Do Unto Others: A Theory and Experimental Test of Interpersonal Preference Factors in Decision Making Under Uncertainty*

Joyce E. Berg† Thomas A. Rietz‡

December 23, 2025

Abstract

We investigate how interpersonal preferences influence decision-making under uncertainty. Standard models assume agents maximize expected utility based solely on their own payoffs, yet experimental evidence often shows apparent instability in risk preferences across institutions. We propose and test a utility framework that incorporates altruism, malice, fairness, and competitiveness alongside risk attitudes. Using five choice tasks that hold own-payoff risk constant while varying effects on another participant's payoffs, we isolate interpersonal factors from framing and strategic uncertainty. Results show that while average choices align with risk-neutral predictions, individual choices exhibit systematic patterns: subjects tend to be altruistic and fairness-seeking, malicious and distinction-seeking, or neutral on both dimensions. These findings explain apparent shifts in risk preferences across institutions even when underlying preferences are stable. This highlights the importance of interpersonal considerations in models of choice under uncertainty.

*This is a preliminary draft. Please do not circulate or quote without permission. For many helpful comments and discussions, we thank Michael Balch, Robert Forsythe, Thomas Gruca, Richard Peter, Robert Weber and seminar participants at the University of Iowa Department of Finance and the MacArthur Foundation.

†Emeritus Professor of Accounting, Tippie College of Business, University of Iowa, Iowa City, Iowa, 52242, joyce-berg@uiowa.edu

‡Soumyo Sarkar Professor of Finance, Tippie College of Business, University of Iowa, Iowa City, Iowa, 52242, thomas-rietz@uiowa.edu

Conflict of Interest Disclosures

Joyce Berg

Joyce Berg reports no conflicts of interest for this research.

Thomas Rietz

Thomas Rietz reports no conflicts of interest for this research.

1 Introduction

Businesses and governments set up institutions (e.g., auctions, bargaining, partnerships, etc.) to value and allocate resources efficiently under uncertainty. Standard economic theory assumes agents maximize expected utility based solely on their own payoffs. Yet, experimental evidence often reveals apparent inconsistencies in risk preferences across elicitation methods and institutional settings. For example, Berg et al. (2005) elicit risk preferences from experimental subjects using three different methods. They find an apparent instability of risk preferences for individual subjects across methods. Their institutions are an individual choice method (Becker et al., 1964) and two different auction methods for inferring subject risk preferences. Subsequent research finds instability across some methods, but not others. For example, Dasgupta et al. (2019) use two different individual choice methods and find relatively consistent risk preference measures within subjects. Using four different methods, Holzmeister and Stefan (2021) observe that, while subjects take on different levels of risk across elicitation methods, "subjects are surprisingly well aware of the variation in the riskiness of their choices" (p. 593). Thus, "inconsistent" may be a misnomer. While these inconsistencies are frequently attributed to framing effects or cognitive biases, we propose an alternative explanation: interpersonal preferences.

We model a decision maker's utility as a function of (1) a decision maker's payoffs under uncertainty and (2) how the decision affects another person's payoffs (again, under uncertainty). The latter, "other regarding," portion of the utility function includes (1) a dimension reflecting altruism versus malice toward the other person, (2) curvature, or risk preferences, over the other person's payoffs and/or (3) a dimension reflecting a preference for fairness (similarity) in payoffs versus competitiveness (distinction) in payoffs. We model altruism in the manner of "pure altruism" (Becker, 1974; Andreoni, 1989) where the utility of another person positively enters a decision maker's utility function.[1] Malice is the opposite: the utility of another person negatively enters a decision maker's utility function (again see Becker (1974) or the notion of "spite" in Brandt et al. (2007) and Kirchkamp and Mill (2021)). To this, we add curvature, i.e., risk preferences, over the other person's payoffs. We model fairness as a preference for maximizing the cross moment in payoffs between two people (similar to the idea of minimizing the difference in payoffs in Fehr and Schmidt (1999) and a preference for "equality" in Fisman et al. (2015).). We call the opposite "competitiveness" or "distinction seeking," a preference for minimizing the cross moment (similar to maximizing the difference between the payoffs of two people as in Frank (1985), though he only considers maximizing one's position relative to others).[2] A unique feature of our work is that we study and measure all of these factors simultaneously through a simple set of decision tasks.

Then, we run an experiment where subjects make a series of five simple choices under uncer-

[1] Our conceptualization of altruism is also somewhat related to "fair mindedness" in Fisman et al. (2015). If the level of altruism in the utility function of a person made the weight on own and another's payoffs equal, they would be fair minded. Our utility function allows for less weight on another's payoffs than own payoffs and allows for malice with an negative weight on another's payoffs.

[2] Our concept of competitiveness is also similar to "correlation aversion" (Eeckhoudt et al., 2007) except that the correlation is not between two lotteries, but between two people's payoffs instead.

tainty. Every choice task affects the decision making subject's payoffs in exactly the same way. Alone, this could be used to infer risk preferences. Further, if subjects did not care about others' payoffs, each task should reveal the same risk preference. However, each choice also affects another subject's payoffs differently. If subjects do care about others' payoffs, this will affect choices in predictable ways. Four of the choices mimic real world situations: individual choice, choice in a partnership, bidding in an auction and bargaining. The fifth helps pin down risk preferences across own and others' payoffs. We use the choices to classify subjects according to (1) risk preferences in own payoffs, (2) altruistic or malicious preferences toward the other subject, (3) risk preferences toward the other subject's payoffs, and/or (4) an interest in fairness or distinction with regard to own and the other subject's payoffs. Our tasks give two advantages: (1) They differ from those where the interpersonal factors were first observed, giving an independent test of interpersonal factors. (2) They effectively isolate these factors from other factors that may drive results in prior work. Finally, we show how the choices can be used to estimate parameters for utility functions that include other regarding preferences.

We find the following:

1. While a few subjects consistently make the same choice, most change their choices when they effect others' payoffs in different ways. If one were to infer risk preferences based only on how the subject's choice affects their own risk (as self-interested economic theory implies), one would conclude that risk preferences were unstable across institutions.

2. While the average subject appears neutral on each dimension, most individual subjects display consistent patterns across choices. They consistently appear to be either (1) risk averse in their own and others' payoffs, (2) risk seeking in both, or (3) neutral in both. They consistently appear to be either (1) altruistic and fairness seeking, (2) malicious and distinction seeking, or (3) are neutral on both dimensions.

3. A relatively simple classification scheme based on differences in a subject's choices across tasks gives results generally consistent with (1) classification based on levels of impact on a matched subject's payoffs and (2) utility function parameters estimated from the subject's choices.

Our results imply that shifts in apparent risk preferences are not necessarily inconsistent if they are across institutions when either (1) some institutions involve other people and others do not OR (2) the impact on others' payoffs differ across institutions. We show a simple method for classifying subjects according to their own risk preferences and other regarding preferences. This can be used in experiments to understand behaviors stemming from other regarding preferences versus other factors. Finally, knowing that other regarding preferences affect behavior, one can design institutions to promote preferred outcomes. For example, consider distributing resources through an auction versus a bargaining procedure. People with a malicious/competitive nature will tend to drive up prices in an auction. Getting such people in an auction might be best if the objective is to achieve the highest possible price. Those with an altruistic/fairness nature will be more likely to reach agreements in negotiations. Getting such people in a negotiation might be best if the objective is to reach a settlement.

2 A little history and literature review

Most economic models assume self-interested, maximizing agents. Most models under uncertainty assume agents maximize expected utility functions with final wealth as the only argument.[3] Much experimental research shows that, when choosing between alternative risky propositions, subjects often appear not to maximize expected utility.[4] Instead, a variety of framing effects and probability judgment biases appear to affect choices. In our experiment, we test for a framing effect and find little impact on choices.

In response to observed anomalies, economists have developed and experimentally tested various non-expected utility models. While they relax some assumptions, most such models still assume self-interested agents who maximize some perceived notion of their own well-being, independent of what happens to others. As Veblen (1909, p. 627) puts it, "conceived in hedonistic terms," conventional economic theory "concerns a disconnected episode in the sensuous experience of an individual."

However, experimental research subjects often appear to care about the payoffs others receive in interactive games with certain payoffs.[5] In particular, Pareto dominant and "fair" equilibria appear to attract subjects (e.g., Murnighan, 2008, among many others). Social psychology research shows that subjects care about the payoffs others receive in a wider variety of situations with certainty. Further, a subject's relationship with or attitude toward another person affects choices.[6] In response, researchers have developed and tested new choice models that include interpersonal payoff comparison arguments. For example, MacCrimmon and Messick (1976) identify several factors influencing choices in social situations.[7] Scott (1972) proposes that egalitarianism affects choices.[8] Many of these factors appear to affect decisions when subjects interact with each other (i.e., when one's payoffs are affected by one's own and the other subject's actions). These lines of research contrast sharply with the large body of experimental research in which conventional economic theory "works" as predicted.

Here, we explore several aspects of these interpersonal effects and ask whether they can explain apparent instabilities of observed risk preferences across institutions. We study whether interpersonal factors affect choices under uncertainty stripping away social context to see whether it appears to be a stable, generic attribute of the subjects themselves. We begin by extending expected utility

[3] von Neumann and Morgenstern (1944), Allais (1953) and Arrow (1964) firmly established this precedent.

[4] See Machina (1987) and Starmer (2000) for surveys.

[5] See Fehr and Schmidt (2006) for a survey.

[6] For example, see Loewenstein et al. (1989) for a summary of such research in dispute situations.

[7] Four of these are based on payoff comparisons, including ones analogous to our definitions of altruism, malice and distinction seeking.

[8] This is analogous to our definition of fairness.

theory to include notions of concern for others' payoffs. We define our concepts of altruism, malice, distinction seeking (competitiveness) and fairness seeking in a social and relationship context free manner as attributes of this utility function.[9] We then show how such factors would affect choices in several specific, relatively sterile situations if the factors were indeed context free.

We ask whether interpersonal factors appear important in laboratory settings without a contextual relationship between subjects and when there is no interaction between subjects.[10] We isolate interpersonal effects using simple choices under uncertainty with five slightly different incentive treatments in a within-subjects design (i.e., each subject makes one choice in each treatment). Under these treatments, the choices a subject makes always affect his or her own payoffs in exactly the same manner. As a result, if subjects only care about their own payoffs, their choices should not change across treatments. The effect on another subject's payoffs changes across treatments. (We refer to this other subject the "matched subject" and the payoffs he or she receives as the "matched payoffs.") The specific effects vary across the treatments. Two treatments serve as benchmarks to assess risk preferences over own and matched payoffs. One effectively is an individual choice, but controls for the presence of another subject. Three treatments study interaction effects under incentive structures that parallel decision making in a partnership situation, a bidding situation, and a bargaining situation. We refer to the treatments accordingly.[11]

Our work contrasts with earlier work in that the average responses here do not deviate significantly across treatments from the risk neutral to slightly risk seeking, self-interested predictions of traditional economic theory. On average subjects are also neutral on the altruism/malice, other risk preference and fairness/competitiveness dimensions. Roughly equal numbers of subjects appear altruistic versus malicious and roughly equal numbers appear fairness seeking versus distinction seeking. Other factors may account for the consistent effects observed in earlier work. Perhaps social context tends to bias the mindsets of subjects toward the altruistic and fair end of the continuum or toward the malicious and distinction seeking end of the continuum. For example, social comparisons may predispose subjects to be altruistic and fair to subjects who are known to be very similar to themselves and malicious and competitive toward subjects know to be different (e.g., "in-group" and "out-group" effects as in Chen and Li, 2009). As we will show below, our design intentionally limits or eliminates such effects. What is left is pure interpersonal effects.

While neutral on average, our work also highlights the consistent patterns in individual subjects across choices. Most subjects are either risk averse across both own and others' payoffs, risk

[9] Definitions of these terms vary. As discussed above, we interpret altruism as the desire to increase a matched subject's payoffs, malice as the desire to decrease matched payoffs, distinction seeking as the desire to maximize the difference between own and matched payoffs (i.e., decrease their cross moment) and fairness seeking as the desire to minimize the difference between own and matched payoffs (i.e., increase their cross moment). By "context free" we mean that the factors are stable across contexts and remain in the absence of context.

[10] We isolate both direct interaction (subjects are unknown to each other, remain anonymous and do not have face to face contact) and indirect interaction through payoffs.

[11] Following the standard in the literature (see e.g., Plott, 1982), we do not use these terms in the experiment to avoid value-laden connotations. Neutral language allows us to test our hypotheses without bringing in external preconceptions and framing effects that could make preferences deviate from those induced by the own and matched payoffs the choices.

seeking across both, or neutral across both. Most are altruistic and fairness seeking, malicious and distinction seeking, or neutral on both dimensions. This highlights the need to consider variations across subjects in experiments that where institutions bring out or reward specific types of behavior. For example, auctions may bring out competitive tendencies (e.g., aggressive bidding in Kagel and Levin, 1999), while ultimatum games bring out altruism or fairness tendencies (e.g., equal spit proposals in Forsythe et al., 1994).

3 Theory

We generalize expected utility to include the impact of actions on the payoffs of another individual (matched payoffs). Arguments include the subject's own and matched payoffs. The first, second and cross partial derivatives determine whether the subject is self-interested or not, altruistic or not, risk averse or risk seeking in his or her own payoffs, risk averse or risk seeking in matched payoffs and fairness or distinction seeking.

Specifically, let $u(x, y)$ be the utility function over own (x) and other's (y) payoffs. We assume self-interest ($u_1(x, y) > 0$) and make the following definitions:

Self-Interest (assumed):	$u_1(x, y) > 0$
Risk Aversion in Own Payoffs:	$u_{11}(x, y) < 0$
Risk Seeking in Own Payoffs:	$u_{11}(x, y) > 0$
Altruism:	$u_2(x, y) > 0$
Malice:	$u_2(x, y) < 0$
Risk Aversion in Matched Payoffs:	$u_{22}(x, y) < 0$
Risk Seeking in Matched Payoffs:	$u_{22}(x, y) > 0$
Fairness Seeking:	$u_{12}(x, y) > 0$
Distinction Seeking:	$u_{12}(x, y) < 0$

If the subject is neither altruistic nor malicious ($u_2(x, y) = 0$) and neither fairness nor distinction seeking ($u_{12}(x, y) = 0$), the utility function defined over x and y becomes the simple utility function over x. A specific example of such a function is the following second moment utility function which is a direct extension of the commonly used mean/variance (i.e., quadratic) utility function:

$$u(x, y) = x - \alpha x^2 + b(y - \beta y^2) - c(x - y)^2, \tag{1}$$

which implies:

$$E(u(x, y)) = E(x) - \alpha E(x^2) + bE(y) - b\beta E(y^2) - cE((x - y)^2). \tag{2}$$

Another example is an extended constant relative risk aversion (CRRA) counterpart:

$$u(x, y) = \frac{x^{1-\alpha}}{1-\alpha} + b \cdot \frac{y^{1-\beta}}{1-\beta} - c(x - y)^2, \tag{3}$$

which implies:

$$E(u(x,y)) = E\left(\frac{x^{1-\alpha}}{1-\alpha}\right) + b \cdot E\left(\frac{y^{1-\beta}}{1-\beta}\right) - c \cdot E\left((x-y)^2\right). \tag{4}$$

In both cases, the parameters α, β, b and c allow for risk aversion in own and matched payoffs and the four interpersonal factors of altruism, malice, fairness seeking and distinction seeking. Of course, interactions between all these terms exist, but roughly speaking, the following representations hold: Self-interest is represented by the first term dominating the correlation effect of c. Risk aversion over own and others' payoffs are represented by $\alpha > 0$ and $b\beta > 0$, respectively. Altruism and malice are represented by $b > 0$ and $b < 0$, respectively (again dominating over the correlation effect of c).[12] Finally, fairness and distinction seeking are represented by $c > 0$ and $c < 0$ respectively.[13] In both cases, if b, *beta* and c are all 0, the utility function becomes a traditional utility function based on own payoffs.

In Appendix II, we prove that, all else constant, subjects will prefer gambles increasing in the properties associated with the interpersonal factors in their utility functions. For example, an altruistic subject will prefer a gamble with a slightly higher expected payoff to the other subject all else constant. Similarly, a fair subject will prefer a slightly higher first cross moment all else constant. Thus, below we ask if subjects react to interpersonal impacts of their choices on others by changing their choices in response to how their choices affect the mean and variance of the matched subject's payoff and first cross moment of own and matched payoffs. This analysis, based on simple comparison, is non-parametric in that it does not rely on the form of the utility function. Then, we estimate parameters that best fit the data for each individual for the quadratic utility function given in equation (1) and the exponential utility function given in equation (3) and analyze the patterns of parameters that best fit the data.

4 Experimental Design and Predictions

4.1 Design

We test interpersonal effects on decisions made under uncertainty by paying two experimental subjects based on one subject's decision and a random draw. Across treatments, decisions made by the decision-making subject always affect his or her own payoffs in the same way. How this subject's decision affects the other (matched) subject's payoff varies by treatment. The decision-making subject never knows anything about the matched subject except how much he or she will receive because of the decision made and the random draw. This isolates pure comparison effects from perceptions and attitudes about the matched subject and from interactions between the matched subject's actions and the deciding subject's own payoffs. By not varying the relationship between a subject's choices and his or her own payoffs, we isolate pure comparison effects from the framing

[12] A negative b is closely related to the idea of "spite" in Brandt et al. (2007) and Kirchkamp and Mill (2021).

[13] A negative c is in the spirit of "correlation aversion" (Eeckhoudt et al., 2007) except that the correlation is not between two lotteries, but between own and matched payoffs.

effects and probability judgment biases that affect choices between alternative risky situations. While these other factors may all be important, we wish to focus only on interpersonal payoff comparisons in this study.

The experiment consists of six sessions of twenty subjects each. We draw subjects randomly from a large volunteer subject pool recruited in undergraduate and MBA classes at the University of Iowa. Subjects are paid $3 for participating (in addition to any earnings they receive as a result of their choice tasks). We have subjects arrive in two adjoining rooms and leave by separate doors to insure anonymity.[14]

Upon arrival, subjects were given copies of the instructions and seated at desks separate from each other. The instructions were read aloud to all subjects from a doorway between the rooms. All questions were repeated and answered so that all subjects could hear.[15]

Each subject made five choices, one for each of five "payoff cards" which listed a series of choices. Each choice corresponded to an amount and probability of payoff for the participant and a "matched participant" (i.e., matched subject). Each card listed the same choices, probabilities of payoff and payoff levels for the participant's own payoffs. The cards only varied in when and by how much the matched subject was paid.[16]

Figure 1: Payoff card for the baseline choice in session F1S1

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff	Ticket≥Cutoff		Ticket<Cutoff		Ticket≥Cutoff		Ticket<Cutoff		Cutoff
Choice	Prize	Prob.	Prize	Prob.	Prize	Prob.	Prize	Prob.	Choice
5	$0.25	0.95	$0.00	0.05	$0.00	0.95	$0.00	0.05	5
15	$0.75	0.85	$0.00	0.15	$0.00	0.85	$0.00	0.15	15
25	$1.25	0.75	$0.00	0.25	$0.00	0.75	$0.00	0.25	25
35	$1.75	0.65	$0.00	0.35	$0.00	0.65	$0.00	0.35	35
45	$2.25	0.55	$0.00	0.45	$0.00	0.55	$0.00	0.45	45
55	$2.75	0.45	$0.00	0.55	$0.00	0.45	$0.00	0.55	55
65	$3.25	0.35	$0.00	0.65	$0.00	0.35	$0.00	0.65	65
75	$3.75	0.25	$0.00	0.75	$0.00	0.25	$0.00	0.75	75
85	$4.25	0.15	$0.00	0.85	$0.00	0.15	$0.00	0.85	85
95	$4.75	0.05	$0.00	0.95	$0.00	0.05	$0.00	0.95	95

[14] For each decision a subject makes, the matched subject is in the other room.

[15] The instructions are given in Appendix I. The rooms are arranged so that subjects in one room cannot see subjects in the other room even when the door is open.

[16] We note that, citing a working paper version of the current paper, Addison and Schmidt (1999) and Daly and Wilson (2001) use the left hand side of our payoff tables as a simple means of assessing risk aversion. Addison and Schmidt (1999) find that responses correlate significantly with shyness in an experiment. Daly and Wilson (2001) find that responses correlate significantly with gender, and that the choices of men are more risk seeking if they are made public in an experiment. Both results accord with theory and other evidence in the manner predicted validating the measure as a means of assessing risk aversion.

Figure 1 shows the payoff card used for the "baseline" choice in session F1S1.[17] A participant chose a row in the table. After all choices were made, payoffs were determined by random draws. These consisted of draws (with replacement) from a box of lottery tickets numbered 00 to 99. If the ticket drawn exceeded the cutoff in the chosen row, the subject received the payment listed in the "Ticket≥Cutoff" column on the left-hand side of the payoff table. If not, the subject received nothing. Thus, each choice corresponded to a probability of receiving an amount cash for the subject. We use it as the measure of response, denoting it by p. These probabilities and cash payments do not change with the treatment. The right side determined when and how much the matched subject received. Here, the matched subject always received $0.

The other (within subject) treatments are implemented by changing when and how much the matched subject is paid as result of the decision making subject's choice and the random draw. Specifically, the payoff cards contained five different "Matched Participant" sections, corresponding to each of five within subject treatments. The first is the "baseline" treatment shown above. In this treatment, subjects make the choice without having any impact on another's payoffs. The Matched Participant payoff portion of the card corresponding to the baseline contained only zeros for payments. While there is another subject, the choice cannot influence the matched subject's payoffs nor the correlation between own and matched payoffs. Thus, this treatment controls for the existence of another subject to make fair comparisons across treatments. In the other treatments, the matched subject receives a payment conditional on the decision-making subject's choice and corresponding random draw. If the ticket drawn exceed the cutoff in the chosen row, the matched subject received the amount given in the "Ticket≥Cutoff" column on the right-hand side of the table. If not, the matched subject received the amount listed in the "Ticket<Cutoff" column.

We created a different set of payoff cards to test for framing effects. The ordering and labeling of payoffs were changed to essentially flip the payoff cards as described below. Again, this did not change the probabilities and payoffs to the decision making subject.

To control for order effects, the subjects received the payoff cards in a random order. To control for wealth effects, all random draws were made after all subjects had made choices for all of their payoff cards.

The first treatment corresponds to the "baseline" payoff card shown in Figure 1 above. Mathematically, if p is the probability of receiving the "own" payoff, the baseline payoff card corresponds to the following choice:

Baseline: Choose $p \in \{0.5, 0.15, \ldots, 0.95\}$. Then,

$$(x, y) = \begin{cases} (\$5 \cdot (1-p),\ \$0) & \text{with probability } p \\ (\$0,\ \$0) & \text{with probability } 1-p \end{cases}. \tag{5}$$

where (x, y) is the tuple of own and matched payoffs respectively. Panels 1 and 2 in Figure 2 show the tradeoffs involved with making the baseline choice. Own payoffs for all treatments are shown in

[17] Frame 1 payoff cards for all treatments appear in Appendix I.

Panel 1. The highest expected value of own payoffs is at 0.45 or 0.55, higher probabilities of lower payoffs decrease variance and, to a point, lower probabilities of higher payoffs increase variance. For each choice less than 0.5, there exists a choice greater than 0.5 with the same expected payoff and a lower variance. Panel 2 shows the impact of choosing p on the matched subject: nothing. The matched subject always receives \$0. This mimics the real world situation of an individual choice, but controls for the mere presence of a matched subject.

The Matched Baseline treatment asks the subject to make the following choice:
Matched Baseline: Choose $p \in \{0.5, 0.15, \ldots, 0.95\}$. Then,

$$(x, y) = \begin{cases} (\$5 \cdot (1-p),\ \$0) & \text{with probability } p \\ (\$0,\ \$5 \cdot p) & \text{with probability } 1-p \end{cases}. \tag{6}$$

Panel 3 in Figure 2 shows how p affects the matched subject. Comparing Panels 1 and 3, the expected payoffs of the two subjects align with each other. However, the variances of these payoffs are mirrored around 0.5. There is no cross moment, but the decision-making subject can affect the risk faced by the matched subject. Thus, the matched baseline serves to identify relative risk attitudes over own and matched participant payoffs.

The other three treatments parallel "real world" situations while allowing us to measure the impact of other interpersonal comparisons on behavior. We discuss the tradeoffs involved in each choice here. Later, we discuss what we can infer from each choice.

The incentives in the following choice correspond roughly to a partnership situation:
Partnership: Choose $p \in \{0.5, 0.15, \ldots, 0.95\}$. Then,

$$(x, y) = \begin{cases} (\$5 \cdot (1-p),\ \$5 \cdot (1-p)) & \text{with probability } p \\ (\$0,\ \$0) & \text{with probability } 1-p \end{cases}. \tag{7}$$

The subjects' payoffs align perfectly, as in a partnership. Comparing Panels 1 and 4 in Figure 2 shows the tradeoffs involved in this choice. The decision-making subject and matched subject have the same risks and returns, but now there is a cross moment factor that can influence the subject's choice. The variance of the matched subject is the mirror image of the variance in the Matched Baseline.

The incentives in the following choice correspond roughly to a bidding situation.
Bidding: Choose $p \in \{0.5, 0.15, \ldots, 0.95\}$. Then,

$$(x, y) = \begin{cases} (\$5 \cdot (1-p),\ \$0) & \text{with probability } p \\ (\$0,\ \$5 \cdot (1-p)) & \text{with probability } 1-p \end{cases}. \tag{8}$$

If the decision-making subject decreases p (i.e., bids less aggressively), the probability of receiving a payoff (winning the auction) decreases but the subject receives more. This action increases the probability that the matched subject receives a payoff (wins the auction) and raises the matched

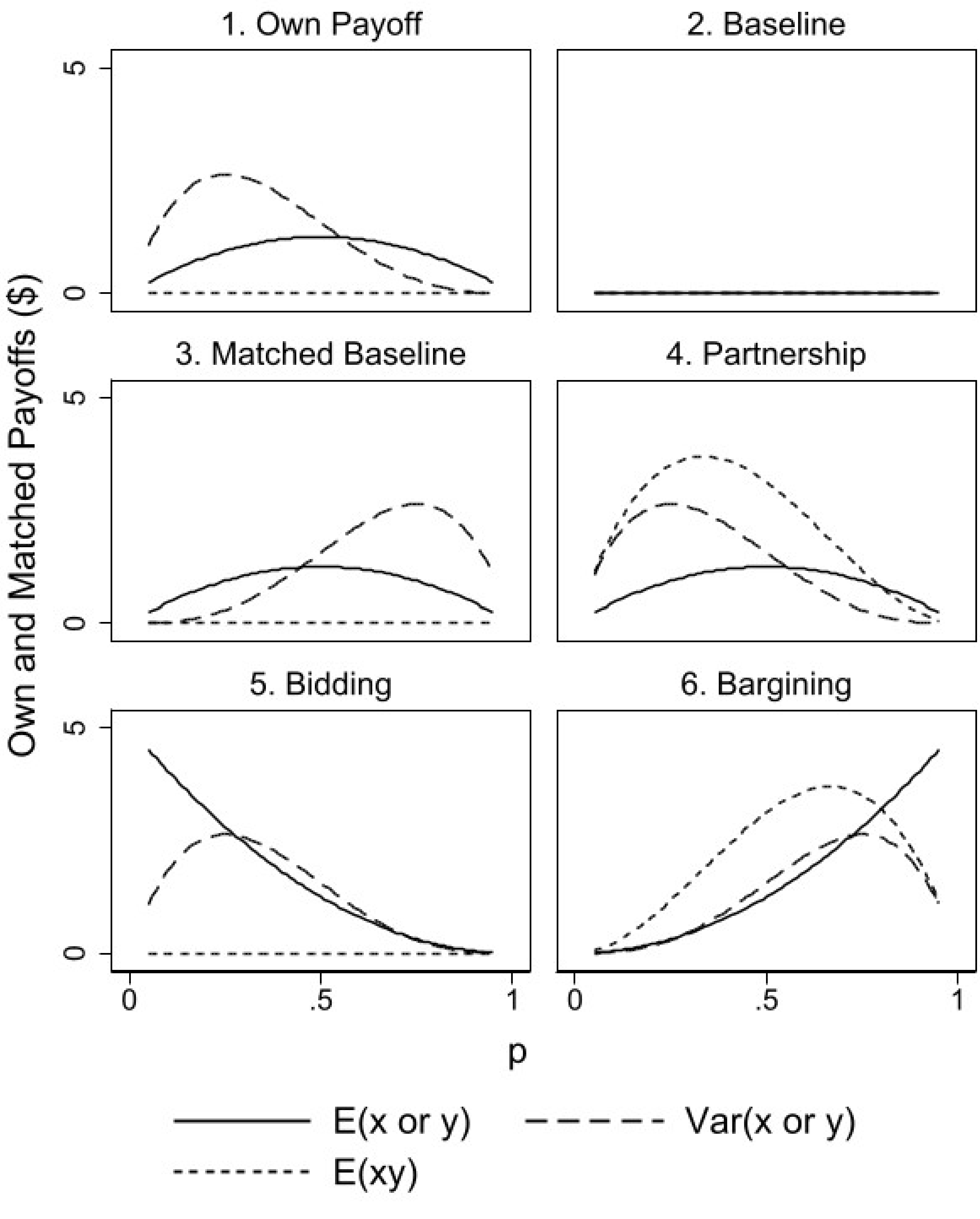

Figure 2: Expected own and matched participant payoffs, variances and cross moments by treatment. Panel 1 shows the expected own payoffs and their variance based on the choice of *p*. Panels 2 through 6 show the expected matched payoffs, their variances and the cross moments of own and matched payoffs for the Baseline, Matched Baseline, Partnership, Bidding and Bargaining treatments, respectively.

subject's payoff size (winning with a lower bid). The opposite holds if the decision-making subject increases the bid. Comparing Panels 1 and 5 in Figure 2 shows the tradeoffs involved in this choice. Here, there is no cross moment. As in the partnership case, the variances of both subjects align perfectly. However, by bidding less, the subject can uniformly increase the expected payoff to the matched subject.

Finally, the following choice corresponds roughly to a bargaining game:

Bargaining: Choose $p \in \{0.5, 0.15, \ldots, 0.95\}$. Then,

$$(x, y) = \begin{cases} (\$5 \cdot (1-p),\ \$5 \cdot p) & \text{with probability } p \\ (\$0,\ \$0) & \text{with probability } 1-p \end{cases}. \tag{9}$$

If the decision-making subject lowers p (i.e., bargains more aggressively), the probability of receiving a payoff (i.e., a settlement) decreases, but the subject receives more while the matched subject receives less. If the decision-making subject increases p (i.e., bargains less aggressively), the probability of receiving a payoff (i.e., a settlement) increases, but the subject receives less while the matched subject receives more. Comparing Panels 1 and 6 in Figure 2 shows the tradeoffs involved in this decision. This is clearly the most complex case. The matched subject's expected payoff and variance are the same as those for the matched baseline. The cross moment mirrors the cross moment for the bargaining choice. The decision-making subject can increase the expected payoff for the matched subject by bargaining less aggressively. This mirrors the bidding treatment.

Payoffs cards for sessions F2S1, F2S2 and F2S3 differed slightly in their presentation. Subjects received payments if the ticket draw was less than the cutoff and the payoff sizes were inverted accordingly. Thus, in these sessions, the "Ticket≥Cutoff" columns were re-labeled "Ticket≤Cutoff;" the "Ticket>Cutoff" columns were re-labeled "Ticket<Cutoff;" and all of the payoff columns were inverted. This changes the presentation frame and will be discussed later. However, for the purposes of presentation, we will use p and the relationship between p and own and matched subject payoffs. These do not vary between the frames.

Subjects were matched and payoff cards were given to them under the following constraints. First, each subject received five different cards, one corresponding to each treatment. Subjects received these cards in ten different orders to mitigate presentation order effects. Each subject was matched with and affected the payoffs of five different subjects in the other room. Similarly, they were affected by an entirely separate group of five different subjects from the other room. Finally, in any given choice, the matched payoff treatment they had (and sent to the matched participant in the other room) differed from the matched payoff treatment they received from the other room as a matched participant. The instructions describe these constraints carefully (except for the exact number of presentation orders), so we assume all subjects were aware of them.

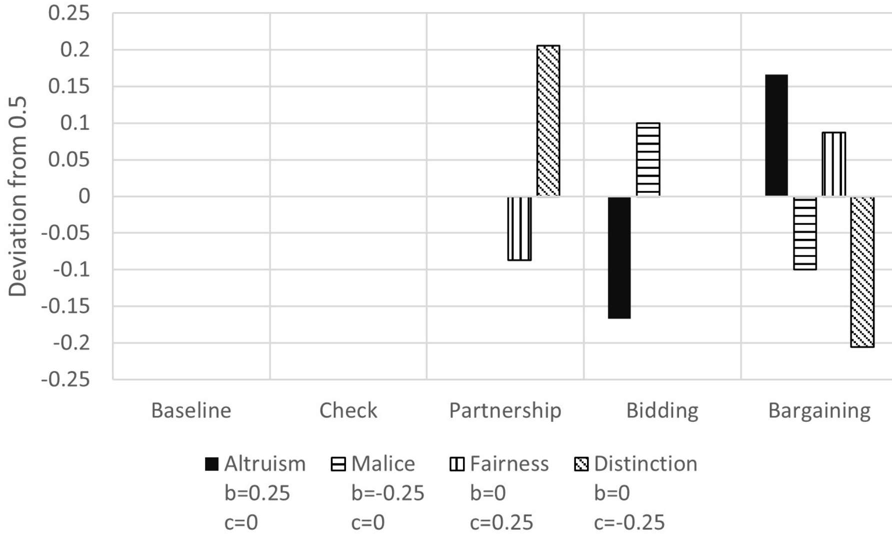

Figure 3: Deviations in optimal probability choice (p) from 0.5 for Risk Neutral Utility Functions with Moderate Levels of Altruism/Malice and Fairness/Distinction Seeking

4.2 Predictions

Figure 3 shows how the four interpersonal factors can influence behavior for risk neutral, self-interested subjects under all treatments. Consider introducing a reasonable level of altruism ($1 > b > 0$ in the utility function given in equation (1)). Because of the desire to increase the other's expected payoffs, the decision maker will bargain less aggressively (increase p in the bargaining treatment to increase the size and likelihood of the other's payoff) and bid less aggressively (decrease p in the bidding treatment to increase the size and likelihood of the other's payoff). A reasonable level of malice ($0 > b > -1$ in equation (1)) will change behavior in the opposite direction as the decision maker tries to decrease the likelihood and size of the other's payoff.

Fairness results in apparent risk seeking behavior in the partnership treatment relative to the baseline treatment. In the baseline treatment a fairness seeking subject may prefer lower payoff, higher probability payoffs because lower value payoffs are closer to the \$0 payoffs of the matched subject. This fairness effect goes away in the partnership treatment because the difference in payoffs is always zero, making the subject appear more risk seeking. In the bidding treatment, the decision maker bids more aggressively (increases p). This decreases the other's payoff when the decision maker receives nothing, increasing the covariance and compensating for the decreased expected value. Intuitively, when the decision maker loses the auction, he or she takes solace in the fact that the other received a low payoff.

Distinction seeking is a desire for distinction between the subjects' payoffs. Thus, it affects behavior in a direction opposite of fairness for the opposite reasons.

5 Results

We discuss the data in terms of probabilities of winning cash based on each subject's choice. Recall, that $p = 0.5$ is the optimal choice for a risk neutral subject who has no preference over matched payoffs, $p > 0.5$ reflects risk aversion and $p < 0.5$ is risk seeking. Our initial analysis is non-parametric, based simply on the pattern of choices observed for subjects. Then, we will estimate parameters for the utility functions in equations (1) and (3).

5.1 Summary of Choices

Table 1 summarizes the choices made by subjects in each treatment, in each session, in each presentation frame, and overall. The point estimates suggest Frame 1 choices do not differ significantly from risk neutral on average, while Frame 2 choices appear slightly risk seeking. This could be interpreted as a a presentation frame effect.[18]

Table 1: Mean choices and standard deviations(in parentheses) for each choice in each session, in each data frame and overall.

Data	Baseline	Bidding	Partnership	Bargaining	Matched Baseline
F1S1	0.480 (0.117)	0.525 (0.085)	0.550 (0.138)	0.480 (0.159)	0.500 (0.185)
F1S2	0.460 (0.165)	0.500 (0.105)	0.440** (0.097)	0.505 (0.161)	0.495 (0.143)
F1S3	0.505 (0.167)	0.480 (0.211)	0.525 (0.112)	0.525 (0.177)	0.520 (0.103)
F2S1	0.415* (0.201)	0.445 (0.182)	0.385** (0.193)	0.375 (0.162)	0.425 (0.202)
F2S2	0.440 (0.234)	0.420** (0.159)	0.450 (0.145)	0.460 (0.200)	0.390** (0.179)
F2S3	0.435* (0.160)	0.485 (0.179)	0.460 (0.152)	0.495 (0.115)	0.480 (0.134)
Frame 1	0.482 (0.150)	0.502 (0.143)	0.505 (0.124)	0.503 (0.164)	0.505 (0.145)
Frame 2	0.430** (0.197)	0.450** (0.173)	0.432** (0.165)	0.443** (0.168)	0.432** (0.175)
Overall	0.456** (0.176)	0.476 (0.160)	0.468** (0.150)	0.473* (0.168)	0.468** (0.164)

*Significantly different from 0.5 at the 90% level of confidence according to t-tests.
**Significantly different from 0.5 at the 95% level of confidence according to t-tests.

While significance is marked using t-tests in 1 for reference, the choices are on a discrete scale and, therefore, do not conform to the distributional assumptions of t-tests. To give a more complete

[18]The payoff tables in Frame 2 were ordered top to bottom from highest own payoff to lowest and from lowest own probability of winning to highest. The payoff tables in Frame 1 were ordered top to bottom from lowest own payoff to highest and from highest own probability of winning to lowest. If subjects start reading the tables at the top and their focus is only pulled to the bottom by higher own payoffs, this may explain the differences.

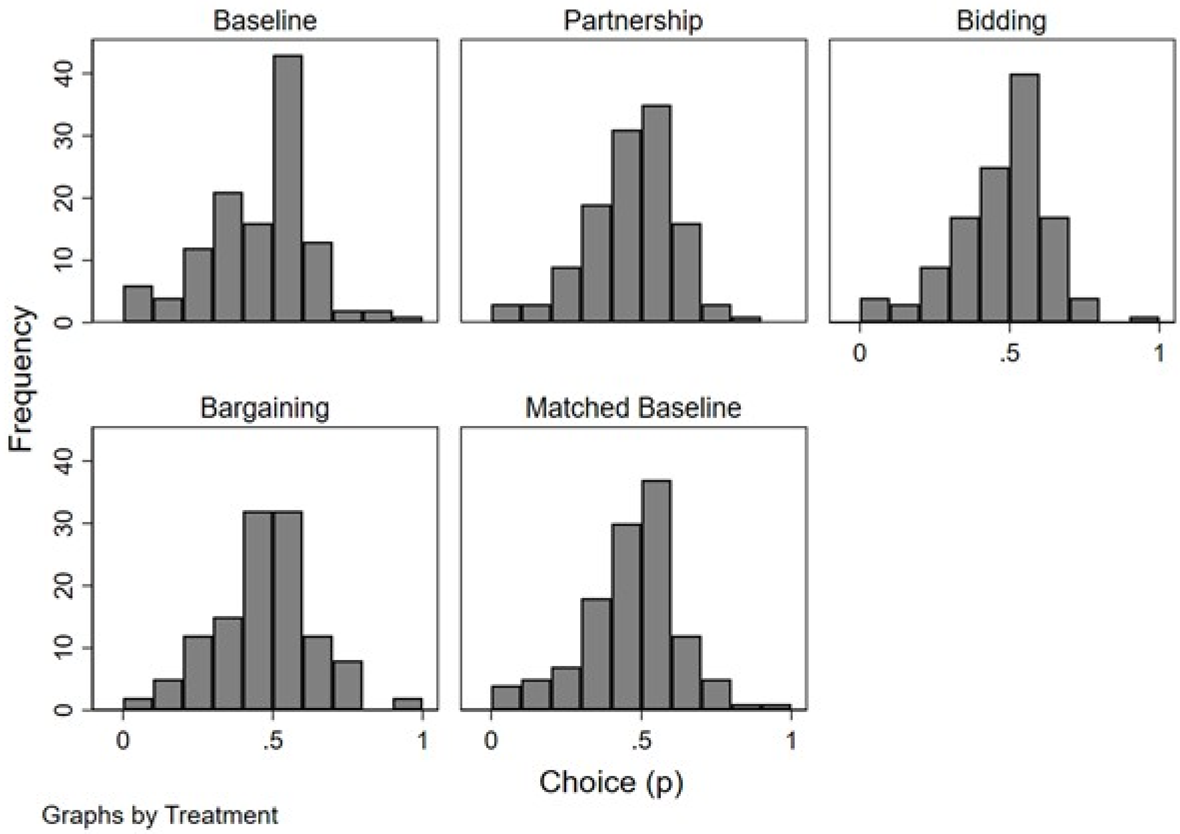

Figure 4: Histograms for each treatment choice across all sessions and frames.

view of the distribution of choices, Figure 4 shows histograms of the choices across treatments, without distinguishing between frames. While there are some apparent shifts in the distributions, none are significant at the 95% level of confidence. Table 2, Panel A presents χ^2 tests for differences in overall distributions across treatments and Panel B presents χ^2 tests for differences across frames within treatments. There is only one case with a difference significant at the 90% level of confidence. This leads to the first result:

Result 1 *The treatments and presentation frames have little if any significant impact on the overall distribution of choices.*

5.2 Stability of Choices

We ask whether subjects behave as pure hedonistic economic theory predicts: Do they each consistently make a single (expected utility maximizing in own payoffs) choice on each of the five payoff cards? Overwhelmingly not. Table 3 shows the frequencies with which individual subjects chose

Table 2: $\chi^2(9)$ statistics for differences in distributions across treatments and frames. P-values appear in parentheses below each χ^2 statistic.

Panel A: Tests for differences in distributions across treatments

lTreatment	Baseline	Partnership	Bidding	Bargaining
Partnership	6.677 (0.671)			
Bidding	9.123 (0.426)	3.403 (0.946)		
Bargaining	16.031* (0.066)	5.998 (0.648)	7.594 (0.576)	
Matched Baseline	8.428 (0.492)	3.323 (0.950)	3.063 (0.962)	4.708 (0.859)

Panel B: Tests for differences in distributions across frames within treatments

Baseline	Partnership	Bidding	Bargaining	Matched Baseline
8.369 (0.497)	9.326 (0.316)	11.999 (0.151)	10.092 (0.259)	11.062 (0.271)

*Significantly different from 0.5 at the 90% level of confidence.

one row in all five payoff cards, chose two distinct rows, three, four, and five distinct rows. It also shows the averages for Frame 1, Frame 2 and overall. The median number of unique choices is three per subject. Only 10.00% of subjects made a single choice across all five payoff cards. In contrast 18.33% made five unique choices across the five treatments. This leads to the second result:

Result 2 *Most subjects make different choices across some or all of the treatments.*

5.3 Patterns in Individual Choices

Here, we develop two classification schemes for preferences revealed by subject choices and how choices should vary across treatments depending on the subject's preferences. Table 4 outlines both classification schemes. The first "directional" scheme shown in Panel A is based simply on directional movements in choices between treatments. Simply put, we look at the slope of the moment of interest (e.g., Var(y) or E(x, y)) and ask whether the difference in two choices increases or decreases the moment over the majority of the 0 to 1 range. Though somewhat arbitrary, we find this scheme does an excellent job in organizing the data sensibly. It is intuitive and computationally simple. However, there are regions where the slope reverses and further shifts in the same direction may decrease the moment. The second "levels" scheme (showan in Panel B) addresses this issue by classifying subjects using absolute levels of the moments. It is slightly more complex, but may describe more accurately the choices of full utility maximizing subjects. However, for subjects using a rule of thumb or satisficing behavior, the directional classification scheme may better capture the behavioral process used by decision makers. In any case, the two schemes are highly correlated and

Table 3: Frequencies of the number of unique choices made by individual subjects

	Number of Unique Choices					
Session	1	2	3	4	5	Median
F1S1	2 10%	5 25%	6 30%	5 25%	2 10%	3
F1S2	2 10%	5 25%	7 35%	5 25%	1 5%	3
F1S3	3 15%	4 20%	5 25%	3 15%	5 25%	3
F2S1	2 10%	4 20%	6 30%	4 20%	4 20%	3
F2S2	0 0%	3 15%	6 30%	3 15%	8 40%	4
F2S3	3 15%	7 35%	5 25%	3 15%	2 10%	2.5
Frame 1	7 12%	14 23%	18 30%	13 22%	8 13%	3
Frame 2	5 8%	14 23%	17 28%	10 17%	14 23%	3
Overall	12 10%	28 23%	35 29%	23 19%	22 18%	3

give similar classification patterns. Next, we discuss the justification for each scheme in detail and compare results based on the schemes. Later, we show how both compare to the signs of parameters from estimated utility functions.

5.3.1 Risk Preferences in Own Payoffs

Using the Baseline choice, we classify subjects according to revealed risk preferences over their own payoffs when they cannot affect the matched subject's payoffs. In both schemes, we classify choices of $p < 0.5$ as risk seeking and $p > 0.5$ as risk averse. The first rows in each panel of Table 4 shows these classifications. In this case, they are the same. We will discuss other cases later. However, the differences in the two schemes will lie near the extremes, where the slopes of $\text{Var}(y)$ or $\text{E}(x, y)$ reverse.

Table 5 shows how many subjects displayed each type of own risk preference (along with matched risk-preferences, discussed next). The last column in Table 5 shows that, overall, about half the subjects appear risk averse (50.83%) and about half appear risk seeking (49.17%). In the baseline, we force subjects to choose between risk aversion and risk seeking by not allowing $p = 0.5$. Because of this, up to 49.17% of the subjects may be risk neutral, but choose either $p = 0.45$ or $p = 0.55$ because they are forced to.

Result 3 *In the baseline treatment, about half of the subjects appear risk averse and half risk*

Table 4: Configuration of the two preference classification schemes

Panel A: Based on Directional Comparisons

Attribute	Benchmark	Classification
Risk Aversion	0.5	$p_{Baseline} > 0.5 \rightarrow$ Risk Averse $p_{Baseline} < 0.5 \rightarrow$ Risk Seeking
Other Risk Aversion	$p_{Baseline}$	$p_{MatchedBaseline} < p_{Baseline} \rightarrow$ Other Risk Averse $p_{MatchedBaseline} = p_{Baseline} \rightarrow$ Other Risk Neutral $p_{MatchedBaseline} > p_{Baseline} \rightarrow$ Other Risk Seeking
Fairness versus Distinction	$p_{Benchmark} = 2p_{Baseline} - p_{MatchedBaseline}$	$p_{Partnership} < p_{Benchmark} \rightarrow$ Fairness Seeking $p_{Partnership} = p_{Benchmark} \rightarrow$ Neutral $p_{Partnership} > p_{Benchmark} \rightarrow$ Distinction Seeking
Altruism versus Malice	$p_{Benchmark} = 2p_{Baseline} - p_{MatchedBaseline}$	$p_{Bidding} < p_{Benchmark} \rightarrow$ Altruistic $p_{Bidding} = p_{Benchmark} \rightarrow$ Neutral $p_{Bidding} > p_{Benchmark} \rightarrow$ Malicious
Altruism/Fairness versus Malice/Distinction	$p_{MatchedBaseline}$	$p_{Bargaining} < p_{MatchedBaseline} \rightarrow$ Altruism/Fairness $p_{Bargaining} = p_{MatchedBaseline} \rightarrow$ Neither $p_{Bargaining} > p_{MatchedBaseline} \rightarrow$ Malice/Distinction

Panel B: Based on Levels of Moments

Attribute	Benchmark	Classification
Risk Aversion	0.5	$p_{Baseline} > 0.5 \rightarrow$ Risk Averse $p_{Baseline} < 0.5 \rightarrow$ Risk Seeking
Other Risk Aversion	$p_{Baseline}$	$Var(y\|p_{MatchedBaseline}) < Var(y\|p_{Baseline}) \rightarrow$ Other Risk Averse $Var(y\|p_{MatchedBaseline}) = Var(y\|p_{Baseline}) \rightarrow$ Other Risk Neutral $Var(y\|p_{MatchedBaseline}) > Var(y\|p_{Baseline}) \rightarrow$ Other Risk Seeking
Fairness versus Distinction	$p_{Benchmark} = 2p_{Baseline} - p_{MatchedBaseline}$	$E(xy\|p_{Partnership}) > E(xy\|p_{Benchmark}) \rightarrow$ Fairness Seeking $E(xy\|p_{Partnership}) = E(xy\|p_{Benchmark}) \rightarrow$ Neutral $E(xy\|p_{Partnership})E < (xy\|p_{Benchmark}) \rightarrow$ Distinction Seeking
Altruism versus Malice	$p_{Benchmark} = 2p_{Baseline} - p_{MatchedBaseline}$	$E(y\|p_{Bidding}) > E(y\|p_{Benchmark}) \rightarrow$ Altruistic $E(y\|p_{Bidding}) = E(y\|p_{Benchmark}) \rightarrow$ Neutral $E(y\|p_{Bidding}) < E(y\|p_{Benchmark}) \rightarrow$ Malicious
Altruism/Fairness versus Malice/Distinction	$p_{MatchedBaseline}$	$E(y\|p_{Bargaining}) > E(y, p_{MatchedBaseline})$ and $E(xy\|p_{Bargaining}) > E(xy\|p_{MatchedBaseline})$ } $\rightarrow$ Altruism/Fairness Any other combination $\rightarrow$ Neither $E(y\|p_{Bargaining}) < E(y, p_{MatchedBaseline})$ and $E(xy\|p_{Bargaining}) < E(xy\|p_{MatchedBaseline})$ } $\rightarrow$ Malice/Distinction

seeking in their own payoffs. On average, they appear risk neutral.

Table 5: Risk Attitudes over Own and Matched Payoffs

Panel A: Based on Directional Comparisons

Risk Attitude Over Own Payoff	Risk Attitude over Matched Payoff: Risk Averse	Risk Neutral	Risk Seeking	Total
Risk Averse	**29**	22	10	61
	24.17%	18.33%	8.33%	50.83%
Risk Seeking	7	14	**38**	59
	5.83%	11.67%	**31.67%**	49.17%
Total	36	36	48	120
	30.00%	30.00%	40.00%	100%

Pearson chi2(2) = 31.5335; Pr = 0.000

Panel B: Based on Factor Levels

Risk Attitude Over Own Payoff	Risk Attitude over Matched Payoff: Risk Averse	Risk Neutral	Risk Seeking	Total
Risk Averse	**30**	22	9	61
	25.00%	18.33%	7.50%	50.83%
Risk Seeking	8	14	**37**	59
	6.67%	11.67%	**30.83%**	49.17%
Total	38	36	46	120
	31.67%	30.00%	38.33%	100%

Pearson chi2(2) = 21.2135; Pr = 0.000

One could conduct a similar exercise and infer risk preferences under an assumption of pure hedonism in each other treatment. According to these measures risk preferences for many individual subjects appear to change across treatments. Between the baseline and matched baseline treatments, 45 subjects (37.5%) appear to “switch” between risk aversion and risk seeking preferences. Respective numbers for apparent “switches” between the baseline and partnership, bidding and bargaining choices are: 50 (41.67%), 43 (35.83%) and 43 (35.83%). This leads to the following result:

Result 4 ***If*** *one ignored the effects of participants’ choices on others, one would conclude that risk preferences are relatively unstable across institutions.*

This evidence is consistent with Berg et al. (2005) who measure apparent risk preferences for subjects across three institutions: a Becker et al. (1964) procedure and two auction procedures. They conclude that apparent risk preferences change across institutions. However, many other factors change across their institutions. The auction procedures entail new kinds of uncertainty

(uncertainty about others' values and strategic uncertainty) as well as interpersonal effects. Here, we find this apparent instability of risk preferences remains without the different types of uncertainty. However, since the only factor that changes in our design is the effect on others' payoffs, we propose interpersonal factors as an alternative explanation.

Next, we classify subjects according to their responses to specific interpersonal factors and look for patterns in these responses.

5.3.2 Risk Preferences in Matched Participant Payoffs

We compare the Baseline treatment to the Matched Baseline treatment to assess each subject's response to affecting the risk faced by the matched participant. Comparing Figure 2, Panels 1 and 3, notice that the expected payoffs for both subjects are the same for each choice. Also, the subject's own impact on his or her own variance does not change between the treatments. Finally, there is a zero-cross moment between own and matched payoffs since the subject and matched participant are never paid at the same time. If the subject is not overwhelmingly malicious ($u_1(x, y) > -u_2(x, y)$), then the only choice-relevant factor that changes across the treatments is the effect the subject's choice has on the risk faced by the matched participant. If the subject is risk averse in the matched participant's payoffs, the optimal p should fall relative to the baseline. If the subject is risk seeking in the matched participant's payoffs, the optimal p should rise relative to the baseline.

The second rows in each Panel of Table 4 shows our classification schemes for other risk preferences. We classify subjects as risk averse, risk neutral or risk seeking in matched payoffs by comparing the choice in the Matched Baseline treatment to the benchmark of the Baseline treatment. In both schemes, we classify a subject as risk neutral in the matched payoff if the choices are the same in the two treatments. As shown in Panel A, in the directional scheme, we classify the subject as risk averse in the matched payoff if $p_{MatchedBaseline} < p_{Baseline}$ and as risk seeking if $p_{MatchedBaseline} > p_{Baseline}$. As shown in Panel B, in the levels scheme, we classify the subject as risk averse (seeking) in the matched payoff if their matched baseline choice decreases (increases) the matched subject's variance relative to what the baseline choice would have given. The correlation between the two classification schemes is 0.9157. The last row in each Panel of Table 5 shows how many subjects were risk averse, risk neutral and risk seeking in matched payoffs according to the two schemes. The distribution of risk preferences over matched payoffs was tilted slightly to risk seeking with 30% to 32% risk averse, 30% risk neutral and 38% to 40% risk seeking. This gives:

Result 5 *Subjects appear somewhat risk seeking in matched payoffs.*

5.3.3 Relationship of risk preferences over own and matched participant payoffs

Having categorized subjects according to their risk preferences over own and matched payoffs, we ask whether there is a systematic relationship between the two. Table 5 shows the relationship between these measures. Most subjects who are risk averse in own payoffs are risk neutral or risk averse in matched payoffs (with the mode being risk averse). Similarly, those who are risk seeking in own payoffs are correspondingly risk neutral or risk seeking in matched payoffs (with the mode being risk seeking). Overall, only 14.16% (14.17%) of subjects appear to have the opposite risk attitudes over own and matched payoffs according to the directional (levels) scheme. The relationship is striking with $\chi^2(4)$ statistics of 31.53 and 21.21 for the directional and levels schemes respectively.[19]

Result 6 *There is a strong relationship between a subjects risk attitudes across own and matched subject payoffs. Subjects tend to appear risk averse in both dimensions, risk neutral in both dimensions, or risk seeking in both dimensions.*

5.3.4 Fairness versus Distinction Seeking

The Baseline and Matched Baseline treatments tell us how the subject is affected by the impact of his or her choice on the expected value and variance of own and matched payoffs. In fact, the shift in choice between them shows how the subject changes because he or she affects the variance of own and matched payoffs in the opposite direction. (Increasing p decreases own variance and increases matched variance.) Here, we use these shifts to create a benchmark for the partnership choice. We make the simplifying assumption that, if the effect on the matched variance is reversed, the shift his or her choice from the baseline by the same amount, but in the opposite direction.[20] Figure 2, Panels 1 and 4 show there are two differences between the matched baseline and partnership choices. First, the effect on matched variance works in the opposite direction. Second, since both subjects are paid at the same time and lose at the same time, the choice of p affects the first cross moment of payoffs ($\mathrm{E}(x, y)$) in the partnership treatment.

The third rows in each Panel of Table 4 shows our classification schemes for fairness versus distinction seeking. To account for the effect on matched variance, we use the benchmark of $2p_{Baseline} - p_{MatchedBaseline}$. This reflects the shift from the Baseline to the Matched Baseline treatment around the choice in the Baseline treatment. (That is, it assumes the subject will be affected by the impact on matched variance by the same amount, but in the opposite direction.) Then, we compare $p_{Partnership}$ to this benchmark and classify subjects as neutral if $p_{Partnership} = p_{Benchmark}$. According to the directional scheme (Panel A), we classify them as fairness seeking if $p_{Partnership} < p_{Benchmark}$ or distinction seeking if $p_{Partnership} > p_{Benchmark}$. According to the levels scheme (Panel B), we classify them as fairness (distinction) seeking if $p_{Partnership}$ increases (decreases) the cross moment relative to $p_{Benchmark}$.

The last column in Table 6 gives the results of this classification for the subjects with benchmarks in the admissible range of choices. (It also gives classifications on a Fairness/Distinction scale, which will discuss next.) For the subjects we can classify, many fall in each category: 41.67% to 43.75% fairness seeking, 22.92% neutral and 33.33% to 35.42% distinction seeking.

[19] This is especially striking because the only way risk averse subjects could be classified as matched risk averse is to decrease the risk of the matched participant at the expense of increasing the risk they faced themselves. Similarly, the only way risk seeking subjects could be classified as matched risk seeking is to increase the risk of the matched participant at the expense of decreasing the risk they faced themselves.

[20] This is an approximation which is correct at $p = 0.5$.

Result 7 *Overall, the median subject is neutral, but the modal subject seeks fairness.*

Table 6: Altruism vs. malice and fairness vs. distinction seeking subject classifications

Panel A: Based on Directional Comparisons

Fairness vs. Distinction	Altruism vs Malice: Altruistic	Neutral	Malicious	Total
Fairness Seeking	**29** **30.21%**	4 4.17%	7 7.29%	40 41.67%
Neutral	3 3.13%	**15** **15.63%**	4 4.17%	22 22.92%
Distinction Seeking	4 4.17%	1 1.04%	**29** **30.21%**	34 35.42%
Total	36 37.50%	20 20.83%	40 41.67%	96 100.00%

Pearson $\chi^2(4) = 77.6147$; p-value = 0.000

Panel B: Based on Factor Levels

Fairness vs. Distinction	Altruism vs Malice: Altruistic	Neutral	Malicious	Total
Fairness Seeking	**25** **36.04%**	4 4.17%	13 13.54%	42 43.75%
Neutral	3 3.13%	**15** **15.63%**	4 4.17%	22 22.92%
Distinction Seeking	8 8.33%	1 1.04%	**23** **23.96%**	32 33.33%
Total	36 37.50%	20 20.83%	40 41.67%	96 100.00%

Pearson $\chi^2(4) = 52.2539$; p-value = 0.000

5.3.5 Altruism versus Malice

Again, we use the Baseline and Matched Baseline choices to create a benchmark for the Bidding choice. Again, we make the simplifying assumption that, if the effect on the matched variance is reversed, the subject's choice shifts from the baseline by the same amount, but in the opposite direction. Comparing 2, Panels 1 and 5 shows there are two differences between the Matched Baseline and Bidding choices. First, as in the Partnership choice, the effect on matched variance works in the opposite direction. Second, the subject can affect the expected payoff of the matched participant. If the subject decreases $p_{Bidding}$, he or she increases both the probability and size of the matched participant's payoff. Essentially, at the expense of his or her own expected payoff, the subject can hand money over to or take money away from the matched participant. An altruist will decrease $p_{Bidding}$ and a malicious subject will increase $p_{Bidding}$.

The fourth rows in each Panel of Table 4 shows our classification schemes for altruism versus malice. To account for the effect on matched variance, we again use the benchmark of $2p_{Baseline} - p_{MatchedBaseline}$. This reflects the shift from the Baseline to the Matched Baseline treatment around the choice in the Baseline treatment. (That is, it assumes the subject will be affected by the impact on matched variance by the same amount, but in the opposite direction.) Then, we compare $p_{Bidding}$ to this benchmark. We classify subjects as neutral if $p_{Bidding} = p_{Benchmark}$ in both schemes. According to the directional scheme, we classify them as altruistic if $p_{Bidding} < p_{Benchmark}$ or malicious if $p_{Bidding} = p_{Benchmark}$. According to the levels scheme, we classify them as altruistic (malicious) if $p_{Bidding}$ increases (decreases) the matched subjects expected payoffs relative to $p_{Benchmark}$.

The bottom row in each Panel in Table 6 gives the results of this classification for subjects that have benchmarks inside the admissible range of choices. Again, according to both schemes, many subjects fall in each category: 37.50% altruistic, 20% neutral and 41.67% malicious.

Result 8 *Overall, the median subject is neutral, but the modal subject is malicious.*

5.3.6 Relationship between Altruism/Malice and Fairness/Distinction Seeking

Having categorized subjects along an Altruism/Malice dimension and Fairness/Distinction dimension, we ask whether a systematic relationship between the two exists. Table 6 shows the relationship between these measures. Most subjects who are altruistic are also fair. Similarly, those who are malicious are also distinction seeking. Finally, those who are neutral in the altruism/malice dimension are also generally neutral in the fairness/distinction dimension. These three categories account for 65.63% to 76.05% of all observations. Again, the relationship is striking with $\chi^2(4)$ statistics of 77.61 and 52.25 for the directional and levels schemes, respectively.

Result 9 *There is a strong relationship between the altruism/malice dimension and the fairness/distinction seeking dimension of revealed other regarding preferences. Subjects tend to appear to be altruistic and seek fairness; appear to be malicious and seek distinction; or are neutral in both dimensions.*

5.3.7 Consistency Check using the Bargaining Choice

The Bargaining choice can be used to determine whether altruism/fairness seeking or malice/distinction seeking dominates. Comparing Figure 2, Panels 1 and 6 shows that the Bargaining treatment is the most complex and has aspects of all four other treatments. As with all the treatments, the impact of the choice on own expected payoffs and variance is the same as in the Baseline treatment. The impact on variance of own payoffs is the same as in the Matched Baseline treatment. The impact on expected matched payoffs is the mirror image of the Bidding treatment. The impact on correlation of own and matched is the mirror image of the Partnership treatment. Thus, subject preferences along both altruism/maliciousness and fairness/distinction seeking dimensions can affect choice.

The last rows in each Panel of Table 4 shows our classification schemes for fairness versus distinction seeking. Here, the effect on matched variance is the same as in the Matched Baseline choice, so we will use the Matched Baseline choice as the benchmark. Both altruism and fairness seeking tend to increase the optimal p. Both maliciousness and distinction seeking tend to decrease the optimal p. Thus, according to the directional scheme, we classify a subject as altruism/fairness seeking dominant if the Bargaining choice exceeds the Matched Baseline choice. We classify a subject as malicious/distinction seeking dominant if the Bargaining choice falls below the Matched Baseline choice. According to the levels scheme, we classify a subject as altruism/fairness (malicious/distinction) seeking dominant if the Bargaining choice increases (decreases) both the expected matched subject payoff and the cross moment relative to the Matched Baseline choice. Otherwise, we classify a subject as neither. We then compare these classifications to the classifications of both altruistic and fairness seeking or both malicious and distinction seeking according to the other four choices.

Table 7 shows the relationship between the classifications according to the Bargaining choice versus the classification using the other four choices. Generally, the modal subject who is classified as both altruistic and fairness seeking according to the other four choices is also classified as altruistic/fairness seeking dominant according to the Bargaining choice. Similarly, the modal subject is neither according to the other choices is also neither according to the Bargaining Choice. However, subjects who are classified as malicious/distinction seeking according to the other four choices tend to be less so according to the bargaining choice.

We note that the bargaining choice is the most computationally complex of the choices. In particular, there is a limited range in which one can increase matched payoffs and increase the first cross moment at the same time. Fairness and altruism can work in opposite directions relative to the baseline choice with a high p. Thus, while the levels method may fit better for fully optimizing subjects, this is also the treatment in which subjects are most likely to resort to satisficing behavior or rules of thumb. This may make the directional method fit better. However, we observe the following in the table, which provides a confirming check on our classification scheme. First, adding the upper right and lower left corners fo each Panel shows that only 14.58% (levels method) to 19.79% (directional method) of subjects switch between Altruistic/Fairness dominant to Malicious/Distinction dominant. Second, adding along the diagonal in each Panel shows that 42.71% (levels method) to 46.88% (directional method) of the subjects are consistently either Altruistic/Fairness dominant, Malicious/Distinction dominant or neither. The other 33% (directional method) to 42.17% (levels method) may be partially consistent. The patterns are not random, albeit weakly so at best for the levels scheme ($\chi^2(4)$ statistics are 11.22 and 6.43 for the two schemes). Thus:

Result 10 *Classifications on the altruism/maliciousness and fairness/distinction seeking dimensions are similar when based on the bargaining treatment as when based on the other four treatments.*

Table 7: Altruism vs. malice and fairness vs. distinction seeking subject classifications

Panel A: Based on Directional Comparisons

Classification Based on Matched Baseline versus Bargaining	Classification Based on Baseline and Matched Baseline versus Partnership and Bidding: Altruistic and Fairness Seeking	Neither	Malicious and Distinction Seeking Dominant	Total
Altruistic and Fairness Seeking Dominant	**16** **16.67%**	5 5.21%	8 8.33%	29 30.21%
Neither Dominant	8 8.33%	**18** **18.75%**	12 12.50%	38 39.58%
Malicious and Distinction Seeking Dominant	11 11.46%	7 7.29%	**11** **11.46%**	29 30.21%
Total	35 36.46%	30 31.25%	31 32.29%	96 100.00%

Pearson $\chi^2(4) = 11.2168$; p-value = 0.024

Panel B: Based on Factor Levels

Classification Based on Matched Baseline versus Bargaining	Classification Based on Baseline and Matched Baseline versus Partnership and Bidding: Altruistic and Fairness Seeking	Neither	Malicious and Distinction Seeking Dominant	Total
Altruistic and Fairness Seeking Dominant	**13** **13.54%**	4 4.17%	8 8.33%	25 26.04%
Neither Dominant	15 15.63%	**20** **20.83%**	13 13.54%	48 50.00%
Malicious and Distinction Seeking Dominant	6 6.25%	9 9.38%	**8** **8.33%**	23 23.96%
Total	34 35.42%	33 34.38%	29 30.21%	96 100.00%

Pearson $\chi^2(4) = 6.4321$; p-value = 0.169

5.4 Parameter Estimation

The non-parametric analysis above depends only on differences in choices relative to derivatives of an unparameterized utility function (technically, derivatives in the central ranges of p) or absolute levels of moments. The disadvantage of this approach is that it assumes subjects do not make errors large enough to affect the choices more than would be implied by the marginal utilities. Parameterizing a utility function allows us to estimate parameters that best fit the observed choices of a subject and perhaps better understand what drives behavior.[21] The advantage of this is that it does not assume accuracy in any particular choice. Instead, it assumes choices on average reflect subject preferences. However, it also involves a trade-off. The utility function may not be correctly specified, or the specification may affect the data that can be explained by it. For example, in the quadratic utility case (equation (1)), no parameter configuration makes p less than 0.35 the optimal choice. While such choices may be explained by the exponential utility function (equation (3)), empirical evidence suggests that the α and β parameters may need to be quite large.[22]

We create four sets of estimates for each utility function to determine what utility function form and which factors best explain the data. We estimate the full version of the quadratic utility model given in equation (1) by finding the α, b, β, and c parameters via the following procedure:

1. Each parameter is between -1 and 1. This implies that the variance factor is less important than the amount received ($-1 < \alpha < 1$), that the matched subject's payoffs are less important that the subjects own payoffs ($-1 < \beta < 1$), similarly the variance in the matched subject's payoffs are less important than the matched subject's payoff level and the subject's own payoffs ($1 < -\beta < 1$ and $1 < -b \cdot \beta < 1$), and the covariance of payoffs are less important than the subject's own payoffs ($-1 < c < 1$).

2. Across the five choices for the subject, the parameters minimize the sum of the squared prediction errors between: (1) the optimal choice given the parameters and (2) the observed choice.

3. Since many parameters may give the same minimum sum of squared prediction errors, we chose the parameters within the minimizing set that minimizes the Euclidean distance between the parameters and zero (i.e., $\min(\alpha^2 + b^2 + \beta^2 + c^2)$). This is the most conservative set of risk and other regarding preferences that best explain the observed data.[23]

[21] We note that we are estimating individual utility functions for each agent, not a utility function to explain the overall data. The overall average choices are essentially risk neutral in own and matched payoffs, neutral on the altruism/malice dimension, and neutral on the fairness/distinction seeking dimension. This drives to zero all parameter estimates based on aggregate data. This is easiest to see using a method of moments estimator. The utility function that leads to all choices equal to 0.45 or 0.55 across the treatments is one with a, b, β and c all equal to zero.

[22] Mehra and Prescott (1985) and Rietz (1988) explore αs and up to 10 to try to explain the observed equity risk premium.

[23] This is computationally intensive because the problem is not concave. For each possible parameter set, we have to check the utility for all possible choices for each of the five treatments to determine the forecast choices implied by the parameters. Then, we have to calculate the sum of the squared prediction errors. Finally, we have to search across parameters to find the set that satisfies criteria 2. and 3. above.

Then, we estimate three restricted versions similarly: one where α is the only estimated parameter (setting b, β and c all equal to 0); one that adds b and β to the estimation (setting c equal to 0); and one that adds c to the estimation (setting b and β equal to 0). This allows us to estimate the impact of each preference factor on the ability to explain the data.

Next, we estimate a full version of equation (3). We use the same procedure as the first estimation except we run two index variables between -3 and 3 by 0.02 increments (excluding 1) and set α, and β equal to indices squared (i.e., both range from -9 to +9 independently).

Finally, we estimate the same three restricted versions of equation (3) as we did for equation (1) to estimate the impact of each preference factor on the ability to explain the data.

Table 8 summarizes the parameters and measures of fit for each model. Across all models, subjects are consistently slightly, but statistically significantly, risk seeking in their own payoffs. Note that other risk aversion in the quadratic model is $b \cdot \beta$ directly. Similarly, the combined sign of b and β determine risk aversion in the exponential model. So, we also include $b \cdot \beta$ in the results. On average, models fit 2 to 4 of the 5 subject choices and fit perfectly for 9% to 50% of the subjects. Not surprisingly, the α-only models fit the worst and the full models fit the best along all measures.

Also not surprisingly, the average coefficients across subjects are often not significantly different from 0. However, the distributions of estimates for parameters cover ranges, which allows us to explain a significant number of observations. Figure 5 shows violin plots for the estimated parameters of the individual subject utility functions. The medians (white dots) are essentially zero for all estimated parameters, but there is a range of all parameter estimates across subjects.

Combined, Table 8 and Figure 5 give us the the next result.

Result 11 *The average estimated parameters with respect to own and other risk preference, altruism and malice, and fairness and distinction seeking, do not differ significantly from zero. However, there is a distribution of parameter estimates along each dimension.*

The question here is how much more explanatory power comes from adding the inter-personal preference factors. To measure this, we define an R^2 for each subject as:

$$R^2 = 1 - \frac{\text{Model Sum of Squared Errors}}{\text{Total Sum of Squares}}, \tag{10}$$

where Total Sum of Squares is derived by finding the choice that minimizes the sum of squared errors between this choice and each of the five choices made by the subject, and Model Sum of Squared Errors is the sum of squared errors from the fitted model predictions and the five choices made by the subject.[24] Because the quadratic models cannot explain choices less than 0.35, the most restricted quadratic model explains the data worse than simply picking the single choice that minimizes the sum of squares across all choices (average $R^2 < 0$). The most restricted exponential model can fit exactly the same data as the sum of squares minimizing choice (average $R^2 = 0$). But, on average the full models explain 62% and 75% of the observed variance across subject choices. In

[24]It makes little sense here to define an adjusted R^2 because there are only five choices per subject. We are using it to measure how much each model explains, not to determine the increase in fit per variable.

Table 8: Summary of fitted model parameters and measures of model fit. For each model, Column 1 restricts b, β and c to 0, Column 2 restricts c to 0, Column 3 restricts b and β to 0 and Column 4 is the full model. Total Sum of Squares is the sum of the squared deviations from the choice that minimizes the sum. The Sum of Model Squared Errors is the sum squared deviations from the model predictions. The Pseudo R^2 is 1 − (Sum of Model Squared Errors)/(Total Sum of Squares).

		Model							
		Quadratic				CRRA			
Parameter	Statistic	1	2	3	4	1	2	3	4
α	Mean	-0.060***	-0.112***	-0.126***	-0.098***	-0.141***	-0.175***	-0.247***	-0.129**
	Std. Err.	0.014	0.023	0.022	0.021	0.044	0.066	0.058	0.065
b	Mean		-0.076**		-0.057		-0.046		0.024
	Std. Err.		0.034		0.037		0.028		0.033
β	Mean		0.081***		0.025		0.039		0.029
	Std. Err.		0.023		0.022		0.09		0.075
$b \cdot \beta$	Mean		0.011		0.016		0.061		0.081**
	Std. Err.		0.013		0.012		0.046		0.035
c	Mean			0.018*	-0.008			0.034***	0.016
	Std. Err.			0.009	0.013			0.01	0.013
# Matched	Mean	1.992	3.325	2.825	3.85	2.083	3.492	2.983	4.1
(out of 5)	Std. Dev.	1.464	1.462	1.364	1.214	1.453	1.39	1.341	1.126
% of Subjects Fit Perfectly		9.17%	27.50%	13.33%	40.83%	10.00%	30.83%	15.83%	50.00%
Total Sum	Mean	0.077	0.077	0.077	0.077	0.077	0.077	0.077	0.077
of Squares	Std. Dev.	0.085	0.085	0.085	0.085	0.085	0.085	0.085	0.085
Model Sum of	Mean	0.086	0.035	0.052	0.025	0.077	0.023	0.04	0.013
Squared Errors	Std. Dev.	0.094	0.052	0.066	0.039	0.085	0.03	0.051	0.026
R^2 Fit	Mean	-0.13	0.462	0.279	0.622	0	0.608	0.444	0.75
	Std. Dev.	0.841	0.824	0.787	0.622	0	0.325	0.275	0.346

*Significantly different from 0 at the 90% level of confidence
**Significantly different from 0 at the 95% level of confidence
***Significantly different from 0 at the 99% level of confidence

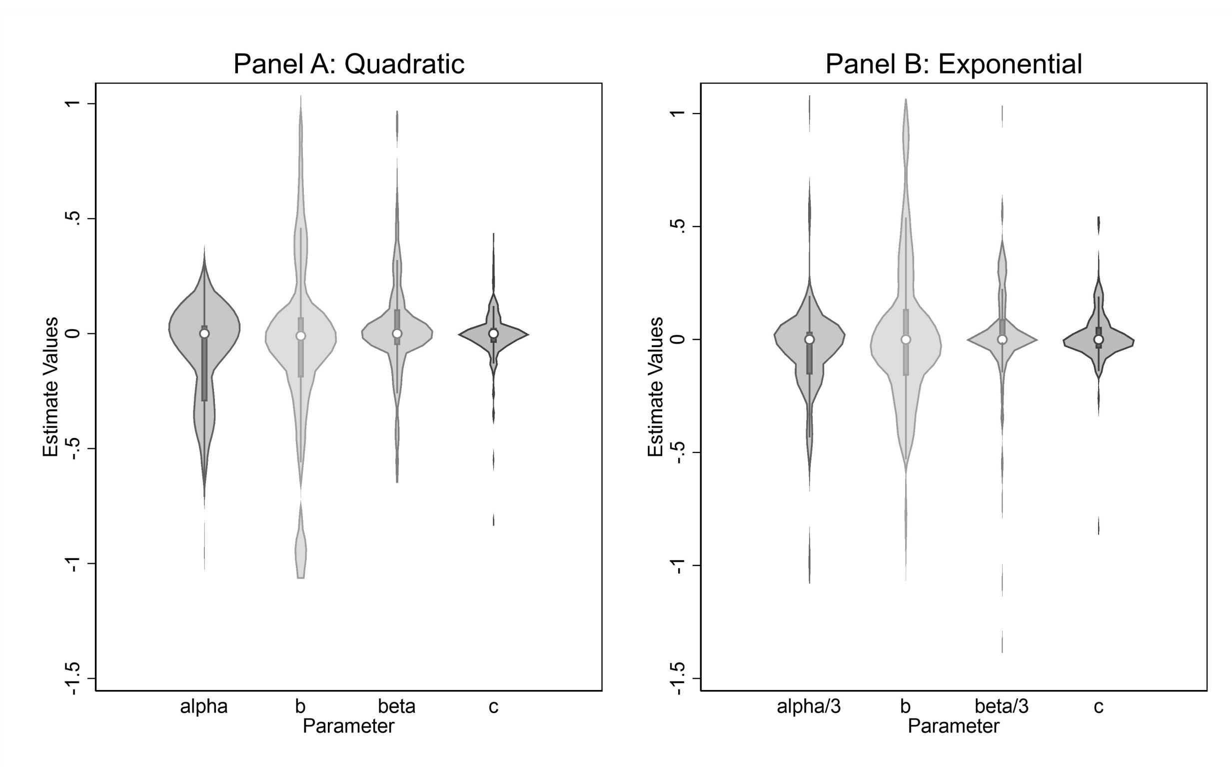

Figure 5: Violin plots of the distributions of parameter estimates. Panel A shows estimates from the quadratic utility function. Panel B for the exponential utility function with α and β estimates divided by 3 for a common scale

the quadratic model, the fairness/distinction factor alone adds 41 percentage points the R^2 while the altruism/malice factors alone add 59 percentage points to the R^2. This leaves 16 percentage points of the increased R^2 explained only by combining all the interpersonal factors. Similarly, in the exponential model, fairness/distinction adds 44 percentage points, altruism/malice adds 61, and 14 can only be explained by the combination. Thus:

Result 12 *Adding interpersonal factors greatly expands the ability to explain intra-subject variance in choices.*

Another way to measure fit is to ask what percentage of subject choices can be explained perfectly by each model. The results are similar. The most restricted quadratic model does worse than the sum of squares minimizing choice. The most restricted exponential model matches it. Adding the interpersonal factors to the quadratic model fits 41% of the subjects perfectly, with the majority of the increase in fit coming from the altruism/malice factors (b and β). Adding the interpersonal factors to the exponential model fits 50% of the subjects perfectly, again with most of the increase coming from the altruism/malice factors (b and β).

Result 13 *Adding interpersonal factors greatly expands the fraction of choices that can be explained by assuming expected utility maximizing subjects.*

Next, we ask whether the estimates correspond to the categorization of preferences derived from the simple comparisons of choices. We use estimates from the full models and correlate them with each other and categorizations measured by directional movements and categorizations measured directly by levels of payoffs and their moments.[25]

Table 9 shows the correlations between the estimated parameters and the directional and level measures of risk and other regarding preferences identified by our non-parametric analysis above. Measured risk aversion and estimated risk aversion are highly correlated across the board. Altruism and malice level measures also correlate strongly with the altruism/malice parameter (b) estimates. Other risk aversion measures are less highly correlated with estimates of $b \cdot \beta$. However, matched variance and covariance interact with each other in both utility functions, possibly weakening the observed relationship. Fairness/distinction measures are strongly correlated with the fairness/distinction (c) estimates in the full models. Thus:

Result 14 *Estimated interpersonal utility function parameters generally agree with measures of interpersonal factors derived from comparing choices or levels of own and matched participant payoffs, variances and cross-moments.*

Finally, the parameter estimates align with the correlation between the altruism/malice and fairness/distinction measures shown in Table 7. The correlation between estimates of b and c is 0.460 ($p = 0.000$) in the quadratic model and 0.563 ($p = 0.000$) in the CRRA model. Thus, the interpersonal factor correlations hold up regardless of the method used.

[25]The latter probably makes more sense because the parameters measure strength of preference.

Table 9: Summary of fitted model parameter correlations with directional measures based on choice comparisons. For each model, Column 1 restricts b, β and c to 0, Column 2 restricts c to 0, Column 3 restricts b and β to 0 and Column 4 is the full model.

			Model							
			Quadratic				CRRA			
Parameter	Measure	Statistic	1	2	3	4	1	2	3	4
Own Risk Preference and $\hat{\alpha}$	Dummy	Correlation	0.456***	0.551***	0.473***	0.513***	0.361***	0.326***	0.376***	0.234***
		p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0 .000	0.01
	Level	Correlation	0.331***	0.480***	0.385***	0.439***	0.341***	0.470***	0.377***	0.332***
		p-Value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Altruism /Malice and $\hat{b}$	Dummy	Correlation		0.12		0.191*		-0.109		0.185*
		p-Value		0.246		0.062		0.290		0.0710
	Level	Correlation		0.278***		0.280***		0.005		0.240**
		p-Value		0.006		0.006		0.963		0.019
Other Risk Aversion and $\hat{b} \cdot \hat{\beta}$	Dummy	Correlation		0.312***		0.276***		-0.119		-0.078
		p-Value		0.001		0.002		0.197		0.399
	Level	Correlation		0.255***		0.108		0.220**		0.134
		p-Value		0.005		0.239		0.016		0.143
Fairness /Distinction and $\hat{c}$	Dummy	Correlation			0.1559	0.071			0.253**	0.227**
		p-Value			0.1294	0.492			0.013	0.026
	Level	Correlation			0.169*	0.452***			0.0511	0.556***
		p-Value			0.099	0			0.621	0.000

*Significantly different from 0 at the 90% level of confidence
**Significantly different from 0 at the 95% level of confidence
***Significantly different from 0 at the 99% level of confidence

Result 15 *Estimated interpersonal utility function parameters show that subjects are generally (1) altruistic and fairness seeking, (2) malicious and distinction seeking, or (3) neutral on both dimensions.*

6 Conclusions

In our experiment, the impact of one's choice on another, matched participant's payoffs appears to affect behavior. Because the choices and how the choices impact one's own payoffs are consistent across treatments, this effect is cleanly isolated. It cannot arise from uncertainty about the matched participant's behavior, interactions with the matched participant, nor from differences in the context of the choices. The results show how interpersonal factors may explain apparent "sub-optimal" behavior in experiments and instabilities in inferred or elicited preference parameters across institutions.

While there is little change in average choices across treatments, individuals frequently change their choices across treatments. The observed changes are systematic. Some subjects' choices indicate altruism. Choices for these subjects often also indicate fairness. In contrast, subjects who's choices indicate malice also make choices indicating competitiveness.

When evaluating behavior in institutions and games where choices affect own and others' payoffs, experimenters should be aware of the possibility that preferences over the payoffs of others may affect behavior. They should take these factors into consideration when making predictions about behavior.

Our design could be used to classify subjects as altruistic/fairness seeking, neutral, or malicious/competitive in advance of an experiment to predict behavior.

There may also be policy implications. Since we can often make the same decisions in different institutions (e.g., forming prices by bidding, bargaining or market exchanges), we can select the institution to promote desired outcomes. For example, if we want an equitable division of surplus from a transaction and we find that individuals are likely to have a greater concern for fairness in bargaining situations, we may want to arrange a transaction through bargaining instead of bidding. Conversely, if we prefer to maximize surplus and we find that bidding encourages this outcome, we may want to arrange the transaction through bidding.

References

Addison, T. L. and L. A. Schmidt (1999). Are women who are shy reluctant to take risks? behavioral and psychophysiological correlates. Journal of Research in Personality 33(3), 352–357.

Allais, M. (1953). L'extension des théories de l'équilibre économique général et du rendement social au cas du risque. Econometrica 21(2), 269–290.

Andreoni, J. (1989). Giving with impure altruism: Applications to charity and ricardian equivalence. Journal of political Economy 97(6), 1447–1458.

Arrow, K. J. (1964). The role of securities in the optimal allocation of risk-bearing. The review of economic studies 31(2), 91–96.

Becker, G. M., M. H. DeGroot, and J. Marschak (1964). Measuring utility by a single-response sequential method. Behavioral science 9(3), 226–232.

Becker, G. S. (1974). A theory of social interactions. Journal of political economy 82(6), 1063–1093.

Berg, J., J. Dickhaut, and K. McCabe (2005). Risk preference instability across institutions: A dilemma. Proceedings of the national academy of sciences 102(11), 4209–4214.

Brandt, F., T. Sandholm, and Y. Shoham (2007). Spiteful bidding in sealed-bid auctions. In Proceedings of the 20th international joint conference on Artifical intelligence, pp. 1207–1214.

Chen, Y. and S. X. Li (2009). Group identity and social preferences. American Economic Review 99(1), 431–457.

Daly, M. and M. Wilson (2001). Risk-taking, intrasexual competition, and homicide. Evolutionary Psychology and Motivation 47, 1–36.

Dasgupta, U., S. Mani, S. Sharma, and S. Singhal (2019). Internal and external validity: Comparing two simple risk elicitation tasks. Journal of Behavioral and Experimental Economics 81, 39–46.

Eeckhoudt, L., B. Rey, and H. Schlesinger (2007). A good sign for multivariate risk taking. Management Science 53(1), 117–124.

Fehr, E. and K. M. Schmidt (1999). A theory of fairness, competition, and cooperation. The quarterly journal of economics 114(3), 817–868.

Fehr, E. and K. M. Schmidt (2006). The economics of fairness, reciprocity and altruism–experimental evidence and new theories. Handbook of the economics of giving, altruism and reciprocity 1, 615–691.

Fisman, R., P. Jakiela, S. Kariv, and D. Markovits (2015). The distributional preferences of an elite. Science 349(6254), aab0096.

Forsythe, R., J. L. Horowitz, N. E. Savin, and M. Sefton (1994). Fairness in simple bargaining experiments. Games and Economic behavior 6(3), 347–369.

Frank, R. H. (1985). The demand for unobservable and other nonpositional goods. The American Economic Review 75(1), 101–116.

Holzmeister, F. and M. Stefan (2021). The risk elicitation puzzle revisited: Across-methods (in)consistency? Experimental economics 24, 593–616.

Kagel, J. H. and D. Levin (1999). Common value auctions with insider information. Econometrica 67(5), 1219–1238.

Kirchkamp, O. and W. Mill (2021). Spite vs. risk: Explaining overbidding in the second-price all-pay auction: A theoretical and experimental investigation. Games and Economic Behavior 130, 616–635.

Loewenstein, G. F., L. Thompson, and M. H. Bazerman (1989). Social utility and decision making in interpersonal contexts. Journal of Personality and Social psychology 57(3), 426.

MacCrimmon, K. R. and D. M. Messick (1976). A framework for social motives. Behavioral Science 21(2), 86–100.

Machina, M. J. (1987). Choice under uncertainty: Problems solved and unsolved. Journal of Economic perspectives 1(1), 121–154.

Mehra, R. and E. C. Prescott (1985). The equity premium: A puzzle. Journal of monetary Economics 15(2), 145–161.

Murnighan, J. K. (2008). Fairness in ultimatum bargaining. Handbook of experimental economics results 1, 436–453.

Plott, C. R. (1982). Industrial organization theory and experimental economics. Journal of Economic Literature XX, 1485–1527.

Rietz, T. A. (1988). The equity risk premium a solution. Journal of monetary Economics 22(1), 117–131.

Scott, R. H. (1972). Avarice, altruism, and second party preferences. The Quarterly Journal of Economics 86(1), 1–18.

Starmer, C. (2000). Developments in non-expected utility theory: The hunt for a descriptive theory of choice under risk. Journal of economic literature 38(2), 332–382.

Veblen, T. (1909). The limitations of marginal utility. Journal of political Economy 17(9), 620–636.

von Neumann, J. and O. Morgenstern (1944). Theory of Games and Economic Behavior. Princeton, New Jersey: Princeton University Press.

Internet Appendices

Appendix I Experimental Instructions

Instructions (Frame 1)

General Instructions

You are about to participate in study of decision making in which you will make several choices. By carefully following these instructions and making good choices, you can earn a considerable amount of money. This money will be paid to you in cash at the end of the experiment.

There are _____ people participating in today's study. You are split evenly between two different rooms. All of you are reading identical instructions. You will not learn the identities of the participants in the other room, nor will they learn yours. However, some of the choices you make will affect the earnings of participants in the other room. You have a set of Payoff Tables which show if and how your choices affect payoffs of these participants. We will discuss these tables later. A separate group of participants in the other room will make choices that affect your earnings in a similar manner.

You have already earned $3 in cash just for showing up. The instructions below explain how you can earn additional money. If you have any questions during this study, please raise your hand and an administrator will answer them. When we have finished reading these instructions and all questions have been answered, we will begin. Do not talk to other participants after this point.

You should have the following materials in front of you:

- these Instructions
- a pen
- a highlighter
- a Consent Form
- a Receipt Form
- five perforated cards (each labeled "Payoff Card")

If you are missing any of these materials, please tell us now.

How Your Choices Affect Your Earnings

Part of your earnings will be affected by the choices you make. You will make five choices in this study. These choices consist of highlighting one row on each of the five Payoff Cards you have in front of you. Do not make these choices until we have completed these instructions and the administrators have answered all questions.

The "Own Payoff Table" (left side) of each Payoff Card contains information about the choices you can make and how those choices affect your payoffs. Specifically, the experiment will be conducted in two stages. In Stage 1, you will highlight a row on each Payoff Card. This row shows how the choice you make will affect the payoffs you will receive during Stage 2.

In Stage 2, a ticket will be drawn from a box in your room to determine the payoff resulting from your choice. The boxes in each room contain 100 numbered tickets. The last two digits on these tickets run from 00 to 99. For each choice, a participant in your room will be asked to draw a ticket from this box. The first ticket drawn will determine the payoff associated with Payoff Card 1. If the ticket number is GREATER THAN OR EQUAL TO the Cutoff Choice specified in the row you highlighted, you will receive the amount of cash shown in the column labeled "Ticket $\geq$ Cutoff" on your Own Payoff Table. If the number on the ticket is LESS THAN the Cutoff you chose, you will receive zero. Note that the row you choose in Stage 1 affects both the chances of receiving a payoff and the size of the payoff you receive. After the payoff for Card 1 has been determined, the ticket will be returned to the box and another ticket will be drawn to determine the payoff for Card 2. We will proceed in this fashion until the payoff for each card has been determined.

Each participant in the experiment will make exactly the same set of choices in Stage 1 as you do. However, their Payoff Tables may be in a different order. In Stage 2, five draws from the ticket box in each participant's own room will determine payoffs for the five Payoff Cards her or she has filled out.

How Your Choices Affect Other Participants' Payoffs

Your choices in Stage 1 may also affect the payoffs of five different participants in the other room. Every participant in this study has been assigned a participant number. You participant number is shown at the top of each of your Payoff Cards. The participant number of the participant whose payoff your choice may affect is also shown at the top of these cards. We call this participant your "Matched Participant" for that choice The identity of your Matched Participant changes for each choice you make.

The effect your choice has on this Matched Participant's payoffs is shown in the Matched Participant Payoff Table on the right-hand side of the Payoff Card. The Matched Participant Payoff Table differs for each Payoff Card. The (single) row you choose on the Payoff Card will determine both how your choice affects your payoffs and how your choice affects your Matched Participant's payoffs.

For each choice, the ticket drawn from the box in your room will determine both payoffs. The shading on the Payoff Card shows the association between your payoff and your Matched Participant's payoff. The shaded portions show payoffs received if the ticket number is greater than or equal to the cutoff you chose; the unshaded portions show payoffs received if the ticket number is less than the cutoff you chose.

At the end of the experiment, you will detach the Matched Participant Payoff Table from each Payoff Card. The experimenter will give these tables to the appropriate Matched Participants in the other room. Thus, your Matched Participant for each choice you make will learn how your choice affected his or her payoffs, the choice you made and the resulting payoffs he or she earned.

How Others' Choices Affect Your Payoffs

Just as your choices may affect the payoffs of participants in the other room, choices made by a separate group of participants in the other room may affect your payoffs. You are the "Matched Participant" for five different participants in the other room. None of these participants are those whose payoffs you affect.

The set of Matched Participant Payoff Tables that you will receive from being a Matched Participant is the same as the set of Matched Participant Payoff Tables shown on the right-hand side of your Payoff Cards. However, in each choice, the other participant's Matched Participant Payoff Table will be different from that portion of your Payoff Card for that choice. Also note that the tickets drawn in each room can differ. Thus, you cannot know how the participants you are matched with affect your payoffs until the study is over. Then, you will receive the five Matched Participant Tables from the participants in the other room whose choices affected your payoff. Thus, you will learn how each of these other participant's choices affected your payoffs, the choice he or she made and the resulting payoffs you earned. At no time will you learn the identities of the participants in the other group or the total payoffs they receive. Similarly, they will not learn your identity or the total payoffs you receive.

Participation and Recording Rules

You have been given a Consent Form, five perforated Payoff Cards, and a Receipt. To participate in this experiment do the following:

1. Read and sign the Consent Form.

2. For each Payoff Card (numbered 1 through 5), select the row that you wish to choose to determine your Own Payoff and your Matched Participant's Payoff. Highlight this entire row on both portions of the Payoff Card. Only one row can be chosen on any card. However, you may choose different rows for different Payoff Cards. If you need to change your choice please notify the administrator before making the change. Cards with more than one row highlighted are invalid without an Administrator's initials.

3. After everyone has completed his or her five Payoff Cards, the administrator will have a participant in each room draw a ticket from the box in his or her room. Recall, this box contains tickets numbered 00 to 99. Record this ticket number at the bottom of both sides of the Payoff Card and highlight the appropriate columns for Your Own Payoff and your Matched Participant's Payoff. This ticket will be returned to the box, and another ticket drawn for the second card. Record this ticket number on the bottom of both sides of Payoff Card 2 and highlight the appropriate columns. This procedure is repeated until a ticket has been drawn for each card.

4. Use the row you highlighted in Stage 1 and columns you highlighted in Stage 2 to determine the payoffs associated with each card. Record each of these amounts in the appropriate space at the bottom of the Payoff Cards.

5. The administrator will collect the Matched Participant Tables from each Payoff Card. These will be given to the five different Matched Participants listed on the Payoff Cards.

6. As the Matched Participant for a separate set of five participants in the other room, you will receive the Matched Participant Tables from these five different participants.

7. Fill in your Receipt with your "Own Payoff" from the five Own Payoff Tables that you have. Then fill in the "Payoff Received as a Matched Participant" from the five Matched Participant Tables you have received. Add these amounts to the $3.00 you received for participating. This result is your "Total Payoffs." Record this total on your receipt.

8. After you have completed your Receipt Form, we will come to your desk individually and pay you this amount in cash.

9. At the end of the experiment, you will also receive a Voluntary Demographic Survey. This survey is voluntary. You may choose to answer none, some or all of the questions. Your payment will not depend on your responses to this survey. However, if you choose to respond, your responses will provide a valuable input to our research. We will keep all survey responses confidential. To respond to the survey, simply circle the appropriate answer or fill in the blank.

Are there any questions?

<u>Voluntary Demographic Survey</u>

Participant Number

This survey is voluntary. You may choose to answer none, some or all of the questions. Your payment will not depend on your responses to this survey. However, if you choose to respond, your responses will provide a valuable input to our research. We will keep all survey responses confidential. To respond to the survey, simply circle the appropriate answer or fill in the blank.

We appreciate your taking the time to fill out this survey.

1. What is your gender? 1 Female 2 Male

2. What is your age?

3. What is your birth order? __________ out of _________ children

4. How may years have you lived in the Midwest? ____________ years

5. Do you have a lucky number? _____________ If so, what is it? _________

   Did it influence your choice in today's study (if so, please describe how)?

6. What is your university status?
    (a) Freshman
    (b) Sophomore
    (c) Junior
    (d) Senior
    (e) MA/MBA candidate
    (f) Law or Medical student
    (g) Ph.D. candidate
    (h) Other
7. What is your major?
    (a) Business
    (b) Social Science
    (c) Humanities
    (d) Natural Science
    (e) Mathematics or Engineering
    (f) Other
8. Please indicate how strongly you agree or disagree with each of the following statements about yourself using the scale on the right, where 1 indicates strongly disagree strongly, 2 indicates moderately disagree, 3 indicates slightly disagree, 4 indicates slightly agree, 5 indicates moderately agree and 6 indicates strongly agree.

	Disagree					Agree
a. I am a very charitable person	1	2	3	4	5	6
b. I believe distinguishing oneself from peers is important	1	2	3	4	5	6
c. I strive for equitable solutions to problems	1	2	3	4	5	6
d. I am very achievement oriented in reaching my own goals	1	2	3	4	5	6

9. Have you ever been a member of any type of sports team? ___________ (yes or no)

   What kind of team(s)?

   When?
10. Do you belong to any clubs or social organizations? ___________ (yes or no)

    Please describe:

Payoff Cards for All Choice Treatments, Frame 1

Payoff Card for Baseline Treatment

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff Choice	Ticket≥Cutoff Prize	Ticket≥Cutoff Prob.	Ticket<Cutoff Prize	Ticket<Cutoff Prob.	Ticket≥Cutoff Prize	Ticket≥Cutoff Prob.	T icket<Cutoff Prize	T icket<Cutoff Prob.	Cutoff Choice
5	$0.25	0.95	$0.00	0.05	$0.00	0.95	$0.00	0.05	5
15	$0.75	0.85	$0.00	0.15	$0.00	0.85	$0.00	0.15	15
25	$1.25	0.75	$0.00	0.25	$0.00	0.75	$0.00	0.25	25
35	$1.75	0.65	$0.00	0.35	$0.00	0.65	$0.00	0.35	35
45	$2.25	0.55	$0.00	0.45	$0.00	0.55	$0.00	0.45	45
55	$2.75	0.45	$0.00	0.55	$0.00	0.45	$0.00	0.55	55
65	$3.25	0.35	$0.00	0.65	$0.00	0.35	$0.00	0.65	65
75	$3.75	0.25	$0.00	0.75	$0.00	0.25	$0.00	0.75	75
85	$4.25	0.15	$0.00	0.85	$0.00	0.15	$0.00	0.85	85
95	$4.75	0.05	$0.00	0.95	$0.00	0.05	$0.00	0.95	95

Payoff Card for Matched Baseline Treatment

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff Choice	Ticket≥Cutoff Prize	Ticket≥Cutoff Prob.	Ticket<Cutoff Prize	Ticket<Cutoff Prob.	Ticket≥Cutoff Prize	Ticket≥Cutoff Prob.	T icket<Cutoff Prize	T icket<Cutoff Prob.	Cutoff Choice
5	$0.25	0.95	$0.00	0.05	$0.00	0.95	$4.75	0.05	5
15	$0.75	0.85	$0.00	0.15	$0.00	0.85	$4.25	0.15	15
25	$1.25	0.75	$0.00	0.25	$0.00	0.75	$3.75	0.25	25
35	$1.75	0.65	$0.00	0.35	$0.00	0.65	$3.25	0.35	35
45	$2.25	0.55	$0.00	0.45	$0.00	0.55	$2.75	0.45	45
55	$2.75	0.45	$0.00	0.55	$0.00	0.45	$2.25	0.55	55
65	$3.25	0.35	$0.00	0.65	$0.00	0.35	$1.75	0.65	65
75	$3.75	0.25	$0.00	0.75	$0.00	0.25	$1.25	0.75	75
85	$4.25	0.15	$0.00	0.85	$0.00	0.15	$0.75	0.85	85
95	$4.75	0.05	$0.00	0.95	$0.00	0.05	$0.25	0.95	95

Payoff Card for Partnership Treatment

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff	Ticket≥Cutoff		Ticket<Cutoff		Ticket≥Cutoff		T icket<Cutoff		Cutoff
Choice	Prize	Prob.	Prize	Prob.	Prize	Prob.	Prize	Prob.	Choice
5	$0.25	0.95	$0.00	0.05	$0.25	0.95	$0.00	0.05	5
15	$0.75	0.85	$0.00	0.15	$0.75	0.85	$0.00	0.15	15
25	$1.25	0.75	$0.00	0.25	$1.25	0.75	$0.00	0.25	25
35	$1.75	0.65	$0.00	0.35	$1.75	0.65	$0.00	0.35	35
45	$2.25	0.55	$0.00	0.45	$2.25	0.55	$0.00	0.45	45
55	$2.75	0.45	$0.00	0.55	$2.75	0.45	$0.00	0.55	55
65	$3.25	0.35	$0.00	0.65	$3.25	0.35	$0.00	0.65	65
75	$3.75	0.25	$0.00	0.75	$3.75	0.25	$0.00	0.75	75
85	$4.25	0.15	$0.00	0.85	$4.25	0.15	$0.00	0.85	85
95	$4.75	0.05	$0.00	0.95	$4.75	0.05	$0.00	0.95	95

Payoff Card for Bidding Treatment

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff	Ticket≥Cutoff		Ticket<Cutoff		Ticket≥Cutoff		T icket<Cutoff		Cutoff
Choice	Prize	Prob.	Prize	Prob.	Prize	Prob.	Prize	Prob.	Choice
5	$0.25	0.95	$0.00	0.05	$0.00	0.95	$0.25	0.05	5
15	$0.75	0.85	$0.00	0.15	$0.00	0.85	$0.75	0.15	15
25	$1.25	0.75	$0.00	0.25	$0.00	0.75	$1.25	0.25	25
35	$1.75	0.65	$0.00	0.35	$0.00	0.65	$1.75	0.35	35
45	$2.25	0.55	$0.00	0.45	$0.00	0.55	$2.25	0.45	45
55	$2.75	0.45	$0.00	0.55	$0.00	0.45	$2.75	0.55	55
65	$3.25	0.35	$0.00	0.65	$0.00	0.35	$3.25	0.65	65
75	$3.75	0.25	$0.00	0.75	$0.00	0.25	$3.75	0.75	75
85	$4.25	0.15	$0.00	0.85	$0.00	0.15	$4.25	0.85	85
95	$4.75	0.05	$0.00	0.95	$0.00	0.05	$4.75	0.95	95

Payoff Card for BargainingTreatment

	Own Payoff Table				Matched Participant Payoff Table				
Cutoff	Ticket≥Cutoff		Ticket<Cutoff		Ticket≥Cutoff		T icket<Cutoff		Cutoff
Choice	Prize	Prob.	Prize	Prob.	Prize	Prob.	Prize	Prob.	Choice
5	$0.25	0.95	$0.00	0.05	$4.75	0.95	$0.00	0.05	5
15	$0.75	0.85	$0.00	0.15	$4.25	0.85	$0.00	0.15	15
25	$1.25	0.75	$0.00	0.25	$3.75	0.75	$0.00	0.25	25
35	$1.75	0.65	$0.00	0.35	$3.25	0.65	$0.00	0.35	35
45	$2.25	0.55	$0.00	0.45	$2.75	0.55	$0.00	0.45	45
55	$2.75	0.45	$0.00	0.55	$2.25	0.45	$0.00	0.55	55
65	$3.25	0.35	$0.00	0.65	$1.75	0.35	$0.00	0.65	65
75	$3.75	0.25	$0.00	0.75	$1.25	0.25	$0.00	0.75	75
85	$4.25	0.15	$0.00	0.85	$0.75	0.15	$0.00	0.85	85
95	$4.75	0.05	$0.00	0.95	$0.25	0.05	$0.00	0.95	95

Appendix II Proofs

Consider two gambles X and X' both in R^2. Denote sets of outcomes as (x, y) and (x', y') respectively. Determine the value of outcomes in the gamble X by approximation around its mean outcome:

$$u(x,y) = \begin{cases} u(\bar{x},\bar{y}) + u_1(\bar{x},\bar{y})(x-\bar{x}) + u_2(\bar{x},\bar{y})(y-\bar{y}) \\ + \frac{1}{2}u_{11}(\bar{x},\bar{y})(x-\bar{x})^2 + \frac{1}{2}u_{22}(\bar{x},\bar{y})(y-\bar{y})^2 \\ + u_{12}(\bar{x},\bar{y})(x-\bar{x})(y-\bar{y}) + \cdots \end{cases} \tag{11}$$

This implies that the expected utility of X is approximately:

$$E(u(x,y)) = \begin{cases} u(\bar{x},\bar{y}) + 0 + 0 \\ + \frac{1}{2}u_{11}(\bar{x},\bar{y})\left(E(x^2) - \bar{x}^2\right) + \frac{1}{2}u_{22}(\bar{x},\bar{y})\left(E(y^2) - \bar{y}^2\right) \\ + u_{12}(\bar{x},\bar{y})\left(E(xy) - \bar{x}\bar{y}\right) + \cdots \end{cases} \tag{12}$$

Approximate the value of the outcomes of X' around the same point, giving:

$$u(x',y') = \begin{cases} u(\bar{x},\bar{y}) + u_1(\bar{x},\bar{y})(x'-\bar{x}) + u_2(\bar{x},\bar{y})(y'-\bar{y}) \\ + \frac{1}{2}u_{11}(\bar{x},\bar{y})(x'-\bar{x})^2 + \frac{1}{2}u_{22}(\bar{x},\bar{y})(y'-\bar{y})^2 \\ + u_{12}(\bar{x},\bar{y})(x'-\bar{x})(y'-\bar{y}) + \cdots \end{cases} \tag{13}$$

This gives an expected utility of:

$$E(u(x',y')) = \begin{cases} u(\bar{x},\bar{y}) + u_1(\bar{x},\bar{y})(\bar{x}'-\bar{x}) + u_2(\bar{x},\bar{y})(\bar{y}'-\bar{y}) \\ + \frac{1}{2}u_{11}(\bar{x},\bar{y})\left(E(x'^2) - 2\bar{x}'\bar{x} + \bar{x}^2\right) + \frac{1}{2}u_{22}(\bar{x},\bar{y})\left(E(y'^2) - 2\bar{y}'\bar{y} + \bar{y}^2\right) \\ + u_{12}(\bar{x},\bar{y})\left(E(x'y') - \bar{x}'\bar{y} - \bar{x}\bar{y}' - \bar{x}\bar{y}\right) + \cdots \end{cases} \tag{14}$$

The difference is:

$$E(u(x',y')) - E(u(x,y)) = \begin{cases} u_1(\bar{x},\bar{y})(\bar{x}'-\bar{x}) + u_2(\bar{x},\bar{y})(\bar{y}'-\bar{y}) \\ + \frac{1}{2}u_{11}(\bar{x},\bar{y})\left(E(x'^2) - 2\bar{x}'\bar{x} + \bar{x}^2 - E(x^2)\right) \\ + \frac{1}{2}u_{22}(\bar{x},\bar{y})\left(E(y'^2) - 2\bar{y}'\bar{y} + \bar{y}^2 - E(y^2)\right) \\ + u_{12}(\bar{x},\bar{y})\left(E(x'y') - \bar{x}'\bar{y} - \bar{x}\bar{y}' - \bar{x}\bar{y} - E(xy)\right) + \cdots \end{cases} \tag{15}$$

Now compare gambles X' close to X in the sense that the outcomes have different expected values, but the same second and higher moments. All terms but the first two drop out. The first term shows that a self-interested person with prefer a higher expected value all else constant. The second term shows that an altruistic person will prefer a higher expected value for the other person, all else constant. Similarly, a malicious person will prefer a lower expected value for the other person all else constant.

Next, compare gambles X' close to X in the sense that outcomes have the same expected values, but vary only in the second moments. Using the equal means, the difference becomes:

$$E(u(x',y')) - E(u(x,y)) = \begin{cases} \frac{1}{2}u_{11}(\bar{x},\bar{y})\left[\left(E(x'^2) - 2\bar{x}'^2\right) - \left(E(x^2) - \bar{x}^2\right)\right] \\ + \frac{1}{2}u_{22}(\bar{x},\bar{y})\left[\left(E(y'^2) - 2\bar{y}'^2\right) - \left(E(y^2) - \bar{y}^2\right)\right] \\ + u_{12}(\bar{x},\bar{y})\left(E(x'y') - E(xy)\right) + \cdots \end{cases} \tag{16}$$

The first term shows that, a risk averse person ($u_{11} < 0$) will prefer lower variance gambles, all else constant. Similarly, a risk seeking person ($u_{11} > 0$) will prefer higher variance gambles, all else constant. The second term shows, that a person risk averse in the other's payoffs ($u_{22} < 0$) will prefer lower variance gambles for the other person, all else constant. Similarly, a person risk seeking in the other's payoffs ($u_{22} > 0$) will prefer higher variance gambles for the other person, all else constant. The third term shows that a fairness seeking person ($u_{12} > 0$) will prefer a higher first cross moment, all else constant. Similarly, a distinction seeking person ($u_{12} < 0$) will prefer a lower first cross moment, all else constant.