Socially embedded risky choice: Fairness, efficiency and social distance

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Abstract

Using a lab-in-the-field experiment in rural Uganda we study how risky choice decisions are influenced by efficiency considerations, inequality aversion and social distance. For this, 319 randomly selected participants choose a lottery which affects both themselves and a paired person. We compare different within-subject treatments that vary in the correlation of risk and social distance between the paired participants, which allows us to separate between competing theories for each subject, as well as its interaction with social distance. We find that while aggregate data shows virtually no treatment effects, it masks substantial heterogeneity amongst subjects. There is evidence that each of the main theories (ex-ante inequality aversion, ex-post inequality aversion and efficiency seeking) has support amongst some subjects, with an ex-ante interpretation of inequality aversion being the least popular.

PRELIMINARY DRAFT: PLEASE DO NOT QUOTE

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1 Introduction

Risk-taking behaviour has traditionally been studied in a social vacuum. While economists have studied risk preferences and other-regarding preferences for several decades, relatively little is known about their interaction. Most risk-taking activities, however, imply changes in (in)equality with others. This interaction is likely to be behaviourally important, which has been recognized recently by a number of experimental studies.

We add two important themes, which have not been addressed yet by this growing literature. First, in many settings there is a trade-off between inequality and efficiency, so that efficiency considerations need to be taken into account when making risky choice decisions. Second, when taking the social embeddedness of risky choice decisions seriously, attention needs to be paid to the fact that substantial variation may exist in social distance. Both efficiency and social distance may exert an important influence on the interaction between risk preferences and social preferences, which will be the main focus of this study.

To study the role of social preferences on risky choice, we use a lottery game in which paired participants choose a lottery which affects both themselves and a paired person. We compare different within-subject treatments that vary the correlation of risk and the social distance between paired participants, allowing us to separate between competing theories for each subject.[1] More specifically, we are able to identify the role of social distance and efficiency considerations on risky choice.

To illustrate, consider a stylised example of a small rural community with limited options for productive economic activity. The village has traditionally planted maize (which thrives under low rains), but one villager has a new option of planting the more profitable coffee (which thrives under heavy rains). Coffee has a higher expected value, but would also all but guarantee inequality as rains would determine whose crop prospered. There are three main theories to guide how we can analyse the decision.

First, it may be that the villager will see the increased inequality as a cost. This could be, in keeping with Platteau (2000), because the villager anticipates increased obligations if heavy rains cause their coffee to grow successfully. Alternatively, in the ex post inequality aversion framework (Fehr and Schmidt, 1999) a choice not to plant coffee could be seen as being motivated by inequality aversion itself, rather then for any anticipated 'social taxes'. Either rationale for the ex post inequality aversion would lead to a disutility being attached to this profitable opportunity, a viewpoint that has been argued partially explains low growth in developing countries, which tend to value equality (e.g. Platteau, 2000). Second, the villagers could follow an ex ante inequality aversion mindset (e.g. Trautmann, 2009), and see only limited inequality in expected values. This mindset would have a much lower cost for any inequality. Third, it is possible that villagers see this

[1] Our interest is not in how the proceeds of risky endeavours are redistributed, but rather on whether the anticipated social consequences of a risky choice affects the decision made. For this reason, we use interested parties rather than uninterested spectators: we wish to see how social preferences affect risk-taking in a society that places a high value on equality.

as an increase in efficiency and diversity. Several papers have examined social preferences in a non-risky environment, and there is some recognition that divergent results on the relative importance of efficiency and inequality are due to different subject pools. While Engelmann and Strobel (2004) find great support for efficiency in a riskless environment using business and economics students, Fehr et al.'s (2006) more diverse subject pool (non-economists in Berlin, Munich and Zurich) exhibited greater inequality aversion. [2] Our own subject pool, residents of rural Uganda, is even less WEIRD [Western, Educated, Industrialised, Rich and Democratic] and more representative of the world as a whole. However, because of limited previous study, it is unclear whether we should expect greater ineqiality aversion or greater efficiency.

Aggregate results show virtually no treatment effects, which is consistent with an ex ante (process fairness) interpretation of inequality aversion. The only significant result from aggregate data is that of a cautious shift, as subjects make less risky decisions when their chosen lottery will affect a partner. However, this conceals large treatment effects at the individual level. All of the main theories (ex ante inequality aversion, ex post inequality aversion and efficiency) receive support from some subjects, with ex ante inequality aversion the least popular. Results from a mixed logit regression, which estimates the distribution of preferences, shows that people are on average loss averse, concerned with others' losses (cautious shift) and are marginally efficiency seeking. The greatest distribution in preferences is found to be amongst non-co-villagers, where there is strong support for three competing hypotheses: efficiency seeking, ex-post inequality aversion and ex-ante inequality aversion. The role of social distance is complex, with the clearest finding being that a subject's behaviour with one partner is not strongly predictive of their behaviour with another, at least where there is a trade off between ext post inequality and efficiency.

Until recently it was typical to treat social preferences and risk preferences as separate domains, though recent literature has attempted to bridge this gap. These attempts can be broadly split into two camps: those that seek to incorporate elements of social preferences in a game or framework typically used to study risk preferences, and vice versa. Starting with the papers that use dictator games, a number of strategies have included some element of risky choice. Cappelen et al. (2013) uses a dictator game *after* risky choice to see whether subjects equalise outcomes. They include both spectators and stakeholders in this, and while they do find a self-serving bias they find similarly mixed results: subjects respond most to ex-ante expected values, but are also influenced by ex-

[2] Engelmann and Strobel (2004) test a few other regarding preference models, and find a combination of maximin, efficiency and selfishness explain the data. They have a three person set up, where a subject makes a unanimous choice between three different distributions affecting all players. In the majority of these treatments a subject's own pay-off was held constant, but it was allowed to vary slightly in some treatments. Interestingly, they implicitly assume no process fairness - the different other-regarding preference models are evaluated on the understanding that individuals consider outcomes rather than expected values. This point is well made by Bolton and Ockenfels (2006), who also report evidence that the willingness to pay for efficiency is lower than the willingness to pay for equity (Engelmann and Strobel, 2006, reply that the costs and benefits of the games don't allow a meaningful comparison).

post fairness. Spectators redistribute around a third of winnings from the lucky to the unlucky when people have made the same choice. This approach, while appropriate to identify fairness concerns in a risky setting, does not focus on the effect of these concerns on risky choice. The approach, however, does allow them to study more sophisticated fairness views, including choice egalitarianism (i.e. the view that only supports ex-post redistribution if inequality is the result of differences in luck but not if it is the result of differences in risky choice.)

Another strategy that has been followed is to add a risky element to the dictator game in order to examine social preferences in a risky context. Krawczyk and Lec (2010) uses a modified dictator game where subjects can distribute tokens to a partner, where the tokens are either portions of a prize (certain) or 10% chances of winning a prize, with idiosyncratic and negative covariate resolutions of the lottery. They find that both ex-ante and ex-post interpretations of inequality aversion are needed to explain the data. Brock et al. (2013) is similar, in that a dictator game is played where the allocation could be either money or tokens in a lottery. They also find support for both ex-post and ex-ante fairness considerations.[3]

There is a smaller literature that takes a risky choice game as its starting point, and adds social considerations. This includes lottery games *without* any distribution option, but compare treatments that differ in the possible outcomes of a paired person. Linde and Sonnemans (2012) played risk games with subjects whose partner received a fixed amount. Subjects in their experiments were observed to be more risk averse if they were unable to earn more than a paired person who received a fixed income, compared to a setting in which they would earn at least as much as the paired person. Assuming the partner is a salient reference point, this contradicts prospect theory with a social reference point and shows the importance of incorporating social concerns when studying risky choice behaviour. Friedl et al. (2014) played a risky choice game framed as an insurance decision, where negative shocks were either idiosyncratic or positively correlated across subjects. They found a higher willingness to pay for insurance in the idiosyncratic treatment, which is consistent with an ex-post interpretation of inequality aversion.

Also relevant here are the papers that study the role of inflicting risk on others. Bolton and Ockenfels (2010) find subjects dislike inflicting risk on others - this is in the context of betrayal aversion. This is also found by Charness and Jackson (2009) and can be interpreted as responsibility alleviation (Charness, 2000). However, this issue is contentious, with multiple contrary findings (Vieider et al., 2015; Andersson et al., 2014; Pahlke et al., 2015; Chakravarty et al., 2011).

In sum, typical findings of this literature are that there is inequality aversion in risky environments, and that neither ex-post nor ex-ante concerns alone explain behaviour. We will contribute to this literature insights on efficiency considerations and social distance. The article proceeds as follows: section 2 introduces the experimental design and

[3]Note also Krawczyk and Lec's (2016) discussion of the strength of Brock et al.'s (2013) evidence.

associated predictions, section 3 presents the results and section 4 concludes.

2 Experimental Design

In this section we present the experimental design. We start with a presentation of the experimental game and treatments, after which we elaborate on the theoretical predictions and procedures.

2.1 The experiment

The experiment consists of three parts. In part 1, subjects are asked to choose one of the eight lotteries shown in table 1. This design is similar to Gneezy and Potters (1997), and ensures a good degree of understanding amongst subjects. The decision is deliberately presented in a way that makes lottery 7 a salient reference, a feature that we'll return to in section 3.1.

Table 1: Lottery Options

Lottery Name	Low p=.5	High p=.5	Expected Value	Spread
7	7,000	7,000	7,000	0
6	6,000	10,000	8,000	4,000
5	5,000	12,000	8,500	7,000
4	4,000	14,000	9,000	10,000
3	3,000	16,000	9,500	13,000
2	2,000	18,000	10,000	16,000
1	1,000	20,000	10,500	19,000
0	0,000	22,000	11,000	22,000

In part 2, participants are anonymously paired and again asked to choose one among the eight lotteries, which now also affects their partner. In other words, each participant acts as a 'dictator' and chooses for both themselves and their partner.[4] Three different risk resolutions are used. First, in 'positive covariate' risk resolution the outcomes of both subjects in a pair are perfectly positively correlated (i.e. both subjects in a pair have either a high or a low outcome). Second, 'negative covariate' risk resolution means the subjects in a pair have opposing outcomes. Third, 'idiosyncratic' resolution means there is no correlation between partner's payouts.

In part 3, participants are faced with the same set-up as in part 2, with the only difference being the partner they are paired with. In particular, each subject is anonymously paired with either a co-villager or a non-co-villager in parts two and three (in a random order). In sum, we vary the risk resolution mechanism and their partner as within-subject

[4]Bolton and Ockenfels (2010) refer to this as 'dictator choice'.

treatments, such that each participant makes seven decisions in total, as presented in Table 2.

Table 2: Within-subject treatment design

Part	Partner	Risk Resolution
1	None	Idiosyncratic
2 or 3	From the Same Village	Positive, Negative and Idiosyncratic
2 or 3	From a Different Village	Positive, Negative and Idiosyncratic

Note: The order of co-villager is randomised, as is the order of the risk resolution in rounds 2 and 3.

2.2 Predictions

A number of clean predictions can be made regarding behaviour in our experiment and are summarised in Table 3. The workhorse model of inequality aversion (Fehr and Schmidt, 1999) describes the utility of subject i with reference to partner j as

$$U_i(x) = x_i - \alpha_i \max\{x_j - x_i, 0\} - \beta_i \max\{x_i - x_j, 0\} \tag{1}$$

where α is a measure of disadvantageous inequality, and β is a measure of advantageous inequality. It is generally assumed that $\alpha_i \geq \beta_i \geq 0$, i.e. inequality cannot increase utility, and inequality is more harmful when you have less than another.

An ex-ante interpretation of this (e.g. Trautmann, 2009) utilises the expected values of x_i and x_j instead of the realized outcomes. In our setting, the expected value of a given lottery does not vary by risk resolution type and so we would expect no treatment effects. The cleanest test of this relates to a comparison between the positive and negative covariate risk treatments, as it avoids including situations with no partner or the idiosyncratic treatment where four outcomes are possible[5]. This leads to the following first hypothesis.

Hypothesis 1 *A solely ex-ante interpretation of social preferences predicts no differences between positive and negative covariate risk treatments.*

The ex-post view does predict differences between treatments. Clearly, with positive covariate risk equality is guaranteed, and so formula 1 reduces to $U_i(x) = x_i$. The negative covariate risk treatment guarantees inequality for seven of the eight lotteries, and so we could rewrite equation (1) as:

$$U_i(x) = x_i \begin{cases} -\alpha_i \max\{x_j - x_i, 0\} & \text{if } i \text{ loses} \\ -\beta_i \max\{x_i - x_j, 0\} & \text{if } i \text{ wins} \end{cases} \tag{2}$$

[5] Throughout, we abstract from probability weighting. While probabilities are always set at 0.5, in the idiosyncratic resolution there are quarter chances of possible advantageous and advantageousness inequality. As such, the idiosyncratic resolutions are not included here, to keep the test as clean as possible.

In our experimental set up we cannot observe α and β independently, so call $\gamma = (\alpha + \beta)/2$. This then reduces (1) in the negative covariate risk treatment to $U_i(x) = x_i - \gamma|x_i - x_j|$, where lotteries incur the disutility of inequality. Any treatment differences between the positive and negative treatments must come in response to the level of inequality, with less risky decisions expected in the negative resolution if subjects are concerned by ex-post inequality.

Hypothesis 2 *A solely ex-post interpretation of F&S-type social preferences predicts greater risk-taking in the positive treatment than in the negative treatment.*

There is another alternative: that subjects do not perceive inequality as a disutility but rather as part of greater efficiency. Engelmann (2012) points out this is also achieved by relaxing the constraint on α and β, so that inequality can result in positive utility. This is related to the Maximin theory of Charness and Rabin (2002) where efficiency joins the minimum payout as an important consideration.

Hypothesis 3 *A high concern for efficiency would predict the negative treatment would see greater risk-taking than the positive one.*

The evidence is somewhat divided on whether deciding for other subjects increases or decreases risk aversion. The theory with the longest empirical support is that of a cautious shift, with subjects reluctant to impose risk on others (see introduction for more). However, there are dissenting voices (Chakravarty et al., 2011; Vieider et al., 2015; Andersson et al., 2014; Pahlke et al., 2015).

Hypothesis 4 *Consistent with the cautious shift hypothesis, subjects will choose less risky lotteries when their decisions affect a partner.*

The role of social distance has been studied in the context of generosity/altruism. It has been shown that generosity as measured by money shared with another paired person in dictator games increases with smaller social distance (Leider et al., 2009; Goeree et al., 2010; Brañas-Garza et al., 2010; Ligon and Schechter, 2012). This supports the idea that people tend to attribute a higher weight to the income of close others (Bohnet and Frey, 1999; Charness and Gneezy, 2008). At the same time, some studies have suggested that people are more sensitive to (un)fairness vis-a-vis persons at lower social distance. Making use of ultimatum games in which participants make hypothetical choices, Kim et al. (2013) found that sensitivity to fairness decreases with social distance.[6]

Both observations suggest that people tend to give a higher weight to the pay-offs of people with lower social distance.[7]

[6] Recent evidence from neurological studies that combined ultimatum games with brain imaging techniques confirms that feelings of unfairness correlate with social distance, but is divided on the sign of this correlation. (Wu et al., 2011) found feelings of unfairness to be stronger when matched with friends, whereas Campanhã et al. (2011) found them to be weaker when matched with friends.

[7] Note that in our setting there is no way to show generosity towards the other person. Also, the option of side payments is excluded, as participants remain anonymous, so anticipated reciprocity or sanctions cannot influence decisions.

For people following an ex-ante view this would not matter, and they would treat people from their village and strangers alike. However, for the ex-post view we would expect that inequality aversion decreases as social distance increases. Translating this into in the F&S utility function, the magnitude of the envy and guilt parameters may differ by social distance. While we cannot independently observe envy and guilt parameters, the magnitude of γ captures the effects, so that we rewrite equation (1) as:

$$U_i(x) = x_i - \gamma_{id}|x_i - x_j| \tag{3}$$

with d an index of social distance and $\gamma = \frac{(\alpha+\beta)}{2}$. [8]

Hypothesis 5 *Social distance does not influence risky choice of people who follow an ex-ante view, while it lowers the importance of inequality aversion of those following an ex-post view.*

Table 3: Theoretical Predictions

Theory	Hypothesis	Lottery Choice Predictions
Ex Ante	1	$Positive = Negative$
Ex Post	2	$Positive > Negative$
Efficiency	3	$Positive < Negative$
Cautious Shift	4	$Individual > Unanimous$
Ex Post with Social Distance	5	$(Pos_{co} - Neg_{co}) > (Pos_{no} - Neg_{no})$

Note: Higher numbers of lottery reflect greater risk aversion, see table 1 for details.

2.3 Procedures

The subjects were randomly chosen from a rural community in Eastern Uganda, with two sessions per day for four days. In each of the four randomly selected central locations, five villages were randomly selected so that the appropriate number of co-villagers could be utilised. Standard procedures (voluntary participation, no communication) were used throughout. Subjects received an average payout of just over 11,000 Ugandan shillings once an unannounced show-up fee of 2,000 UGS was included. This represents a little under three day's labour in the local economy, while the experiment lasted around 3 hours.

All subjects knew that one decision would be chosen to be played for real, and that risk resolution took the form of retrieving either a red ball (representing the 'Low' amount) or a white ball (representing the 'High' amount) from a bag. These colours were used throughout, from the trays used in explanations to the decision sheet showing all eight lotteries. The different risk resolution mechanisms were described using specific names.

[8]Peters and Bos (2008) find that when matched with friends people become more satisfied with being underpaid and less satisfied with being overpaid (so envy becomes smaller, and guilt becomes stronger); as we cannot disentangle envy and guilt we don't expect this to influence risky choice.

‘Positive covariate risk’ was introduced as ‘pick once’, meaning one ball was selected and affected both partners in the same way (e.g. the red ball would mean both partners receiving the low amount). ‘Negative covariate risk’ was introduced as ‘different’ meaning that one ball was selected for the first partner, with the other receiving the ball that was left in the bag. The ‘idiosyncratic’ resolution was introduced as ‘pick twice’ meaning that after the first ball had been selected, it was replaced and a second draw was made for the second subject.

To ensure understanding of the instructions each of the seven decisions is based on the same basic lottery with consistent visual aids, and so parts 2 and 3 built on part 1. The slow and culturally appropriate explanation of each element of the game, and the use of control questions resulted in high levels of comprehension. On average subjects answered a set of control questions correctly in 95% of cases, with 82.5% of subjects getting all fifteen control questions right. As literacy cannot be guaranteed all decisions were made with an enumerator.

A word is required on the use of the within-subject design, given concerns that subjects may not be fully incentivised to exert mental energy for every decision or may respond to perceived experimenter demand effects and alter their behaviour (see Charness et al., 2012, for a discussion). We have attempted to mitigate these concerns by opting for a substantial pay-off, almost three-days wages, and asking control questions for each decision. The data tells us that the control questions were more likely to be answered correctly in part 3 than in part 2, with an increase from 95% to 97%. These control questions reveal a high level of understanding, lending confidence to the view that the costs associated with a within-subject design are more than outweighed by the added ability to examine individual level preferences. This is motivated by a consistent finding of heterogeneity in social preferences in a risky environment (Blanco et al., 2011; Fehr and Schmidt, 2010; Conte and Moffatt, 2014; Brock et al., 2013; Cappelen et al., 2013).

3 Results

Simple tests provide an overview of the empirical evidence. The dataset is large: 319 subjects[9] made seven decisions resulting in 2,233 decisions. In the next subsection data is used for each possible option, meaning 17,864 observations are included. Because of the extent of the data used, only the cleanest tests are presented in this section, with attention paid to the key characteristics of the data.

Result 1 *There is a cautious shift when one’s decision affects another, revealing other-regarding preferences play a role. However, there is no evidence that the safe shift is more pronounced for co-villagers than non-co-villagers.*

[9]While we randomly selected 320 subjects, one of those selected was not physically able to complete the experiment due to poor hearing. Luckily, their partner’s decision was chosen to be paid out. Throughout, we exclude this datapoint.

Figure 1: Percentage Choosing Each Lottery, By Treatment

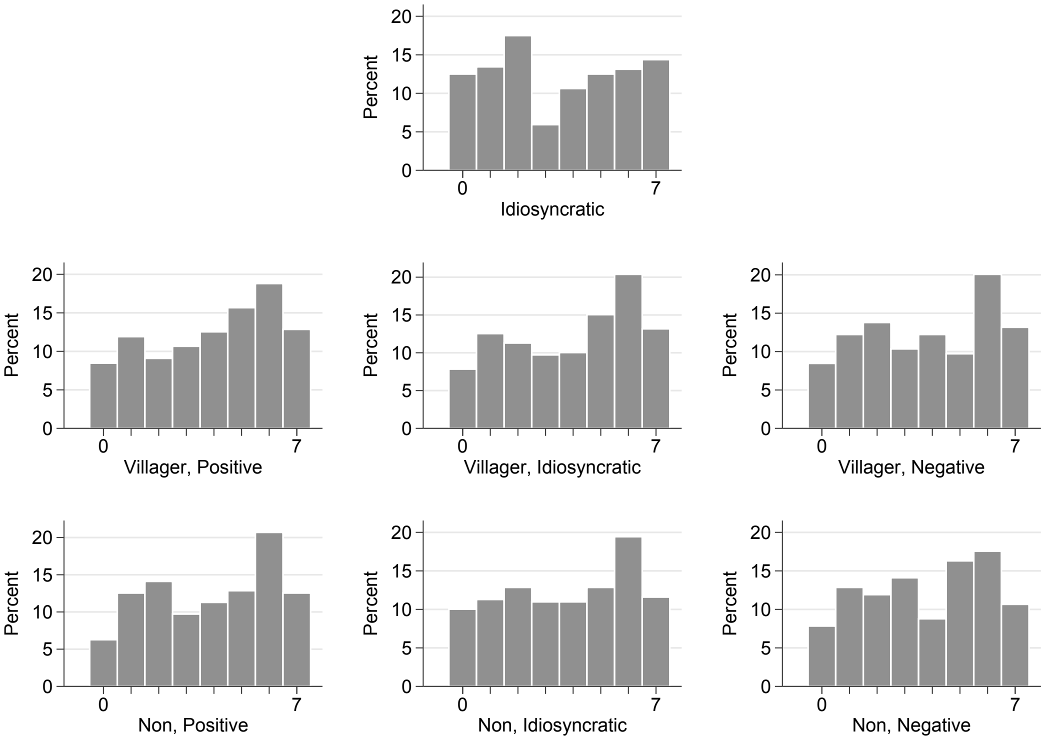


Table 4: Aggregate Treatment Effects, with Fixed Effects

Treatment	Coefficient (Standard Error)
Villager, Positive	0.433***
	(0.154)
Villager, Idiosyncratic	0.439***
	(0.153)
Villager, Negative	0.307*
	(0.157)
Non, Positive	0.411***
	(0.145)
Non, Idiosyncratic	0.257*
	(0.156)
Non, Negative	0.254*
	(0.153)
Constant	3.502***
	(0.107)
Within R^2	0.01
Observations	2,233

Note: The depdendent variable is the number of the lottery chosen, with a higher number meaning more risk aversion. The excluded category is the individual decision from round 1. Significance at the 10%, 5% and 1% levels are denoted by 1, 2 and 3 stars respectively. Errors are clustered at the individual level.

Table 4 shows that for all of the six treatments with partners, the chosen lottery is significantly less risky than the individual choice. A direct test sees a mean lottery increase from 3.5 for the individual lottery to 3.85 for rounds two and three, which is significant at the 5% level (T=2.56, p=0.01). The percentage risking everything (i.e. choosing the 22/0 lottery) for rounds 2 and 3 is also significantly lower at the 5% level (from 12.5% to 8.2%, Z=2.56, p=0.01). The change for non-villagers of 0.39 is not significantly different from the change for villagers 0.31 (T=0.46, p=0.64), i.e. the cautious shift is not more pronounced for close others.

Result 2 *Subjects' behaviour is remarkably consistent across treatments, with few significant treatment effects at the aggregate level.*

Figure 1 plots the percentage of subjects choosing lotteries 0 to 7 (where the higher the number the greater the risk aversion), by treatment. In aggregate, behaviour looks remarkably consistent across treatments. To illustrate this further, consider table 4, which displays a regression on the lottery chosen with treatments as independent variables and fixed effects for individuals. The excluded category is the individual choice treatment, and table 4 shows that each treatment in round 2 and 3 is significantly different from round 1. None of the other treatments are significantly different from each other.

Result 3 *Aggregate behaviour hides substantial heterogeneity in individual-level treatment effects.*

Tables 5 and 6 provide details of the percentage of subjects that conform to the three main theories in each round. We can see that a slim majority (52%) are consistent in the two rounds, with a large number of subjects changing their strategy according to the identity of their partner. These switches of strategy are not in a consistent direction, with table 6 showing that behaviour is essentially symmetrical: a very similar number of people switch from playing according to an ex post inequality mindset to an efficiency seeking mindset when moving from co-villager to non-co-villager as those moving from non-co-villager to co-villager. This explains why aggregate behaviour reveals no treatment differences, while individual behaviour reveals substantial treatment effects.

Result 4 *The partner's identity does not systematically affect the difference between positive and negative treatments.*

With co-villagers, the average difference in the lottery chosen between positive and negative treatments is 0.125 (standard deviation of 2.33), whereas with non-co-villagers it is 0.157 (standard deviation of 2.39). This means that on average subjects prefer slightly riskier lotteries in the positive treatment, but there is no difference according to the identity of the partner.

In short, we do not find a simple magnifying effect, where subjects respond in the same way but with different intensity to different partners.

Table 5: % of Sample that Conform to Different Theories

Theory	When playing with: Co-Villager	Non	Either	Both
Ex Ante	26%	26%	36%	16%
Ex Post	38%	40%	58%	20%
Efficiency	37%	35%	56%	16%

Table 6: Consistency of Behaviour by Model and Partner

		Non Co Villager Ex Ante	Ex Post	Eff.
Co-Vill.	Ex Ante	16%	4%	6%
	Ex Post	5%	20%	15%
	Efficiency	5%	14%	16%

Note: These are calculated purely on the basis of negative and positive treatments, and so unconfounded by responsibility (individual treatment) or probability weighting (a concern with the idiosyncratic treatment, as there are quarter chances of (dis)advantageous inequality).

3.1 Mixed Logit

In order to examine more closely the relative strength of competing concerns, we estimate a mixed logit model in the spirit of Engelmann and Strobel (2004). Whereas they recovered parameter estimates describing the characteristics of the average subject using a conditional logit, the mixed logit approach is able to estimate the spread of characteristics amongst the population using maximum simulated likelihood (see Revelt and Train, 1998; Train, 2003; Cameron and Trivedi, 2005; Hole, 2007, for more on the method) by estimating both a point estimate and a standard deviation for a normal distribution.

We now turn to the reduced form to be estimated. Following Stott's (2006) recommendation, we adopt a sign-dependent power function from the multitude of functional forms functions available. Wakker (2008) has shown this has several desirable probabilities, see Veider et al (16, EI) for a discussion. While the sign-dependent power function is seen as a good compromise between fit and parsimony, we cannot independently observe gain and loss utility given the choice environment selected, as they are virtually collinear. Two simplifying assumptions are possible: to either fix one parameter as a constant, or to fix them equal to each other. Given the evidence that gain utility is often approximately linear (Vieider et al., 2015) we use this assumption, and allow the curvature of loss utility to be freely estimated. This simplification may mean that if gain utility is concave we underestimate the convexity of loss utility, but makes tjhe model tractable. We also abstract from probability weighting, as probabilities are unchanged throughout the experiment.

First, in round 1 an individual must trade-off between greater expected value and the higher spread of riskier lotteries. Specifically they are faced with eight lotteries of the form (x^h, x^l), where higher expected values are related to higher spread, and $x^h \geq x^l$. Using a Cumulative Prospect Theory (CPT) framework, we can state that an individual faces the following:

$$u(x) = (x^h - r)^\alpha + \lambda(x^l - r)^\beta$$

where the reference r is 7,000 as discussed previously: the script introduces lottery seven $(7,7)$ first, and all subsequent lotteries are explained from this starting position. For simplicity and tractability we assume $\alpha = 1$ and $\lambda < 1$. This is consistent with risk aversion and is akin to normalising these parameters while allowing the free parameter to describe a wide range of behaviour. The assumption does mean that this specific reduced form may not be as applicable to other domains, but it does suit the current choice environment. The individual decision then becomes:

$$u(x) = (x^h - r) + \lambda(x^l - r)^\beta$$

where λ and β are parameters to be estimated. Now, for a positive treatment in part 2 or 3, ex post inequality concerns are absent as equality is guaranteed, but concerns relating to a risky or cautious shift apply. We can model this in the same way as one's own trade-off between expected value and spread, with the parameter δ measuring the extent to which losses are felt for other players.

$$u(x) = (x^h - r) + \lambda(x^l - r)^\beta + \delta(x^l_o - r)^\beta$$

Lastly, a term is added to capture concerns relating to Ex post inequality. As pointed out by Engelmann (2012), an independent variable that captures ex post inequality aversion could easily capture efficiency concerns: it merely depends on the sign of the coefficient.

$$u(x) = \underbrace{(x^h - r)}_{\text{Expected Gain}} + \underbrace{\lambda(x^l - r)^\beta}_{\text{Own Spread}} + \underbrace{\delta(x^l_o - r)^\beta}_{\text{Other's Spread}} + \underbrace{\gamma[x^h - x^h_o + x^l - x^l_o]^\beta}_{\text{Ex Post Inequality}} \tag{4}$$

This simple equation can capture risk aversion, a cautious/risky shift, ex post inequality aversion and efficiency motivations. Aspects of the equation resemble the Expected Inequality Aversion model, which effectively weights ex post and ex ante efficiency concerns (Fudenberg and Levine, 2011; Saito, 2013). In our setting ex ante equality is guaranteed, but the ex post inequality is captured in (4) by the third term.

As pointed out by López-Vargas (2014), a nonlinear formulation of inequality aversion is more realistic than the standard EIA model: here we expect that inequality is increasingly costly (ex post inequality aversion) or beneficial (efficiency). This point is very clear in our experimental set up, as a linear interpretation would be unable to explain any choices of lotteries 2-6.

Equation (4) can then be estimated using a combination of non-linear and linear mixed logit, which allows for coefficients to be normally distributed amongst the population. Table 7 summarises the key predictions from different theories regarding equation (4). The first expectation is simply that subjects are risk averse, and so $\lambda < 1$ i.e. that greater spread incurs a disutility. The effect of greater spread for another is captured by δ, with a cautious shift being consistent with $\delta < 0$. The sign of γ is able to lend support to the theories of either ex post inequality aversion, ex ante inequality aversion,

Table 7: Theoretical Predictions: Mixed Logit

Theory	Predictions
Risk Aversion	$\lambda < 1$
Cautious Shift	$\delta < 0$
Risky Shift	$\delta > 0$
Ex Post Inequality Averse	$\gamma < 0$
(Only) Ex Ante Inequality Averse	$\gamma = 0$
Efficiency Seeking	$\gamma > 0$
Social Distance is irrelevant	$cov(\gamma, \gamma_o) = 1$
Social Distance is irrelevant	$cov(\delta, \delta_o) = 1$
Homogeneity within population of efficiency/ex post inequality aversion	$\delta_{SD} = 0$

Note: Higher numbers of lottery reflect greater risk aversion, see table 1 for details.

or efficiency seeking behaviour. Throughout, standard deviations are useful indicators of the uniformity of behaviour amongst the subject pool.

Table 8 shows the results of two structural models estimated by mixed logit. The second model differs by allowing the parameters δ and γ to differ by partner identity, but otherwise the two models are identical. The exponent β is estimated using nonlinear mixed logit[10] to be 1.018, lending a very slightly convex nature to loss, inequality and efficiency concerns. The results presented are in line with expectation when there are clear predictions: subjects dislike losses at around the commonly found $\lambda = 2$ mark and they (on average) dislike inflicting losses on others (with a much smaller strength than their own losses). The estimated standard deviation for δ is consistent with contradictory findings in the literature, where evidence for both cautious shifts and risky shifts are found. The most interesting coefficient estimate is γ, where on average subjects are found neither to be ex post inequality averse nor efficiency seeking, but rather model 1 shows a significantly large spread in preferences.

For Model 2, most of the implications are exactly the same: subjects dislike their own loss and marginally dislike other's loss. Regarding others' losses, the coefficient estimates do not really differ by partner identity. However, estimating a γ for each partner *does* reveal differences: there is only a significant standard deviation for non co-villagers. This is evidence that subjects conform more to an ex ante view of fairness with co-villagers, and are more likely to be either efficiency seeking or ex post inequality averse when their partner is of a different village. This is shown particularly clearly in figure 2.

Table 9 shows the estimated covariance of different parameters. The most interesting part of these is the high correlation between the two δs, implying that the cautious/risky shift is not heavily influenced by the partner's identity. There is no such correlation for

[10]Specifically, a nonlinear mixed logit model is estimated using the methods described by Andersen et al. (2012). This provides a value of β which is then used to estimate a mixed logit model, which has more sophistication post estimation commands. For example, this facilitates plotting the spreads in figure 2, the out-of-sample prediction and the covariance estimates in table 9.

Table 8: Mixed Logit Parameter Estimates

	Model 1			Model 2	
Variable	Estimate	SD	Variable	Estimate	SD
λ	-2.00***	0.52***	λ	-2.01***	0.51***
	47.51	7.35		44.19	6.97
			$\delta_{CoVillager}$	-0.128***	0.35***
δ	-0.11***	0.36***		2.74	4.03
	2.76	5.83	δ_{non}	-0.11**	0.34***
				2.52	4.02
			$\gamma_{CoVillager}$	0.011	0.025
γ	0.013	0.0289**		0.88	1.55
	1.39	1.98	γ_{non}	0.016	0.07***
				1.26	3.20

Note: Below each estimated parameter and standard deviation is the associated z value. Both models use the value of alpha found using nonlinear mixed logit (1.018, with a 95% confidence interval of 0.99-1.05). They differ in that Model 2 allows delta and gamma to differ by partner's identity (co villager/not), whereas model 1 does not. The distribution of the parameters from model 1 are plotted in the upper panel of figure 4, Model 2 in the lower panel. Both models are estimated using the user-written command `mixlogit` *in Stata 14 (Hole, 2007).*

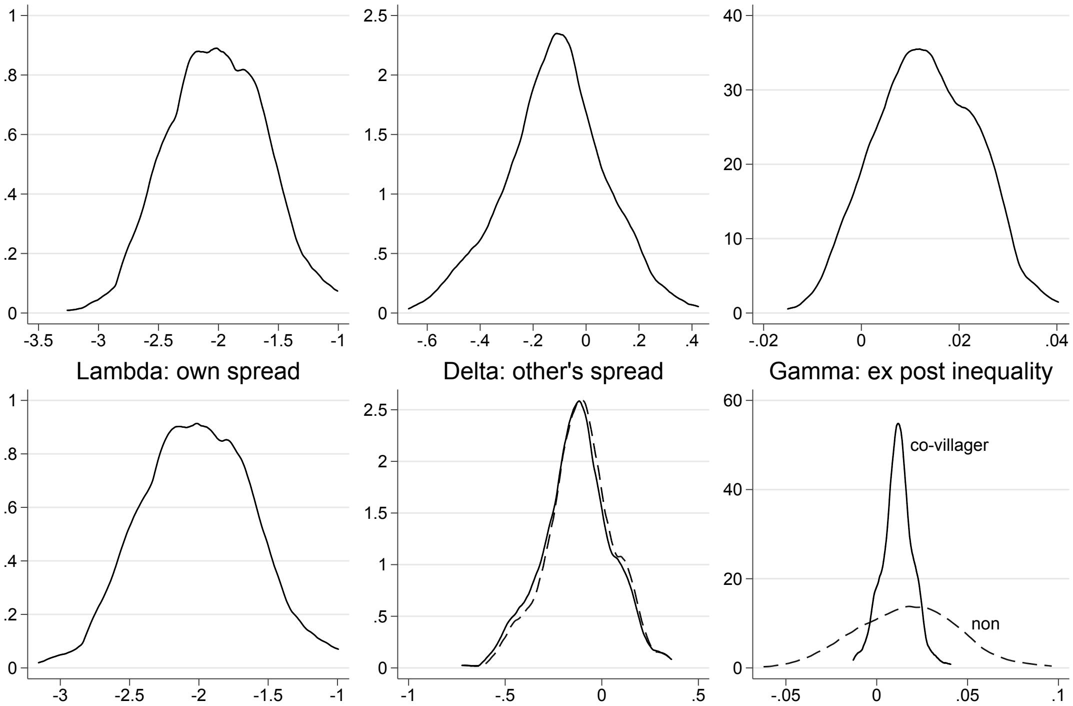
γ and therefore no such corollary. In other words, there is limited ability to be able to predict whether a subject will act in an ex ante, ex post or efficiency seeking way by observing how they have interacted with a different person. In essence, the effect of social preference on risky choice appears to be more domain-specific than the cautious/risky shift.

Table 9: Covariance

Model	Comparison	Covariance	z Stat
	λ & δ	-0.095*	1.88
1	λ & γ	-0.0067	0.93
	γ & δ	0.002	0.39
	λ & δ_{own}	-0.09	1.42
	λ & δ_{other}	-0.076	1.28
	λ & γ_{own}	-0.0032	0.34
	λ & γ_{other}	-0.012	1.34
	γ_{own} & δ_{own}	0.0013	0.18
2	γ_{own} & δ_{other}	0.0013	0.19
	γ_{other} & δ_{own}	0.0017	0.20
	γ_{other} & δ_{other}	0.0017	0.21
	γ_{other} & γ_{own}	0.0017	1.00
	δ_{other} & δ_{own}	0.118**	2.07

In order to test the validity of the model, we test the model out-of-sample. Essentially,

Figure 2: Percentage Choosing Each Lottery, By Treatment



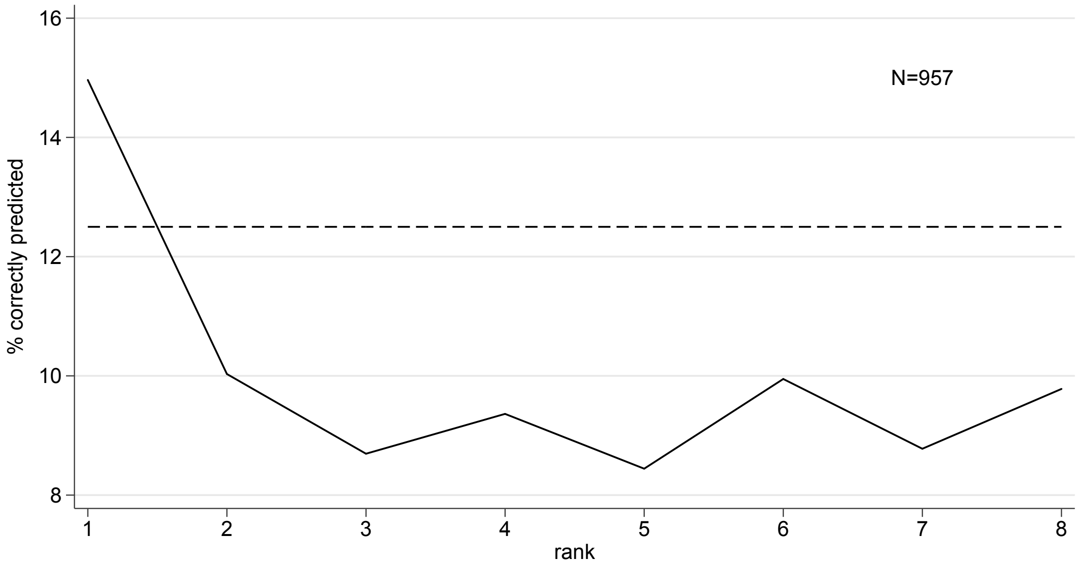
we run the model on the whole sample, collecting parameter estimates. These are then used as starting values for when the model is run on just the first 4 decisions, which are then used to predict every subjects last three decisions.[11] This means that the model is estimated on a variety of co-villager and non-co-villager, as the order of these pairings is randomised. Figure 3 then plots, for the 957 decisions, which rank was assigned to the actual choice. A perfect prediction would show a line at 100 in rank one, and zero elsewhere. Chance (showed by the dotted line) would on average get 12.5% right for each rank. The actual predictions do outperform chance, predicting around 15% of choices correctly.

4 Discussion and Conclusion

We examine risky choice with social consequences, using a novel experimental design and subject pool. We present a conceptually identical risky decision between eight lotteries, but vary the expected level of inequality in different treatments. Aggregate data is shown to be potentially misleading, as a naive reading of the data would lend support to the theory of ex ante inequality aversion. Results that allow for heterogeneous behaviour show that ex ante inequality aversion is actually the least important of the three main theories. It is worth noting that a between subject design would suffer the same problems as the aggregate data, as it would be unable to identify individual-level treatment effects.

[11]This approach means the model contains information on the correlation between the two δs, thus allowing for a test based on this correlation.

Figure 3: Percentage Choosing Each Lottery, By Treatment



Given the debate surrounding the relative importance of efficiency and ex post inequality aversion amongst different subject pools (Engelmann and Strobel, 2004; Fehr et al., 2006), our results are informative. We find heterogeneity *within* our subject pool: while the average subject is found to be significantly ex post inequality averse, around one third of subjects are efficiency seeking. In other words, a majority of subjects do not feel inequality as a disutility, but are attracted to riskier choices if there is guaranteed inequality.

The use of two types of partner (co-village and non-co-village) for every subject allows the effects of social preferences to be examined more thoroughly, using individual level behaviour. However, results indicate that there is no predictable direction to the effect of subject type on behaviour. We had expected social preferences to play a stronger role for co-villagers, but this does not appear to be the case. Many subjects conform to different theories in different rounds: an unpredictability that was also found by Blanco et al. (2011). Before recommending characteristics of new theories, it is important to reflect on Fehr and Schmidt's (2010) arguments regarding whether social preference models that are more accurate will be tractable enough to be useful. For our specific subject pool, the results show that current research underplays the role of efficiency seeking amongst rural farmers.

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