Fairness and Risk in Ultimatum Bargaining

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Abstract: We conduct an experiment in which subjects play an ultimatum game but, rather than bargaining over money, they bargain over lottery tickets for a prize. Compared to the standard ultimatum game, proposers offer a significantly lower percentage of lottery tickets, which is inconsistent with either ex ante or ex post fairness. In contrast, responders have a significantly higher acceptance threshold, which is consistent with ex post fairness. By varying the timing of the accept/reject decision of responders, we also show that intentions matter and present evidence of a choice anomaly in responder preferences concerning their willingness to accept extreme inequality.

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1. Introduction

We are concerned with how risk affects behavior in an ultimatum bargaining environment. Prior theoretical work on fairness preferences (Krawczyk, 2011; Andreozzi et al., 2013; Saito, 2015; Chassang and Zehnder, 2016) considers two approaches to the evaluation of outcomes when there is uncertainty about the final distribution of payoffs: *ex ante fairness* and *ex post fairness*. That is, given a known lottery over outcomes, agents either evaluate the fairness of ex ante expected payoffs, or they evaluate the fairness of ex post outcomes by expected utility maximization. Distributional models of social preferences (e.g., Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Andreoni and Miller, 2002; Charness and Rabin, 2002) implicitly assume expected utility maximization when extended to lotteries over outcomes. If these models are to preserve ex ante fairness concerns, then they violate the independence axiom (Fudenberg and Levine, 2012).

Empirical evidence suggests that both types of fairness concerns affect behavior. Several papers demonstrate the importance of ex ante (or procedural) fairness in decision-making (e.g. Bolton et al., 2005; Kircher et al., 2009; Cappelen et al., 2013; Bartling et al., 2014; López-Vargas, 2015). Trautmann and van de Kuilen (2016) provide evidence from a risky choice task that ex post (or distributive) fairness cannot be dismissed. Krawcyck and Le Lec (2010) and Brock et al. (2013) observe that a mix of procedural and distributive concerns best explain data from probabilistic dictator games.[1]

In this study, we experimentally investigate how fairness ideas impact bargaining when there is risk – and the allocation of risk is endogenous – as well as how the timing of the resolution of uncertainty influences behavior.[2] We used a within-subjects design, which enables us to observe how fairness preferences differ between a standard ultimatum game and a risky ultimatum game in which bargaining is over the distribution of lottery tickets for a mutually exclusive prize. We also varied between-subjects whether the uncertainty was resolved before or after the responder

[1] A related strand of literature considers the relationship between relative social position and risk preferences (e.g. Vendrik and Woltjer, 2007; Hill and Buss, 2010; Rohde and Rohde, 2011; Lahno and Serra-Garcia, 2015; Linde and Sonnemans, 2012; Freidl et al., 2014; Müller and Rau, 2019). Freundt and Lange (2014) provide experimental evidence from a dictator game that giving declines when recipients are believed to be non-risk-averse.

[2] An early experimental bargaining study involving uncertainty is Shogren (1992). He found no substantive difference in bargaining behaviour over ex ante lotteries for a fixed reward versus ex post rewards given a fixed probabilistic schedule and strong evidence to support normative appeal of the equal split. There are several design aspects of Shogren's study that make his findings difficult to compare with ours. First, bargaining is face-to-face rather than anonymous. Second, one party has an advantageous (if inefficient) outside option. Third, the size of the pie is endogenously determined by the negotiation process.

made his/her acceptance decision. The experiments, hypotheses and analysis plan were pre-registered in the AEA RCT registry.

The ultimatum game has served as a natural environment for studying fairness considerations in the experimental literature. The risky variant can be thought of as a stylized representation of the uncertainties inherent in real-world bargaining settings. Many negotiations involve uncertainties that have yet to be resolved at the contracting stage, and the allocation of risk is often at the heart of these negotiations. Examples include risk-sharing in contingent contracts (Bazerman and Gillespie, 1999), cost overruns in procurement (Bajari et al., 2014), demand uncertainty in labor negotiations (Riedl and van Winden, 2012), wholesale price contracts in supplier-retailer relationships in which inventory risk is allocated exclusively to one party, or more complicated supply-chain contracts in which the risk is shared between the parties (Cachon, 2004).

We find clear evidence of a mismatch between proposer beliefs (as inferred from their offers) and responder fairness preferences. Compared to the standard ultimatum game, proposers offer a significantly lower percentage of lottery tickets, which is inconsistent with either ex ante or ex post fairness. In contrast, responders have a significantly higher acceptance threshold, which is consistent with a preference for ex post fairness.

Individuals are heterogeneous in the importance attached to different fairness motives. For between 40 and 60% of responders, behavior is best explained by ex post fairness. This lends support to the plurality of fairness views found in related experiments involving uncertainty among stakeholders (Cappelen et al., 2007; Brock et al., 2013) and impartial spectators (Cettolin and Riedl, 2017). Unlike these studies, uncertainty is not exogenous in our design.[3] Instead, in the risky ultimatum game, proposers determined their own chance of winning conditional on their beliefs about fairness. The resulting mismatch between preferences and beliefs led to a greater likelihood of disagreement.

Several previous experimental studies of standard ultimatum game observe that responders are more willing to accept inequality if the proposer's actions are perceived as kind (Blount, 1995; Charness and Rabin, 2002; Offerman, 2002; Falk et al., 2003; Charness, 2004; Falk et al., 2008). We find some evidence that intentions matter for responder behavior after the resolution of

[3] See Cappelen et al. (2013) and Cettolin and Tausch (2015) for examples of studies in which risk exposure is a choice and its implications for ex post income redistribution.

uncertainty, although the strength of this evidence depends on whether the direct response or strategy method was used to implement responder acceptance decisions.

Our study also contributes to recent literature assessing the dynamic inconsistency of fairness preferences (Trautmann and Wakker, 2010; Andreoni et al., 2016; Trautmann and van de Kuilen, 2016). We uncover evidence of a choice anomaly in responders' acceptance decisions. Specifically, responders are more likely to accept a zero payoff allocation after the resolution of uncertainty in the risky ultimatum game, than they are to accept a zero payoff allocation in the standard ultimatum game or a lottery ticket allocation that guarantees a zero payoff in the risky ultimatum game.

This anomaly is observed both between- and within-subjects and implies that uncertainty creates a "veneer of absolved responsibility" such that people are more willing to accept inequality than they might otherwise let on. Andreoni and Bernheim (2009) observe that individuals like to be perceived as fair, demonstrated by a lowering of dictator game offers when their source is obscured by nature. Bartling and Fischbacher (2012) find that subjects can at least partially absolve themselves of responsibility by delegating allocation decisions to a random device. Our results suggest that, in an ultimatum bargaining environment involving uncertainty, responders perceive less need to demonstrate their aversion to inequality ex post and/or view ex post rejection as a weaker signal of their fairness preferences.

2. Theory: Ex Post versus Ex Ante Fairness

We consider a simple setting in which two agents, A and B, engage in ultimatum bargaining, where A is the proposer and B is the responder. To fix ideas, consider a bilateral trading relationship where Agent A seeks to buy an item from Agent B and where the surplus generated from a trade is 1. We assume that there are two states of the world, also denoted A and B, which give rise to different surplus distributions. Prices are state dependent; without loss of generality, we have $p_B > p_A \geq 0$.

The timing of the game is as follows:

1. Agent A allocates probabilities over the two states, z to State B and $(1 - z)$ to State A.
2. Agent B observes the proposed allocation and can accept or reject.

3. The state is revealed and payoffs (x, y) – x for Agent A, y for Agent B – are realized. If Agent B accepts, then in State A the payoff vector is $(1 - p_A, p_A)$, and in State B the payoff vector is $(1 - p_B, p_B)$. If Agent B rejects, then there is no trade and the payoffs are $(0,0)$.

Standard game-theoretic arguments predict that Agent B accepts all probability allocations over states in Stage 2, thus in Stage 1 Agent A allocates full probability to her preferred State A.

Consider instead a model of Fehr and Schmidt (1999) aversion to inequitable payoffs from the perspective of Agent B (the perspective of Agent A is symmetric).[4] The utility function is as follows,

(1) $$u_B(x, y) = y - \alpha_B \cdot \max[0, x - y] - \beta_B \cdot \max[0, y - x],$$

where α_B measures the aversion to disadvantageous inequality and β_B measures the aversion to advantageous inequality. Player types, as defined by their inequity aversion parameters, are common knowledge. To simplify the exposition, we assume that $\beta_B = 0$, i.e., Agent B is not averse to advantageous inequality.[5]

When outcomes are uncertain, we are concerned not only with the final payoffs x and y, but also preferences over joint payoff distributions implied by the lottery $F(x, y)$. Two approaches are suggested in the literature (e.g. Brock et al., 2013). Either agents evaluate fairness of ex post outcomes by expected utility maximization:

(2) $$w^{EP}(F) = \int u(x, y) dF(x, y),$$

or they evaluate the fairness of expected outcomes ex ante:

(3) $$w^{EA}(F) = u(E[x], E[y]).$$

The approaches are not mutually exclusive: a convex combination of the two might best represent preferences (Fudenberg and Levine, 2012).

[4] Since there is a bilateral reference group for payoff comparisons, the predictions are unchanged by using the alternative outcome-based model of Bolton and Ockenfels (2000).

[5] This assumption has empirical relevance from bargaining experiments (e.g., De Bruyn and Bolton, 2008). We acknowledge that in our setting, inequity aversion might just as well be interpreted as a more general notion of social loss aversion. Disentangling the nuances behind these alternative interpretations is beyond the scope of this paper.

2.1. Ex Post Fairness

Let us consider the most relevant case: $p_A < 1/2, p_B \geq 1/2$. That is, Agent A is advantaged in State A and Agent B is advantaged in State B. From (2), Agent B's utility from accepting is:

$$(1-z)[p_A - \alpha_B(1-2p_A)] + zp_B.$$

Thus, Agent B will accept if and only if:

$$z \geq 1 - \frac{p_B}{p_B + \alpha_B - p_A(1+2\alpha_B)}.$$

Suppose that Agent A proposes an allocation z^*, which will be accepted. Her expected utility is:

$$(1-z^*)[1-p_A] + z^*[1-p_B - \alpha_A(2p_B - 1)].$$

This will be non-negative so long as:

$$z^* \leq \frac{p_A - 1}{p_A + \alpha_A - p_B(1+2\alpha_A)}.$$

Thus, there will be a subgame perfect equilibrium in which Agent A proposes $z^*$and Agent B accepts if and only if:

$$z^* = 1 - \frac{p_B}{p_B + \alpha_B - p_A(1+2\alpha_B)} \leq \frac{p_A - 1}{p_A + \alpha_A - p_B(1+2\alpha_A)}. \tag{4}$$

The more Agent B cares about disadvantageous inequality, the less must Agent A care about it for there to be an equilibrium which ends in agreement.

2.2. Ex Ante Fairness

First note that in our environment, $E[x] = (1-z)(1-p_A) + z(1-p_B)$ and $E[y] = (1-z)p_A + zp_B$. There are two cases to consider.

Case (i). For $(p_A, z): p_B < p_B^{EA}$, so that Agent B is at a disadvantage from an ex ante perspective. From (3), Agent B's utility from accepting is:[6]

[6] Note that p_B^{EA} is defined as the State B price that achieves ex ante payoff equality, and is given by $p_B^{EA} = p_A + (1/2 - p_A)/z$.

$$E[y] - \alpha_B(E[x] - E[y]).$$

Agent B will accept if and only if:

$$z \geq \frac{\alpha_B - p_A(1+2\alpha_B)}{(p_B - p_A)(1+2\alpha_B)}.$$

Suppose that Agent A proposes an allocation z^*, which will be accepted. Her utility is $E[x]$, which is always non-negative.

Thus, there will be a subgame perfect equilibrium in which Agent A proposes z^* and Agent B accepts if and only if:

(5) $$z^* = \frac{\alpha_B - p_A(1+2\alpha_B)}{(p_B - p_A)(1+2\alpha_B)} \leq 1.$$

Case (ii). For $(p_A, z): p_B \geq p_B^{EA}$, Agent B will accept any allocation since $E[y] \geq 0$, and Agent B is in an advantaged position relative to Agent A.

Suppose that Agent A proposes an allocation z^*, which will be accepted. Her utility is:

$$E[x] - \alpha_A(E[y] - E[x]).$$

This will be non-negative so long as:

$$z^* \leq \frac{p_A(1+2\alpha_A) - 1 - \alpha_A}{(p_A - p_B)(1+2\alpha_A)}.$$

Thus, there will be a subgame perfect equilibrium in which Agent A proposes z^* and Agent B accepts if and only if:

(6) $$z^* = \frac{p_A(1+2\alpha_A) - 1 - \alpha_A}{(p_A - p_B)(1+2\alpha_A)} \geq 0.$$

2.3. Comparison

Let us fix the state prices at $p_A = 0$ and $p_B = 1$. This case makes the trade-offs most salient: in State A, Agent A (the proposer) obtains all of the surplus from trade, while in State B, Agent B (the responder) obtains all of the surplus from trade. Thus, it is as if there is a single, indivisible prize that Agent A wins in State A and Agent B wins in State B. We will test this case in our experiment.

Under ex ante fairness, we know from (5) that the responder's minimum acceptance threshold is $z_{ea}^* = \alpha_B/(1+2\alpha_B) \leq \frac{1}{2}$, which also coincides with the acceptance threshold in the standard ultimatum game. Under ex post fairness, we know from (4) that the responder's minimum acceptance threshold is given by $z_{ep}^* = \alpha_B/(1+\alpha_B) \geq z_{ea}^*$. That is, under ex post fairness, the responder requires a greater probability of winning to accept.

Furthermore, the two models have different predictions regarding the possibility of disagreement. Let F be the cumulative distribution function (c.d.f.) of player types having support $[0,\infty)$.[7] Then:

(i) Under ex ante fairness, for all $\alpha_B \in (0,\infty)$, there exists a proposal $z \in (0,0.5)$ such that $E[y] - \alpha_B(E[x] - E[y]) > 0$, which will be accepted by Agent B and which Agent A is willing to propose. Thus, ex ante fairness always yields agreement.

(ii) Under ex post fairness, for all α_B there exists $\alpha_A^*(\alpha_B)$ such that Agent A is unwilling to make an offer that Agent B would accept. Then, the probability of disagreement is $1 - F(\alpha_A^*(\alpha_B))$. It follows that the expected probability of disagreement is given by $\int(1 - F(\alpha_A^*(\alpha_B)))f(\alpha_B)d\alpha_B > 0$.

Thus, if players evaluate fairness of outcomes ex ante, they are more likely to reach an agreement and there should be no difference in the minimum acceptance thresholds between the standard and risky ultimatum games that we have described. If players are governed by ex post fairness, then Agent B's minimum acceptance threshold is higher in the risky ultimatum game than in the standard ultimatum game, and it may be so high that Agent A is unwilling to make an offer that Agent B would accept.

3. Experimental Design

Our experiment sought to understand how subjects' behavior differs between a risky and standard ultimatum game to gain insights into how risk affects fairness preferences. To this end, we conducted several experimental treatments. In all treatments, subjects participated in both the standard and risky ultimatum game variants and maintained the same role across variants (within-subjects design). We randomized the order of presentation of the two ultimatum games and limited

[7] Recall that we are assuming complete information.

feedback of accept/reject decisions as well as the resolution of any uncertainty until all decisions had been made.[8]

In one set of experiments, we employed a direct response (DR) method for responders, while in another we employed the strategy method (SM) to get more precise information about their thresholds. We call these treatments Risk-DR and Risk-SM, depending on the response method.

In both ultimatum game variants, there was $6 to be divided between the proposer and responder if they could reach an agreement. In the standard game (henceforth "Standard UG"), proposers could make offers in increments of $0.10. In the risky game (henceforth "Lottery UG"), the proposer was allocated 100 "lottery tickets" to divide between the proposer and the responder. If the offer was accepted, then the computer would randomly select one winning lottery ticket and the player holding that lottery ticket would receive $6 and the other person would receive nothing.

We conducted a further two treatments in which, in the Lottery UG, the decision to accept or reject comes after the resolution of uncertainty. That is, before the responder decides, he/she knows the outcome of the lottery. In one of these treatments, we followed a direct response procedure, while in the other, we used an outcome-conditional strategy method in which the responder chooses to accept or reject conditional on winning and conditional on losing the lottery. We call these treatments Intent-DR and Intent-SM because they were designed to provide insight on the role of intentions on one's willingness to accept ex post inequality.

Table 1 summarizes the full set of treatments conducted. The sample size for our Risk-DR and Risk-SM gives us 75% power to detect an offer effect size of 3 percentage points and 99% power to detect an offer effect size of 5 percentage points. Further details on our sampling procedure can be found in our pre-registration. The Intent-SM treatment was not part of our original pre-registration and was added later to test an additional hypothesis suggested by our original results, and to give us greater power to test our intentions hypotheses.

TABLE 1—EXPERIMENTAL TREATMENTS

Treatment	Order	*N* (P, R)	Treatment	Order	*N* (P, R)
Risk-DR	Standard, Lottery	58 (29, 29)	Intent-DR	Standard, Lottery	78 (39, 39)
Risk-DR	Lottery, Standard	54 (27, 27)	Intent-DR	Lottery, Standard	78 (39, 39)
Risk-SM	Standard, Lottery	43 (21, 22)	Intent-SM	Standard, Lottery	73 (36, 37)
Risk-SM	Lottery, Standard	46 (23, 23)	Intent-SM	Lottery, Standard	63 (31, 32)

Note: *N* broken down by Proposer (P) and Responder (R).

[8] Subjects were not provided any information about the second ultimatum game task until after the first task had been completed. This protocol ensured that the validity of behaviour in the first task would be preserved even if we found evidence of order effects.

3.1. Hypotheses

As discussed above, behavior is expected to differ between the Standard and Lottery UG depending on whether participants are motivated by ex post or ex ante fairness concerns. However, in addition to this theoretical reasoning, it was our intuition that the presence of risk in the Lottery UG may induce responders to accept less. This could be for several reasons. First, players might value the chance to win in the Lottery UG more than the expected value in the Standard UG.[9] This could arise due to non-linear probability weighting or an additional "utility of winning". Second, it could be that the anticipation of regret (Loomes and Sugden 1982; Bell 1982) lowers the utility from rejecting an offer of a strictly positive number of lottery tickets. This is because she would regret rejecting before the resolution of uncertainty only to later find out that she *would have* won.[10] Which behavioral tendency best-describes behavior is an empirical question and so we pre-registered the following competing hypotheses:

Hypothesis 1. In the Risk-DR and Risk-SM treatments:

(a) Because of a concern for ex ante fairness, neither responder nor proposer behavior will differ between the Standard and Lottery UG;

(b) Because of a concern for ex post fairness, the responders' minimum acceptance thresholds will increase in the Lottery UG relative to the Standard UG and, consequently, proposers will offer more;

(c) Because players value the chance to come out ahead greater than the expected value, responders' minimum acceptance thresholds will decrease in the Lottery UG relative to the Standard UG and, consequently, proposers will offer less.

Our Intent-DR treatment was designed to test whether there is a relationship between the proposer's offer and the responder's willingness to accept ex post inequality. Other social

[9] Müller and Rau (2019) provide theoretical and experimental evidence that inequality averse subjects prefer to take more risky decisions when they lag behind a peer, than when they act in isolation. This effect stems from the interaction between subjects' sensitivity to social comparison and the marginal utility of an additional dollar. Their prediction, however, does not easily carry over to our environment. In the Lottery UG, the reference allocation is equal and there is opportunity for both parties to come out ahead, which is endogenous to the players' decisions.

[10] Larrick and Boles (1995) argue that the effect of regret may be more subtle and could be influenced by feedback. This is because there are two types of regret: Accepting the offer and learning that you lose (and hence must live with a highly unequal outcome) or rejecting the offer and learning that you would have won. When no feedback is given about the lottery upon rejection, rejecting is relatively more attractive as it means the responder will not experience the regret from losing. In contrast, if feedback is given regardless of the decision, then accepting becomes relatively more attractive because doing so ensures that the responder will never regret rejecting only to learn that she would have won. In fact, this was precisely our intuition for why acceptance thresholds would be lower, even though responders did not receive feedback about the lottery following a rejection – we believed that responders would anticipate this feeling and, consequently, be more inclined to accept. We will come back to this issue after presenting our results.

preferences models (Rabin 1993; Dufwenberg and Kirchsteiger, 2004; Falk and Fischbacher, 2006) emphasize that players respond to the perceived kindness or intent of other players' decisions relative to the set of possible actions. Moreover, past work on procedural fairness (Bolton et al 2005; Wang 2017) suggests that decision makers are more willing to accept disadvantageous inequality if it arises from a fair process. In our case, the outcome is more fair towards the responder, the larger the share she was offered. We had the following competing hypotheses:

Hypothesis 2. In the Intent-DR treatment, upon learning that the responder lost:

(a) There is no relationship between the amount offered and the acceptance decision in the Lottery UG;

(b) There will be a positive relationship between the offers and acceptance decisions in the Lottery UG.

If Hypothesis 2(b) is true, then a responder is more likely to accept, even after learning that she lost the lottery, the more that the proposer offered to her. Because of the exploratory nature of Intent-SM, we defer further discussion related to it until after presenting our first results.

3.2. Experimental Details

The experiment was conducted as Human Intelligence Tasks (HITs) on the Amazon Mechanical Turk (AMT) platform in May and June 2020. Prior studies on AMT have replicated core findings in the behavioral economics literature and demonstrated their comparability with laboratory subject pools, both for individual and interactive decision-making tasks (e.g. Paolacci et al., 2010; Horton et al., 2011; Suri and Watts, 2011; Amir et al., 2012; Goodman et al., 2013; Arechar et al., 2018).[11] The experimental software was programmed using oTree (Chen et al., 2016). We have data from a total of 493 subjects.[12] Groups of participants were randomized to experimental treatments and no subject participated in more than one treatment.[13]

To ensure subjects understood the experimental details, we implemented two sets of control questions, one set after the instructions for each task. Subjects had to answer all questions correctly

[11] Outside of AMT, Chesney et al. (2009) and Hergueux and Jacquemet (2015) find support for the reliability of behaviours elicited in ultimatum games conducted online.

[12] 10 subjects displayed inconsistent behaviour in at least one task in the strategy method treatments and data involving these subjects are excluded from the analysis below. We define inconsistent behavior as switching from accept to reject, or reject to accept, more than twice in an ordered list of proposals. The raw choice sequences for inconsistent responders can be found in the Supplementary Materials. The results are qualitatively unchanged by inclusion of these choice sequences.

[13] A randomization check is provided in the Supplementary Materials.

to proceed to the ultimatum game tasks and any subject that failed to do so after three attempts was removed from the experiment.[14] After completion of the comprehension check for the first task in any session, subjects entered a waiting lobby. As soon as the lobby contained at least two subjects, a pair was formed, and roles were assigned to the matched participants. The roles were maintained for the second task. After completion of the comprehension check for the second task, subjects also entered a lobby for matching. Subjects were informed that they would be randomly and anonymously matched with another participant, who may differ from their match in the first task. To balance the competing goals of random re-matching across tasks while maintaining subjects' attention, a period of one minute had to expire before any participant could be matched with the same person as in the first task. As a result, 85.8% of subjects were matched with a different subject in the second ultimatum game.

Attrition and inattention are significant challenges for interactive experiments conducted online (see Arechar et al., 2018). We designed the experiment to minimize these concerns. In addition to the comprehension checks and matching "on the fly", we included concise instructions and on-screen timers that triggered removal from the experiment upon expiration. Further details are provided in the Supplementary Materials.

Subjects were paid the outcome of one of the Standard or Lottery UG tasks, which was determined at random by the computer after completion of both tasks and paid in addition to a participation fee of $0.50. The experiment took around 15 minutes to complete and the median (mean) subject earned $3.50 ($2.98), implying an hourly wage of $12-14.[15] At the end of each session, subjects completed a short questionnaire consisting of non-incentivized attitudinal and demographic questions.

[14] If the subject had already completed one task successfully, he or she was paid the participation fee.

[15] See Hara et al. (2018) for a discussion of worker earnings on AMT.

4. Experimental Results

4.1. Behavior in Risk-DR and Risk-SM

In Table 2 we provide summary results of proposer and responder behavior in the Standard and Lottery UG.[16] To facilitate comparison, all offers and acceptance thresholds are normalized as the percentage of the pie available ($6 in Standard UG and 100 lottery tickets in Lottery UG).[17]

TABLE 2—SUMMARY RESULTS IN RISK-DR AND RISK-SM

Game	Proposed Amount	Acceptance Frequency	Minimum Acceptance (SM)
Standard UG	47.38% (11.98)	91.09% (28.63)	31.67% (17.62)
Lottery UG	43.78% (13.92)	81.19 (39.28)	38.13% (19.45)

Note: Mean values with standard deviations in parentheses.

There are clear differences between the Standard UG and Lottery UG, but these differences depend on the role. Specifically, proposers offer *less* (consistent with Hypothesis 1(c)) in the Lottery UG and the difference is significant ($p = 0.033$).[18] On the other hand, consistent with Hypothesis 1(b) (ex post fairness), responders had *higher* thresholds and were *less* likely to accept the proposer's offer. Both differences are significant at $p < 0.02$.

In Table 3, on the left-hand side, we classify subjects depending on whether their proposal or acceptance threshold was higher/equal/lower in the Lottery UG than in the Standard UG. Comparing the panels (a) and (b), we observe a stark difference in the classification by player role and this is confirmed with Fisher's Exact Test ($p < 0.01$). Indeed, 60% of responders behave in a manner consistent with ex post fairness in that they report a strictly higher threshold for the Lottery UG than for the Standard UG.

[16] We detect no significant difference in offers or accept/reject decisions depending on whether responders used the DR or SM elicitation method. We also detect no significant order effects depending on whether the Standard UG was played first or second. The only minor exception is that proposers offered slightly more in the Standard UG when it was first ($p = 0.087$). The analysis pools over these dimensions.

[17] In our Risk-SM treatment, to simplify the strategy method elicitation, we implemented a two-level approach (similar to the iterative multiple price list of Andersen et al., 2006, for the elicitation of risk preferences). Five responders expressed non-monotone strategies, in which case they did not go to the second level. In our analysis, for their minimum acceptable offer, we took the mid-point between their first accepted level 1 option and the option immediately below. Our results are qualitatively unchanged if these subjects are excluded.

[18] Unless otherwise stated, tests are two-sided, parametric *t*-tests. Our results are robust to using alternative non-parametric tests.

For responders, we can consider an alternate classification of their fairness preferences. For example, given their response in the Standard UG, we can calculate the implied degree of inequality aversion, α_B^S and then use this to predict the thresholds in the Lottery UG under the assumptions of ex post fairness, $z_{ep}^{*,L}(\alpha_B^S)$, and ex ante fairness, $z_{ea}^{*,L}(\alpha_B^S)$. We then compare these predictions with the stated threshold and, for each prediction, calculate the squared difference.[19] We say that the subject is consistent with the fairness notion – ex ante or ex post – depending on which notion minimizes the squared difference between actual and predicted threshold.

Using this classification, 40% of responders are best described as having ex post fairness preferences, while 53.33% of responders are best described as having ex ante fairness preferences. We note that in this classification, *all* the responders who reported equal or lower thresholds are classified according to the ex ante model.[20] On the other hand, 1/3 of responders who reported higher thresholds in the Lottery UG are, nevertheless, classified according to the ex ante model. Regardless of the classification method, we see that a sizeable fraction of responders display behavior consistent with ex post fairness concerns. By contrast, relatively few proposers increase their offers in the Lottery UG, which indicates that there may be a mismatch between proposers' beliefs about responders' fairness concerns and responders' actual fairness concerns.

TABLE 3—CLASSIFICATION OF TYPES

(a) Proposers

By Strategy Comparison	**Frequency**
Propose More (i.e., Ex Post Fairness)	20.00%
Propose Same (i.e., Ex Ante Fairness)	49.00%
Propose Less	31.00%

(b) Responders

By Strategy Comparison	**Frequency**	**Least Squares Consistency**	**Frequency**
Require More (i.e., Ex Post Fairness)	60.00%	Ex Post Fairness	40.00%
Require Same (i.e., Ex Ante Fairness)	13.33%	Ex Ante Fairness	53.33%
Require Less	20.00%	No Fairness Concerns	6.67%
No Fairness Concerns	6.67%		

Note: For proposers, we use data from both the Risk-DR and Risk-SM treatments, while for responders, we only use data from the Risk-SM treatment. We say that a responder has no fairness concerns if their stated strategy indicated that they would either accept 0 or the lowest positive increment for both the Standard and Lottery UGs.

[19] We also repeat the procedure starting from the stated threshold in the Lottery UG.

[20] In the Supplementary Materials, we go further and estimate the posterior probability that a responder is classified as either an ex post or ex ante fairness type. To do this, we conduct a structural estimation and permit noise in the responders' decisions. The results are consistent with the least squares method. We find that neither fairness approach can well explain responders who require less in the Lottery UG, as captured by posterior probabilities for these responders around 1/2.

4.2. Behavior in Intent-DR and Intent-SM

Table 4 shows summary results of behavior in the Standard UG and Lottery UG of the Intent-DR treatment. For the Lottery UG, we condition on whether the proposer or responder held the winning lottery ticket.

TABLE 4—SUMMARY RESULTS IN INTENT-DR

Game	Proposed Amount	Acceptance Frequency	
		Proposer Won	Responder Won
Standard UG	45.34% (11.35)	92.31% (26.82)	
Lottery UG	45.44% (17.01)	56.41% (50.24)	97.44 (16.01)

Note: Mean values with standard deviations in parentheses.

First, observe that unlike in the Risk-DR and Risk-SM treatments, the proposals for the Standard UG and Lottery UG are virtually identical, though substantially more variable in the Lottery version. This may suggest that proposers believe that their intentions will matter, and they adjust by offering more than they otherwise would.

Second, we see that when the proposer was revealed to be the winning lottery ticket holder, 56.41% of responders accepted the proposal, even though it meant that they would receive \$0 and the proposer would receive \$6. This suggests that they are either not motivated by inequality aversion or there is some other factor that influences their decision to accept such an unequal split. Our Hypothesis 2(b) was that this would be driven by the intent of the proposer, with the responder more likely to accept the larger the share offered. Indeed, the Spearman rank correlation is positive at 0.155, but we cannot reject that it is zero ($p = 0.345$). Column (1) of Table 6 also reports the results of a logistic regression with dependent variable being a 0/1 indicator for accepting after it was revealed that the responder lost and the lone explanatory variable is the offer made by the proposer. As can be seen, the coefficient is positive but not significant. An alternative possibility is that these subjects are concerned about efficiency and ex post prefer to maximize the earnings of the pair (Charness and Rabin, 2002).[21]

The Intent-DR data also suggest an inconsistency in many subjects' behavior. Observe that in Risk-SM, over 90% of responders had strictly positive minimum acceptance thresholds in the

[21] Related are the money burning experiments of Zizzo and Oswald (2001) and Zizzo (2003). A significant fraction of subjects in these experiments chose to reduce the earnings of (predominantly richer) others at private cost to themselves, after the resolution of a gambling stage.

Standard UG and Lottery UG. That is, for over 90% of responders, the payoff vector (self, match): $(0,0) \succ (\gamma, 6-\gamma)$ for some dollar amount, $\gamma > 0$, in the Standard UG and $(0,0) \succ [(0,6)\ w.p.\ \mu; (6,0)\ w.p.\ 1-\mu]$ for some probability, $\mu > 0$, of winning in the Lottery UG. Yet, our results from Intent-DR suggests that $(0,6) \succ (0,0)$ for over 50% of responders. Combining these preferences (in the Standard UG for simplicity) yields: $(0,6) \succ (0,0) \succ (\gamma, 6-\gamma)$, which violates monotonicity.

Although suggestive of anomalous behavior, the above analysis rests on a between-subjects comparison. To test the robustness of this finding, we designed the Intent-SM treatment. In this treatment, responders participated in the strategy method version of the Standard UG and in an outcome-conditional strategy method version of the Lottery UG. For the latter, after learning the proposed number of tickets sent by the proposer, the responder stated whether she would accept the proposal if she held the winning ticket and also if the proposer held the winning ticket. After making her decisions, the uncertainty was revealed, and her relevant choice was implemented.

Table 5 provides summary statistics for the Intent-SM treatment. Proposer behavior is virtually identical to the Intent-DR treatment and, as before, there is no difference in proposals between the Standard UG and Lottery UG. For responders, the minimum acceptance threshold is, on average, 27.00%, which is not significantly different from the Risk-SM treatment.

TABLE 5—SUMMARY RESULTS IN INTENT-SM

Proposed Amount (Standard UG)	Proposed Amount (Lottery UG)	Minimum Acceptance Threshold in Standard UG	Frequency Accept if Proposer Wins	Frequency Accept if Responder Wins
43.98%	44.85%	27.00%	73.91%	98.55%
(10.93)	(11.17)	(16.51)	(44.23)	12.04

Note: Mean values with standard deviations in parentheses.

TABLE 6 —LOGIT REGRESSIONS FOR ACCEPTANCE DECISION IN INTENT TREATMENTS

Variable	(1) – Intent-DR Only		(2) – Intent-SM Only		(3) – Pooled	
Amount Offered (%)	0.0048	(0.0053)	0.0059**	(0.0028)	0.0055**	(0.0027)
Indicator for Intent-SM					0.1757*	(0.0935)
Minimum Acceptance Threshold in Standard UG			-0.0091***	(0.0028)		
Number of Observations	39		69		108	

Note: The dependent variable is a 0/1 indicator for whether the responder accepted upon losing the lottery. The table reports estimated marginal effects with standard errors in parentheses. *, **, and *** denote significance at the 10, 5 and 1% level, respectively.

Turning to the acceptance frequencies, we see that 73.91% of responders state that they will accept even if the proposer wins, i.e., they receive \$0 and the proposer receives \$6. This is higher than in the Intent-DR treatment and a proportions test is marginally significant ($p = 0.062$), which suggests a difference between direct response and the outcome-conditional strategy method in willingness to accept inequality. Columns (2) and (3) of Table 6 also show stronger support for our intent hypothesis (Hypothesis 2(b)). That is, responders who were offered more are significantly more likely to accept when they lose the lottery and are faced with a highly unequal outcome.

We find that 46 out of 69 responders in Intent-SM display the anomalous behavior identified above; that is, they report a strictly positive acceptance threshold in the Standard-UG but then indicate acceptance conditional on losing the lottery.

What might explain this behavior? One possibility is that subjects adopt an ex ante fairness perspective even after learning the outcome of the lottery. Trautmann and van de Kuilen (2016) found that 27% of subjects in their experiment subscribed to procedural fairness after the resolution of uncertainty. This argument requires our intent Hypothesis 2(b) to hold, for which we found modest support (when combining data from Intent-DR and Intent-SM). However, 6 out of 14 responders (42.9%) accepted the (0,6) split even though the offer that they received was less than or equal to their minimum acceptance threshold in the Standard UG. Thus, intentions cannot be the full story.

Another possibility is that responders do not attribute responsibility to proposers for outcomes in the Lottery UG in the same way that they do in the Standard UG. Bartling and Fischbacher (2012) find strong empirical support for a measure that assigns most responsibility for an unfair outcome to the player whose action had most influence on the likelihood of that outcome. This explanation neglects the fact that proposers had direct control over the probability of winning or losing and could choose to make the game fair or unfair.[22] Nevertheless, it is plausible that the resolution of uncertainty moderates reciprocal considerations relative to the deterministic and ex ante lottery cases. In this sense, risk produces a "veneer of absolved responsibility".

To see this, suppose the proposer offered 30% to the responder and it was revealed that the responder lost. The responder could reason that the proposer bears most – but not all – responsibility for her receiving zero. At the same time, if she rejects the offer, then she would bear 100% of the responsibility for the proposer receiving zero. The implied imbalance in responsibility

[22] For a discussion of why rule-based (or strategy) fairness makes inequalities more acceptable, see Wang (2017).

may leave her compelled to accept the unequal outcome. Future work should seek to disentangle fairness preferences from issues about responsibility for allocations.

One issue with the between-subjects identification of this anomaly is that it relied on a strategy method elicitation from the Risk-SM treatment and compared it to a direct response decision from the Intent-DR treatment. Prior ultimatum game experiments (e.g., Eckel and Grossman 2001) report lower acceptance frequencies in the strategy method versus direct response formats, a finding which we also replicate. Hence, the mismatch in elicitation methods could overstate the true prevalence of this behavior. Our Intent-SM treatment alleviates this concern on two fronts. First, it is a within-subjects comparison and, second, for both the Standard and Lottery UGs, we employ the strategy method. Therefore, the treatment effect should still be valid so long as the strategy method affects behavior in the same way (relative to direct response) for the two treatments. The fact that we find even stronger evidence for the choice anomaly suggests that it is a real phenomenon.[23]

5. Conclusions

Many situations in which agents must negotiate a division involve uncertainty over outcomes. It is therefore important to assess how individuals judge the fairness of allocations when there is risk. By comparing behavior in the standard ultimatum game and a risky ultimatum game variant, we were able to gain insight into this question. For both proposers and responders, we observed an apparent heterogeneity in whether behavior is best explained by ex ante or ex post fairness concerns. This is consistent with prior empirical work on the evaluation of fairness over lotteries. However, we also found that more responders displayed behavior consistent with ex post fairness – reporting higher minimum acceptance thresholds – than was anticipated by proposers in their offers. As a result, uncertainty drove a greater frequency of disagreements.

A possible source of this mismatch between beliefs and preferences is regret. Regret is not captured by existing models of fairness when evaluating outcomes under uncertainty but, if salient, may induce inequity-averse responders to raise their minimum acceptance thresholds during

[23] The ideal test would employ a direct response procedure in both treatment arms. However, such an exercise would prove costly because proposers' offers are often substantially above the minimum acceptable offer of responders and identification of the anomaly comes from subjects who reject a strictly positive amount in the Standard UG or the Lottery UG (before the resolution of uncertainty) but reject in the Lottery UG after the resolution of uncertainty reveals that the proposer won. We take heart from Brandts and Charness (2011), who report that "in no case do we find that a treatment effect found with the strategy method is not observed with the direct-response method" (p. 375).

bargaining for fear of ending up with a highly unequal outcome. This is not the only channel through which regret might work: it is just as plausible that inequity-averse responders are more accommodating in their acceptance decisions to reduce the chance of foregoing a profitable opportunity that they would later come to lament. Future work might try to disentangle the interaction between risk, fairness and regret, for example by varying the feedback presented to responders after rejection of an offer in the Lottery UG (for a related experiment, see Larrick and Boles, 1995).

We also uncovered evidence of a choice anomaly amongst responders. Specifically, despite having strictly positive minimum acceptance thresholds in both the Standard and Lottery UG, many responders were willing to accept the $(0,6)$ outcome – 0 for self – when they were able to accept or reject the proposal after the uncertainty surrounding the allocation was resolved. Proposers might use such knowledge to improve their bargaining position, for example presenting offers as contingent on uncertain events.

The reasons for this anomaly remain unclear, not least because we found only weak evidence that proposers' intentions attenuated ex post reciprocity. It may be that some responders are able to adopt an ex ante perspective and reason that they would have accepted the proposal before the realization of uncertainty, so they should accept it after. But a non-trivial fraction of responders accepted even after receiving offers below what was acceptable to them in the Standard UG. Another possibility is that mediation of outcomes via a random device changes the psychological nature of ex post rejection, absolving the proposer of some responsibility that would have otherwise been attributed to him.

To get a clearer sense of the underlying cause of this choice anomaly, further research is needed to observe a sufficient number of proposals that are low enough to truly test responders' thresholds. Nevertheless, the results give us pause, because they reveal that – when confronted with extreme inequality arising from the allocation of risk – subjects are more willing to accept such an outcome than they might otherwise report.

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