prize, the intensity of their sense of fairness can be represented, in this context, by the curvature in their indifference curves.[3] At one extreme, if the subject A exhibits no sense of fairness, then his indifference curves will be straight lines, such as line 1, along which p_A is constant. However, if he is concerned about the fairness of the allocation procedure, and regards the two other subjects in the group as equally deserving of the prize then, assuming that his preferences are continuous, the indifference curves may be convex, as shown by line 2 indicating strict preference for fairness.[4] This indifference curve depicts a willingness to sacrifice one's own probability of winning to attain a fairer overall allocation procedure.

In the experiment, a subject is presented with a line segment, in this simplex, along which his own probability of winning varies with the probabilities of the other subjects, and is asked to choose a point along it. If the subject is not concerned about fairness, then he should select the endpoint that gives him the maximum probability of winning. If, however, the subject does possess a sense of fairness, and if fairness calls for the assignment of equal probabilities of winning to other subjects that have equal claims for the prize (e.g., equal treatment of equals) then the optimal lottery may be represented by a point in the interior of the line segment.

[3]See Karni and Safra (2000a) for a detailed analysis.

[4]The continuity of the preference relation rules out lexicographic orderings under which concerns for fairness may

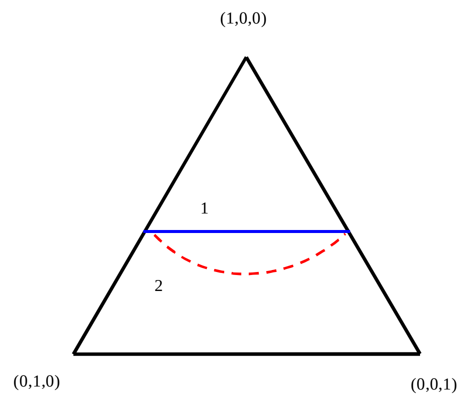


Figure 1: Characterization of indifference curves. Line 1 characterizes a person with no preference for fairness. Line 2 characterizes a person who exhibits a preference for fairness.

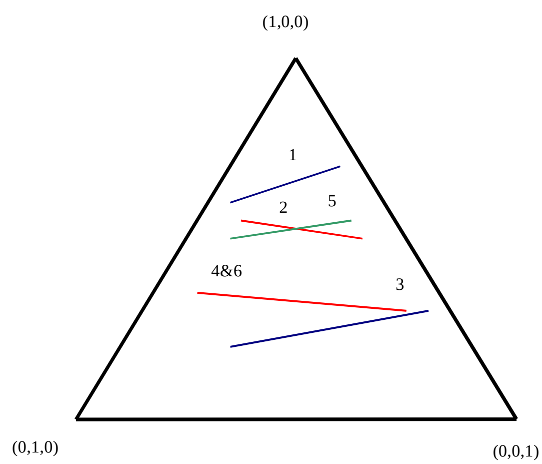


Figure 2: Graphical representation of the line segments used in the experiment.

	Endpoint 1			Endpoint 2		
	p_A	p_B	p_C	p_A	p_B	p_C
$Q1$	70	5	25	60	35	5
$Q2$	55	35	10	50	10	40
$Q3$	30	5	65	20	55	25
$Q4$&$Q6$	35	55	10	30	10	60
$Q5$	55	10	35	50	40	10

Table 1: Lotteries defining the endpoints of the line segments used in the experiments.

The subjects were asked to make a total of six choices along 5 different line segments. These are depicted in Figure 2 and the lotteries defining the endpoints of the line segments are shown in Table 1. The line segments chosen possessed some specifically designed similarities to allow the investigation of specific issues to be discussed in more detail later. After each choice, the groups of players were reshuffled randomly, but the subjects retained their type throughout the experiment (that is, a subject who was assigned type A at the outset remains type A for all six trials).

The use of multiple sequential choices raises the possibility that subjects could engage in behavior based upon compounding the lotteries across choices. This could have lead the A subject to think that he was being fair by staying at the starting endpoint of the line segment in all of the choices. (The reasoning would be that, over the course of the experiment, this might equalize the chance of winning for subjects B and C). Consequently, even if A did not move from the endpoint, it would not have been possible to conclude that these choices were not motivated, in part, by a concern for fairness. To overcome this problem, only the first lottery was used to generate actual payoffs. The choices made by the type A subjects on this question were used in the actual lotteries that determine the winner of the $15 prize. To ensure that the subjects believed the lotteries were run fairly, an extra subject was recruited in each session to run the lotteries with a pair of 10-sided dice and then observe that the proper amount of money was inserted into envelopes to pay the subjects at the end of the experiment.

Because only one line segment was used to select an actual lottery, this raises a question concerning the reliability of the answers given for the other five questions. To aid in determining the degree to which this is important, half the subjects were asked question 1 first and the other half question 2. By checking the degree of consistency between the choices of the two groups on the paid and unpaid question, we test the degree to which subjects display a stronger preference for fairness when the decision is hypothetical versus when it is real.

An example of the interface used in this experiment can be found in the Appendix. The subjects were presented with an initial allocation indicating the chances, out of 100, for each subject in the group to win the lottery. These chances appeared as colored slices of a pie. Subjects could use a slider bar to move along the line segment between this point and the other endpoint. With each movement of the slider bar, both the chances of the subjects to win and the pie chart were updated accordingly. The final choice of a subject can be represented by a number $\lambda \in [0, 1]$ such that λ is the weight used to create the convex combination of the endpoints resulting in the chosen allocation. For all questions, a choice of $\lambda = 1$ indicates that the type A subject chose the point that maximized his probability of winning while a choice of $\lambda = 0$ indicates that he chose an allocation procedure that minimized his chance of winning. Note that lower values of λ correspond to greater equality of the probability of winning assigned to subjects of types B and C.

be a dominated concern.

One complication to this analysis was introduced because of the desire to list the probabilities of each subject winning the lottery as integers between 0 and 100. This caused the actual line segments the subjects were choosing along, to be jagged instead of smooth. The formulae used to generate these probabilities were :

$$\begin{aligned} p_A &= Round(\lambda\overline{p}_A + (1-\lambda)\bar{q}_A) \\ p_B &= Round(\lambda\overline{p}_B + (1-\lambda)\bar{q}_B) \\ p_C &= 100 - p_A - p_B \end{aligned} \tag{1}$$

where p_i is the probability allocated to subject $i \in \{A, B, C\}$ by the choice of λ while $\bar{p}_i$, is the probability that subject i would win at the upper endpoint and $\bar{q}_i$ is the probability at the lower endpoint. The slider bar used had 31 discrete "click" points including the starting point along it that the subjects could choose. The number λ was then calculated by taking the "click" point along the slider bar chosen and dividing it by the number of discrete clicks that were made available.

The subjects used in these experiments were drawn from two separate populations. One group of subjects consisted of (mainly) undergraduate and (some) graduate students at The California Institute of Technology (CIT), and the other consisted of students from Pasadena City College (PCC). In total 135 subjects participated in these experiments, with 69 from CIT and 66 from PCC. Each session included subjects from only one population or the other.

Earnings from these sessions consisted of 1 out of every 3 subjects winning a \$15 prize, in addition to their show-up fee, and the other 2 out of 3 subjects receiving only their show-up fee. For CIT subjects, the show-up fee was \$5 and for the PCC subjects the show-up fee was \$10.[5] The sessions for these experiments lasted from 20 minutes up to 40 minutes. Most sessions lasted between 20 and 30 minutes.

3 Results

3.1 Methods

The experimental results are choices of probability mixtures $(\lambda, (1-\lambda))$ of two lotteries, where, for each question, λ denotes the weight on the lottery that gives A the distribution that first-order stochastically dominates all the other feasible distributions in his choice set. Underlying these choices, we hypothesize, is the subject's weighting of the importance of the fairness of the overall allocation procedure relative to his or her own probability of winning, as outlined in Section 2. Let $\lambda_i \in [0, 1]$ be the observed choice of subject i, from the discrete choice set $\{\alpha_0 = 0, \alpha_1, \alpha_2, ..., \alpha_{J-1}, \alpha_J = 1\}$ and assume that $0 < \alpha_1 < \alpha_2 ... < \alpha_{J-1} < 1$. Let $\widetilde{\phi}_i = \mathbf{x}_i\beta + \varepsilon_i$ be an unobservable latent random variable measuring the subject i's intensity of the sense of fairness, and ε_i is a random variable representing unobservable factors determining the subject's choice. This is a noisy approximation of the intensity of the sense of fairness characterized in Karni and Safra (2002a). Then there exist threshold parameters, $(\mu_1, ..., \mu_J)$, such that if $\mu_j \leq \phi_i \leq \mu_{j+1}$ then $\lambda_i = \alpha_j$, for all $j = 0, 1, ..., J-1$.

In the estimated model, we include indicators for each distinct question in the experiment to capture any variation in choice behavior due to the differences in budget constraints. The rest of the regressors include various other characteristics of the subject or the session. The first is a dummy variable for the sex of the subject, MALE, equal to 1 if the subject was male and 0 for female.

[5] The reason for the differential is simply to encourage PCC students to travel the extra distance to Caltech where the experiments were run. In addition, some subjects redeemed recruitment coupons worth \$10 that are given to PCC students when they sign-up to be on the recruitment list to be used in their first experiment.

We have two dummy variables for whether or not the question resulted in earnings. As discussed before, half of the subjects saw Q1 first and it generated earnings while the other half saw Q2 first and it generated earnings. We have the variable PAY which is equal to 1 if the question will result in payment and then we have PAY*Q2 which is that variable interacted with a dummy variable if the question was Q2. Both are there to determine if the hypothetical choices are different than the paid choices while the interacted variable is there to determine if there was a difference in this depending on whether or not the paid question was Q2. Also, to determine if the ordering issue mattered, i.e., whether subjects saw Q1 or Q2 first, we have a dummy variable, ORDER, equal to 1 if Q1 was first and 0 if Q2 was first. This variable, however, is intended to capture possible overall differences in the average behavior of the two groups, not just their behavior on the paid questions. Although it may not be obvious from the previous formal account of the ordered probit model, it is nonetheless the case that the signs of the coefficient (given that the underlying regressor is always positive) indicate more selfish choices when positive, less selfish choices when negative, compared to the baseline choice of Question 1, not paid.

We estimate a random effects ordered probit model. The random effects specification means that we treat the error, ε_i, as being composed of two parts, an individual-specific component, which is the same for every observation on an individual, and an idiosyncratic component which varies over different observations on an individual.[6] Since choices are ordered along each line segment in the simplex, we can treat each mixture choice with positive mass in the distribution of choices as a discrete choice. In fact, however we have reduced the full set of discrete choices observed into 9 categories, as shown in table 2. We have done this because the random effects estimation cannot be performed if the cell counts in a category are too small. Henceforth, we may refer to these new choice categories as the λ choice of the subject, though it should be kept in mind that each of these choice categories correspond to a range of choices in the actual experiment. With a few exceptions, the range for a category is .10. The range for category 0 is .15, due to the small number of choices in this lower range. The range for category 4 is .20. The vast majority of choices in this range (94% of them) lie between .5 and .6 however, even though the full range is from .45 to .65. We formed one larger category here to avoid possible misleading inferences resulting from choices that would be near a border between category at .55 (e.g., there are large concentrations of choices at .533 and at .566). Category 8 contains a range of only .05, but with a very large concentration of choice at 1. The table also shows the distribution of choices by the three player types over the 9 categories. Finally, note that none of the actual λ choices lie on the border between categories. There were choices at .1, .2, etc., which was the main reason for using .15, .25, etc. as the borders between categories.

Table 3 contains results of the random effects ordered probit regression model which help us summarize efficiently the within- and between-question differences. We have only presented the regression results for type A subjects because theirs was the only choice that was incented. We briefly describe the choice behavior of the B's and C's below but will subject them to no analysis. The dependent variable is CHOICE, the mixture category corresponding to the chosen λ_i, while the regressors are as explained above. The coefficients and corresponding p-values for the z-statistics are reported for each variable. The table also reports Groups(OBS) (the number of groups for the random effects, i.e. subjects, and the number of observations per subject), LL (log-likelihood for the estimated model), and the p-Value, the probability associated with the model chi-squared test for the regression.

The regression for A subjects has significant coefficient estimates on MALE, CIT, and ORDER. The positive sign on the first two indicate that males and CIT students, on average, made signifi-

[6]We use the REOPROB procedure, an ADO routine in Stata written by Guillaume Frechette.

Choice Category	**Type A**	**Type B**	**Type C**
0 ($0 \leq \lambda \leq .15$)	3	6	3
1 ($.15 < \lambda \leq .25$)	3	7	9
2 ($.25 < \lambda \leq .35$)	8	13	11
3 ($.35 < \lambda \leq .45$)	6	0	12
4 ($.45 < \lambda \leq .65$)	118	73	145
5 ($.65 < \lambda \leq .75$)	7	6	6
6 ($.75 < \lambda \leq .85$)	6	6	5
7 ($.85 < \lambda \leq .95$)	23	10	8
8 ($.95 < \lambda \leq 1$)	96	140	71

Table 2: Bins used for choices of λ in the ordered probit regression with number of choices in each bin by subject type.

Indep Variable	**Choice**	
	Coefficient	**P-Value**
MALE	0.92	<0.01
CIT	1.04	<0.01
PAY	0.37	0.40
PAY * Q2	0.54	0.42
ORDER	-0.89	0.01
Q2	-0.52	0.43
Q3	-0.07	0.35
Q4	-0.44	0.36
Q5	0.19	0.36
Q6	-0.42	0.36
Groups(OBS)	45(6)	
LL	-306.98	
P-Value	.00	

Table 3: Ordered Probit Results for Choice Mixture Chosen.

Player Type	Type A	
Category Chosen	Cat. 4	Cat. 8
MALE	-33%*	+30%*
CIT	-37%*	+32%*
PAY	-14%	+12%
PAY*Q2	-31%	+26%
ORDER	+28%*	-21%*
% of Choices	44%	36%

Table 4: Marginal Effects on Probability of Choice for Modal Choices. * indicates significance at the 1% level.

cantly more selfish choices. The negative signs on the ORDER variable indicate that the group of subjects for whom Question 2 was the paid question were significantly less selfish (on all questions, on average). The regression includes estimated "cut-points," which are essentially constant terms for each of the discrete choice categories (and correspond to the threshold values discussed earlier). We do not report these, except to note that a majority of them are significant.

While the signs of the coefficients indicate the general nature of the shift in behavior, towards higher probabilities of more selfish choices, a more precise measure of the effects of the variables can be obtained by computing the marginal effects of the variables on the estimated probabilities of the various choices. There are 45 discrete choice values in the subject choices, and we have reduced these to 9 distinct categories. We compute marginal effects for the two modal choices: category 4, corresponding to choices between .45 and .65 (about 41% of all choices) and category 8, corresponding to choices between .95 and 1 (about 39% of all choices), which together account for 80% of all choices. Typically, we find (for the significant coefficients) that a positive sign on the coefficient corresponds to an increase in the probability that category 8 is chosen, and a decrease in the probability that category 4 is chosen, while a negative sign indicates the reverse.

Table 4 contains the results of these computations. The table shows the change in the probability of choice for a change from 0 to 1 of each independent variable, computed with the other independent variables at their mean sample values. We do not show the z-statistics (which are very similar to those of the estimated coefficients in the regressions), but only indicate whether the effect is significant at the 1% level or better by an asterisk. In general, the marginal effects are computed with the relevant dummy variable equal to one vs. zero, and all other variables at their sample means. The one exception is the marginal effect for PAY*Q2, where we set the PAY variable set to one or zero along with the PAY*Q2 variable. Thus, for this variable only, the marginal effect is very specifically the effect of pay on choosing for question 2.

An example of how to read these results is that male type A subjects are 30% more likely to choose category 8 (and 33% less likely to choose category 4) than female subjects. Similarly, CIT students are 32% more likely to choose category 8 (and 37% less likely to choose category 4) than are Pasadena City College students. In general, the significant effects are large, which is not surprising, given the concentration of choices in the two categories in question.

3.2 Further Analysis

Next we take a closer look at the results from our experiment by presenting histograms of the choice behavior in order to convey the general structure of the data. We will then proceed through the main questions of interest using the results from the previous regressions and additional tests in order to establish a clear answer to each question.

3.2.1 Comparison of Choices Between Subject Types

Figure 3 contains a histogram of the choices made by the A players for all questions. We have also included figures 4 and 5 which contain the same for both players of type B and C.[7] We present the latter two just for completeness in presenting the data. We will include some descriptive discussion of these data but due to the uncertainty involved in understanding the choices by B and C players, we will subject them to no formal analysis.

On all of the questions, the distribution of A and C choices appear to be remarkably similar. For these subjects there is a bimodal distribution to the choices with one mode at $\lambda = 1$ and this has the natural interpretation of being the most selfish choice for the A subject. The second mode for each question occurs at a λ that comes closest to equalizing the winning probabilities for the B and C players on that line segment. We refer to this point as the LETO for a question as it is the most fair λ associated with a notion of fairness involving Equal Treatment of Others.[8] The distributions for B subjects are also, typically, bimodal, but with a larger mode at 1 than is the case for A or C subjects. Note that these are distributions of the original choices, not the categories used in the regression analysis.

As already mentioned, our main concern is with the behavior of subjects of type A whose choices affect the ultimate payoffs. Due to the fact that choices of λ were restricted to the set $[0, 1]$, all interior λ choices can be interpreted as near optimal choices for the subject.[9] The large number of choices at 1 may well be the result of a censoring effect of the possible choices as the constraint may be binding for these subjects. To grasp the censoring effect recall that ϕ_i is a measure of the intensity of the sense of fairness. It may be assumed to be distributed over the half-open interval $[0, \infty)$. Given a line segment $(\bar{p}, \bar{q})$, let $\lambda^* (\bar{p}, \bar{q}; \phi_i)$ be the optimal choice of subject i who is assigned the role of A. Clearly, $\lambda^* (\bar{p}, \bar{q}; \cdot)$ is a monotonic decreasing function of ϕ_i, that is, the more intense is the individual sense of fairness, the more he is willing to sacrifice his own chance of winning to attain a fairer allocation procedure.[10] Hence the distribution of ϕ_i induces a distribution on $\lambda (\bar{p}, \bar{q}; \phi_i)$. However, the actual range of $\lambda (\bar{p}, \bar{q}; \phi_i)$ is $[\lambda_i^f (\bar{p}, \bar{q}), 1]$, where $\lambda_i^f (\bar{p}, \bar{q})$ denotes individual $i's$ fairest allocation procedure. Let $\bar{\phi}_i$ denote the value that satisfies $\lambda \left(\bar{p}, \bar{q}; \bar{\phi}_i\right) = 1$. Then, the effect of censoring on the induced distribution of $\lambda (\bar{p}, \bar{q};)$ is that it tends to have a concentration at 1. Specifically, $\Pr\{\lambda \left(\bar{p}, \bar{q}; \bar{\phi}_i\right) = 1\} = \Pr\{\phi_i \leq \bar{\phi}_i\} = F \left(\bar{\phi}_i\right)$, where F denotes the cumulative distribution function of ϕ_i. It was the likely presence of this type of censoring, as well as the milder censoring due to the discrete choice set that subjects faced, that

[7] Before proceeding, one unanticipated, feature of the data must be noted. Subjects B were asked what they would choose if they were subjects A, the deciders. In designing their role we intended them to suppose themselves in the position of A and make their choices accordingly. It seems, however, that some B subjects answered the questions as if they were in the position of having the power to determine the allocation procedure, but with themselves still occupying the place of B and getting the chances of winning for a B subject from any given allocation. On line segments choices that slope down to the left (1, 3 and 5), some B subjects (12% of them) chose the lowest point on the line segment. Such choices maximize their chances of winning the prize while minimizing the chances of subject A to win the prize. This behavior makes no sense from the point of view of subject A, since the choice entails simultaneous sacrifice of the subject's own chances of winning and of the fairness of the allocation procedure as a whole. We interpret these choices as reflecting a misunderstanding of the point-of-view that they were supposed to take. To make our case, we note that while occasionally A subjects chose an allocation procedure that minimized their own chances of winning, this occurred in less than 1% of choices. Consequently, in comparing the three histograms in each figure, it is more instructive to shift the mass on the choice of $\lambda = 0$ in the relevant histogram to $\lambda = 1$.

[8] The values of the LETO for each question are as follows: Q1-0.60, Q2-0.54, Q3-0.33, Q4&6-0.52 and Q5-0.54.

[9] Only "near" optimal because the choice set of λ's was limited to discrete choices.

[10] For a formal proof of this assertion see Karni and Safra (2002a).

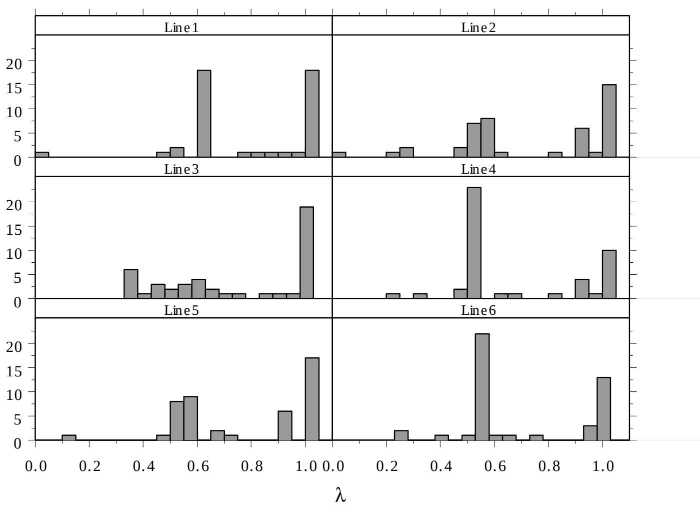


Figure 3: Histograms of choices for players of type A over all line segments.

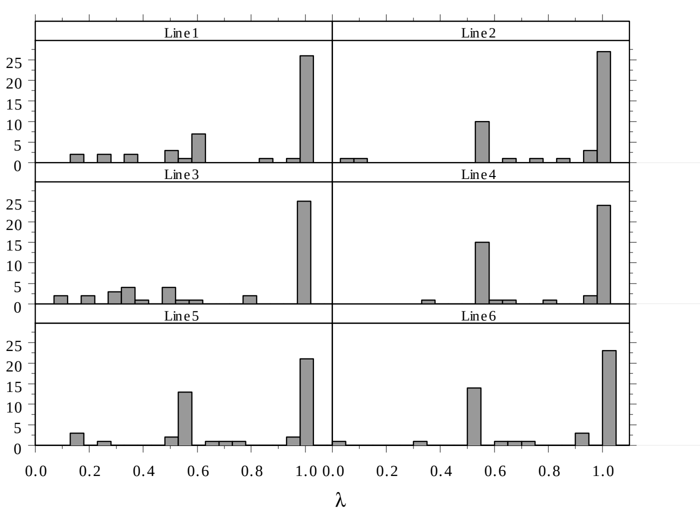


Figure 4: Histograms of choices for players of type B over all line segments.

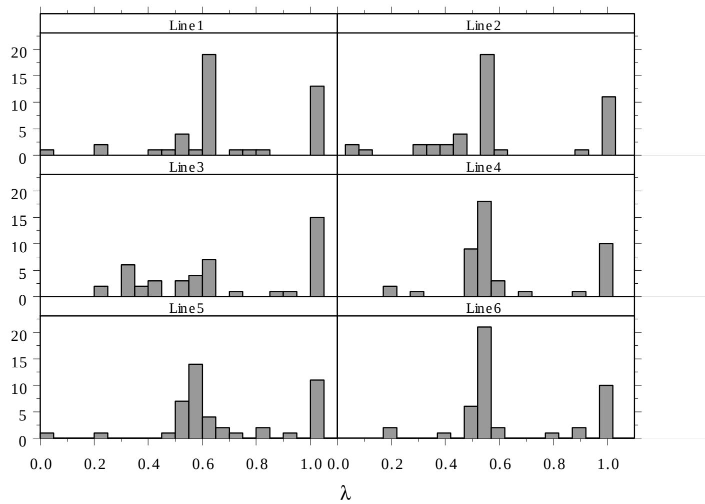


Figure 5: Histograms of choices for players of type C over all line segments.

led us to use the ordered model to estimate the various effects in the previous section.

Perhaps the most important finding, regarding the choices of the A subjects, is the willingness, of a substantial number of them, to trade off their own probability of winning to attain a fairer overall allocation, of these probabilities, among the subjects in the group. This confirms the hypothesis in Karni and Safra (2002) that indifference curves in this environment may be curved instead of horizontal as detailed in figure 1. Due to the nature of the choice task, it was not possible to conduct enough incented choices to construct a map of the space of indifference curves, but this result is enough to show that curvature exists.

3.2.2 Paid versus Unpaid questions

In view of the fact that five of the six questions the subjects answered generated no payoffs, it is natural to ask what, if any, effect this had on the answers. A standard hypothesis from "induced value theory" (Smith [1976]) is that subjects behave more selfishly when the choice has real consequences. The experiment was set up to facilitate addressing this question by having half of the subjects see question 1 first and answer it knowing it will generate a payment and then having the other half answer question 2 first knowing it will generate a payment. The answers on these questions can be compared under paid and unpaid situations to determine if there is a systematic difference in behavior under the two treatments.

The first piece of evidence on this subject comes from the ordered probit results in table 3. The coefficients on both the PAY and PAY*Q2 variables are insignificant for A subjects. The interpretation of these results is that the subjects who made choices on Q1 and Q2 when they were paid did not choose in a manner that is significantly different from those subjects who were not paid based on those decisions.

There might appear to be a complication to this issue in that the ORDER variable is negative and significant. This means that those subjects who saw Q1 first were, on average, less selfish than those who saw Q2 first. Note, however, that this has nothing to do with whether Q1 was first and paid or Q2 was first and paid, but rather reflects an average difference between the subsamples.

This is because the estimated effect takes into account response on all questions, not just the paid questions. One possible explanation for this ORDER effect is that in question 1, the A player begins in a greater position of "wealth" relative to question 2 in that the probability of winning for the A player on question 1 is always greater than on question 2. It is possible that not only were people when in such a position more willing to be generous towards the other players but that this generosity carried forward to other questions as something of an imprinting effect.

Overall, the evidence indicates that there was no difference in behavior between our hypothetical and paid questions for type A players. This allows us to examine the choices we see on all of the hypothetical line segments without having to construct a correction for any hypothetical bias. Again, we chose this approach of paying only on the first choice and not on all or a randomly selected choice as a means of eliminating any lack of independence issues across questions. These results tell us that by doing so we did not create any other problems from the hypothetical nature of most of the questions.

3.2.3 Effect of Prize Size

As mentioned above, an interesting issue in regard to preferences for fairness is whether or not this preference changes based on the importance of the decision. One could construct an argument for why someone might become more selfish as the importance of the prize increases but alternative arguments could be constructed for the reverse as well. We constructed questions 4 and 6 to address this issue as they are almost identical questions, with the only difference being the size of the hypothetical prize. On question 4, the prize was \$15 while on question 6 the prize was \$45.

The results from the ordered probit regression in Table 3 show that the responses to questions 4 and 6 are close to identical (and, as for the PAY variable, are not significant) indicating that there is little difference in the responses obtained on the two questions. A Wilcoxon signed rank test regarding the equality of the matched pairs of responses results in a z-statistic of -0.2836 and p-value of 0.7767. Thus, contrary to what we expected, we find no statistically significant difference in the choices on these two questions that can be attributed to the size of the prize.

3.2.4 Symmetry

Once we allow departures from the standard self interest model, it is important to verify that the general structure of preference theory still holds leading to consistency of choices. In our experiment consistency in the form of symmetry requires that behavior on questions 2 and 5 should be similar as these line segments are identical except the positions of the B and C subjects have been reversed. Because B and C subjects have identical status in the game, the A subjects should see no reason to treat one differently from the other. Thus if the A subjects do treat B and C symmetrically, their choices on the two line segments should be similar.

The estimated coefficients in the ordered probit model, shown in table 3, are insignificant. The histograms in figure 3 look remarkably similar, which tends to reinforce our conclusion that there is no significant difference here. A Wilcoxon signed rank sum test and a Kolmogorov-Smirnov test for the differences in the distribution of λ's across questions 2 and 5 for type A subjects results in p-values of 0.25 and 0.995 respectively. These tests were performed on the raw choice data, not based on the bins used in the estimation, and the results confirm the indication from the histograms and the regression results that the A players do treat the B and C players symmetrically.

4 Conclusions

The main purpose of this study was to test for the existence of preferences for fairness over random allocation procedures, using experimental methods. This is different from most of the literature dealing with individual sense of fairness, in that our design tests the subjects' response to fairness of the procedure, while most other studies focus on the fairness of the ultimate allocation. Our results show that, in these situations, a substantial proportion of subjects are willing to sacrifice their own probability of winning to effect a fairer overall allocation procedure.

While results suggesting that subjects' conduct is governed, in part, by a sense of fairness are by no means new, ours do possess some novel characteristics. Compared to standard two-person dictator game results, such as Forsythe et al. (1994), in which subjects give up approximately 20% of the certain pot of money to make the allocation more fair, our subjects in contrast look relatively selfish. In this experiment, subjects are required to give up relatively little, in expected value terms, to make the overall allocation procedure substantially fairer, yet a significant number of our subjects display no willingness to do so. This indicates that preferences for fairness, in this context, may not be as strong as in environments in which the decision maker is dividing certain amounts of money. One possible explanation for this is that the two recipients in this game never observe the probabilities chosen by the decision maker, only the outcome. Thus whether the decision maker is fair or not can not be ascertained by the recipients. This separation between choice and outcome may induce decision makers to be less fair.

There are two mechanisms that might deliver this outcome. One is contained in the results of Hoffman et al. (1994), in which the authors show that, by increasing the social distance between the decision maker and the recipient, the offers in the dictator game went down. By not showing the recipients the choice of A, we generated what amounts to substantial social distance in the form of cover on the part of A. Specifically, A could win the prize whether or not he behaved selfishly. The participants do not know. Alternatively, the results in Dana et al. (2004) suggest that if a decision maker can make someone else at least partially responsible for the outcome (in this case, the randomization process or the experimenter) then he acts substantially more selfishly or that behavior consistent with preferences for fairness "decreases substantially when the connection between choices and outcomes is obfuscated." In our experiment, the connection between choices and outcomes is substantially obfuscated through the use of the probabilistic allocation. Since the apparent strength for preferences for fairness decreases, it suggests that the decision maker is not necessarily concerned with fairness in itself, but rather is concerned with not appearing unfair in the minds of others. Our results are consistent with those of Dana et al. in this regard.

There is one important issue in the interpretation of our results, mentioned in section 3.2, that merits further discussion. The fact that the roles of the subjects were assigned randomly, might make them regard the assignment procedure itself as an integral part of the allocation procedure, embodying the notion of equal treatment. If this is the case, then subject A may feel justified in taking full advantage of the situation in which he finds himself by choosing that allocation procedure that maximizes his probability of winning. This is an alternative explanation for the observed concentration of A subjects choosing the upper endpoint of the line segment. This may also explain why some C subjects, indicate that this is a fair choice, thus explaining the puzzle as to why many C subjects regard the choice of the upper endpoint as fair. Perhaps the most striking result then is that, given this possible interpretation, still a significant number among the A subjects, the "deciders," chose to sacrifice some of their own probability of winning to attain a fairer allocation procedure. This behavior lends support to the theory of self-interest seeking moral individuals of Karni and Safra (2002).

The results further suggest the specific ways in which what subjects construe as "fair" choices are something that have to do with the social context in which they are choosing, and how such a context can be thought of as another layer on top of ones personal, selfish preferences. In particular, in the experiment, the context for A subjects is that the payoff of the other subjects in the group is determined by their choices, and that seems to matter to them. The results show that this tendency towards fairness tends to carry over to all of the questions, even though they know that only the first question counts. The B subjects, on the other hand, do not have to worry about this. Their answers are supposed to be what they would choose if they were the A subject, and they tend to act more selfishly. The C subject choices do not count either, but they were explicitly asked for what the *fair* allocation procedure is. The fact that the distribution of their answer is similar to that of the choices of A may indicate a misunderstanding of what they are asked to do or that many of them believe that it is fair that the subject who has the power to should decide to act selfishly. At any rate, the behavior of C subjects and the study of what the subjects in such experiments consider to be "fair" allocation procedures, warrants further examination.

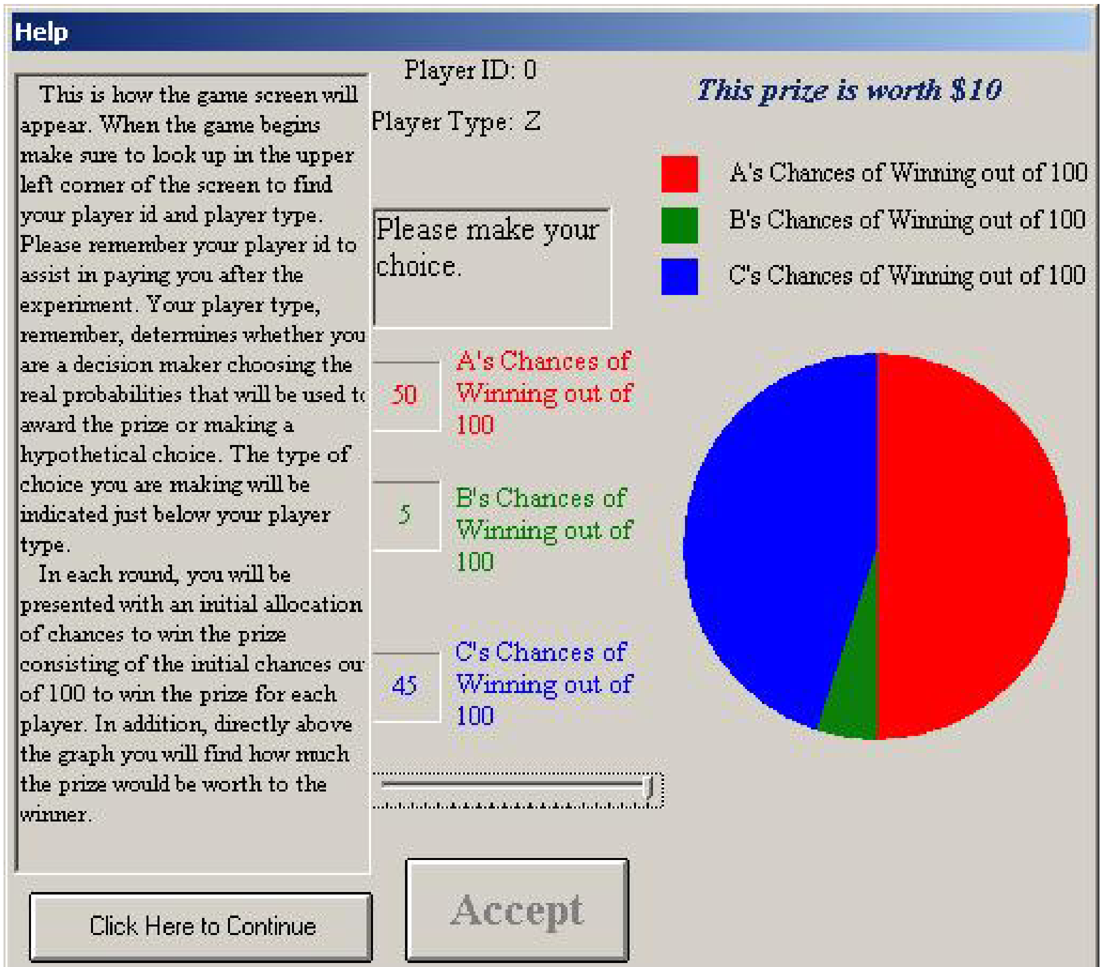
APPENDIX
A. Experiment Instructions

The experiment is begun by recruiting a volunteer from the subjects to serve as a monitor for the experiment. Once a subjects has volunteered, the experimenter reads the following message to the rest of the participants.

> Thank you for participating in today's experiment. In a few moments, I will ask you to turn to the computer screen in front of you and log-in to the system. Once you have done so, you will be lead through a series of help screens detailing the choice task you will be asked to engage in as well as the interface you will be using. Please practice with the interface so that you understand well how it works.
>
> You will be asked in this experiment to make 6 separate decisions concerning different lottery allocations. The first of these lotteries will be run according to the rules that will be detailed in the instructions. The next 5 will be hypothetical choices and will not be used to determine your earnings in this session. The lotteries will be run by the volunteer monitor using these two ten-sided dice to ensure that they are run fairly. The monitor will also observe and ensure that the proper amount of money is placed in each envelope.
>
> If there are any questions during the experiment, please raise your hand and I will come to assist you. Are there any questions at this point?
>
> Please log-in to the system and begin.

Once the subjects login to the computer system, they are presented with a series of help screens leading them through the experiment. The first is another introduction screen.

> You have volunteered to participate in an economic experiment on decision making. If you have any questions during the experiment please raise your hand and ask the proctor.
>
> In this experiment, you will be asked to make a series of 6 choices. For each of these choices, you will be asked to make a decision concerning the chances to win a prize for a group consisting of yourself as well as two other participants in the room. One of you



will be designated as player A, one player B and one player C. With each new choice, the group you are in will change but your player type will remain the same throughout the experiment. Player A will be presented with a choice of how to allocate the chances of winning a prize between the three group members. Players B and C will both be making choices that will have no impact on who wins the prize. At the conclusion of the experiment, the probabilities chosen by the player A's for the first choice will be used to award the prize associated with that decision. Once the prizes have been assigned, everyone will be paid their show-up fee and winnings in cash.

If at any point you have a question, please raise your hand and a proctor will help you. Please refrain from talking during the experiment and from looking at the screens of other participants.

After they press a button to continue, a version of the interface, Figure 4, is brought up with a box along the left hand side that contains text explaining how the experiment will work. The first block of text orients them to some of the content of the interface screen.

This is how the game screen will appear. When the game begins make sure to look up in the upper left corner of the screen to find your player id and player type. Please

> remember your player id to assist in paying you after the experiment. Your player type, remember, determines whether you are a decision maker choosing the real probabilities that will be used to award the prize or making a hypothetical choice. The type of choice you are making will be indicated just below your player type.
>
> In each round, you will be presented with an initial allocation of chances to win the prize consisting of the initial chances out of 100 to win the prize for each player. In addition, directly above the graph you will find how much the prize would be worth to the winner.

The next screen explains how players will make choices.

> At the beginning of the experiment, you will be randomly assigned a player type that will remain constant throughout the experiment. In each period, however, the group you are in will change.
>
> If you are designated as a player of type A then you will be choosing how to allocate chances to win the prize in each period. At the beginning of each turn, you will be presented with an initial distribution. In this example player A has been allocated 50 chances to win, player B 5 and Player C 45. If you are player A, you will be able to use the slider bar at the bottom of the screen to change these probabilities.

The third screen explain in general terms what players B and C will be doing and has the players practice moving the slider bar. As the text indicates, players could not advance past this screen without moving the slider bar.

> If you are designated as a player B or C you will be asked to make a hypothetical choice. You will also do this by moving the slider bar. Your choices will have no impact on anyone's payoffs.
>
> Try moving the slider bar around now to see how it works. Notice that the graph on the right shows a pie chart representation of the possibility of each player winning. As you move the slider bar, the graph updates automatically as do the text boxes indicating the chances for each group member to win.
>
> Note: You must try moving the bar to continue.

The final screen explains how players submit their choices.

> Once you have made your choice for the allocation, click on the button labeled "Accept." You will be asked to confirm your choice before it is sent on to the server. When everyone's choices have been submitted, the groups will be reshuffled and you will move to the next choice.
>
> Try making a selection with the slider bar clicking on the "Accept" button now to see how it works. Clicking on the "Continue" button now will begin the game.

Once players advance past this screen, they enter into the actual experiment interface. Before all of the other subjects are finished with the instructions, all of the controls are greyed out and inactive and there is a dialog box on the screen asking the subjects to wait patiently. Once all subjects have finished the instructions, the dialog boxes disappear, the controls are enabled and the experiment begins.

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