JENA ECONOMIC RESEARCH PAPERS

2013 – 024

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www.jenecon.de

ISSN 1864-7057

The JENA ECONOMIC RESEARCH PAPERS is a joint publication of the Friedrich Schiller University and the Max Planck Institute of Economics, Jena, Germany. For editorial correspondence please contact markus.pasche@uni-jena.de.

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June 5, 2013

Abstract Willingness to take risk depends on whether the risk affects others as well as oneself and on how the risk affects one's position *vis-à-vis* others. Taking a bet can improve one's position relative to others or threaten it. We present an experiment that explores individual attitudes to lotteries that involve both oneself and another subject. Individuals consistently and strongly dislike obtaining safe but unfair social outcomes rather than playing fair but risky social lotteries. This effect is apparent whether the unfair safe social outcome benefits them or the other. Subjects are also more risk averse when facing social lotteries than when facing lotteries that involve only themselves. There is a small but consistent and significant tendency to avoid social lotteries that impose a risk on the other. An attempt to reconcile those findings with standard models of social preferences shows that a high weight given to considerations of *ex-ante* inequality goes some way towards explaining the decisions of our subjects. It remains difficult however to account for the magnitude of their aversion to safe but unequal social outcomes.

Keywords Social preferences, Risk attitudes, Inequality aversion, Altruism, Procedural fairness, Utility measurement
JEL Codes: C91, D63, D81

> Like all the men of Babylon, I have been proconsul;
> like all, I have been a slave.
>
> Borges, The Lottery in Babylon

1 Introduction

Risk considerations often involve thinking about how possible outcomes from the risky situation may affect one's position *vis-à-vis* others. There are many situations where risk and distributional arguments come into play. Knowing how people react to social risk is necessary to answer some basic economic questions. Are people keener to insure against catastrophic "aggregate risk", such as a tsunami, that affects all, or against individual risk, such as a car accident, that affects only them? When setting taxes on capital gains, should lucky people who were successful on the stock market be taxed more than those who gained only little, even though all had the same chances originally? When allocating public health spending, should a risk that affects badly a few individuals only receive more attention than a risk that moderately affect many? When starting a new research project, should one work jointly with others, whereby one's success is theirs too, or rather work on one's own and compete to be the first to innovate? There are also many situations from the literature in game theory or experimental economics that have distributional aspects under uncertainty. From the point of view

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of a proposer, any offer p in the ultimatum game determines a lottery $((0,0), \pi(p); (100-p, p), 1-\pi(p))$ — to be read: "both get 0 if the offer of p by the proposer is rejected, which has probability $\pi(p)$, while the proposer gets $100-p$ and the responder p if the offer is accepted". Similarly, interpersonal considerations complicate the solution of games with mixed strategies as those determine lotteries between outcomes that may be more or less fair – see Bardsley et al (2010), Chapter 7, section 3.3. Finally, in a two-person game such as chess, agreeing to a draw or keeping on playing also depends on one's social and risk preferences.

Outcomes for others are usually not spelled out explicitly when people are asked by experimenters to consider possible outcomes from a risky situation along with their probability of occurrence. Outcomes for the subjects are shown to participants but not the outcomes for others. The experiment that is analyzed in this paper therefore manipulates the social outcomes a subject obtains from a lottery along with those of an unrelated other, both social outcomes depending on the outcome of random draws. Making the social outcome of others explicit gives a more finely tuned understanding of attitudes to risk. Agents may be risk neutral if their outcome is positively correlated with the outcome for others, or they may not care about inequality in outcomes if all have the same chances in terms of expected social outcome *ex-ante*. Interesting also is how agents find a balance between risk and fairness, that is, how they make their choice between a social outcome that is unfair but not risky *vs.* a lottery that is fair but risky. Some may be more willing to take a risk if that is to avoid a safe but disadvantageous outcome. Examining the interaction between risk and social preferences makes this work similar in spirit to Andersen et al (2008) who examine the interaction between time and risk preferences, or to Güth et al (2008) who examine the interrelation of risk, time and other-regarding preferences.

The first task is to explore how social outcomes for others affect perception of risk and how risk affects consideration of the outcomes of others. We compare our results with those in the existing experimental literature on the topic. As in most of the existing literature, we compare the probability with which subjects choose a safe outcome rather than a lottery in different social settings. However, those probabilities are derived from parametric estimation of subjects' utilities, rather than observed directly from subjects' choices. The approach is to first fit a range of possible utility functions to the decisions made by our subjects, and then determine, based on estimates of the parameters of their utility functions, how subjects choose between various types of safe and risky social lotteries. The approach is therefore parametric rather than non-parametric as in most of the literature on the topic. While findings from parametric methods may be less robust than those from non-parametric methods, an advantage of this approach is that subjects can be shown a wide variety of social lotteries without all of them needing to be directly comparable so as to be able to directly compare subjects' choices across different situations. More flexibility in the design of choice situations obtains more robust estimates of subjects' social preferences as subjects can be exposed to a wider range of social lotteries and there is less contamination of choice patterns across choice instances.

After comparing our results with the existing literature on perceptions of risk in a social setting, we go one step further by assessing whether subjects' preferences can be reconciled with existing models of preferences in social settings, such as the inequality aversion models of Fehr and Schmidt (1999) and Bolton and Ockenfels (2000), or models of altruism such as that in Cox and Sadiraj (2007). We do so by estimating directly the parameters of social utility functions that take account of both risk attitudes and social preferences. In doing so, we first adopt a consequentialist approach, assuming that "people make decisions on the basis of on an assessment of the consequences of possible choice alternatives" (Loewenstein et al, 2001) and that they anticipate emotions that will result from their choices. Those emotions are triggered not only by their own result from a lottery, but also by the result of the draw of outcomes for the other. In a second step, we go beyond anticipated emotions and take account of the immediate emotions associated with facing a choice that involves an unfair outcome. We allow for the possibility that subjects judge the choice they are faced with on the basis of whether it gives themselves and the other equal chances in terms of expected social outcome. We do so by estimating econometrically the weight that agents give to equality of opportunity (*ex-ante*) *vs.* equality in terms of outcomes (*ex-post*) in their decisions. We reduce the question to comparing the weight that agents give to *ex-post* utility, calculated based on the expected utility of the lottery – $E(U(L))$ – *vs.* the weight attributed to *ex-ante* utility, calculated based on the utility of the expected value of the lottery – $U(E(L))$. We show that this approach which combines fairness judgments with an evaluation of consequences goes some way towards explaining patterns of choices among social lotteries. This further circumscribes how social choice under uncertainty differs from social choice in a safe setting.

2 The experiment

Each of the subjects in the experiment was assigned a "pair" anonymously. Subjects were offered a series of choices between two lotteries, A, on the left and B, on the right. Lotteries specify social outcomes for oneself ("me" or "decision-maker") and for the pair ("you" or "recipient"). For example, a subject may choose between $A = (70, 68)$ and $B = ((70, 31), \frac{1}{2}; (60, 90), \frac{1}{2})$, to be read "70 for me, 68 for you" *vs.* "half a chance of $(70, 31)$ and half a chance of $(60, 90)$".

Subjects were asked how much they were ready to pay to obtain social outcomes from lottery A rather than from lottery B. They were shown a representation of lotteries (Figure 1) and were invited to input a price that makes them indifferent between lottery A and lottery B. The figure reflects the input of a price of 4 for lottery A. They were told a random number would be drawn between 0 and 15 and that they would obtain lottery A at a price equal to that random number if the price they were willing to pay for lottery A was higher than that random number.

Fig. 1 Social lottery representation, reflecting the input of a price of 4.

This elicitation mechanism combines aspects of pairwise choice procedures as in Hey and Orme (1994) with the Becker-DeGroot-Marschak mechanism (Becker et al, 1964). Hey et al (2009) discuss the advantages and disadvantages of various preference elicitation methods and conclude that pairwise choice is more precise and less biased than other popular methods. Pairwise choice elicitation is complemented with elicitation of indifferences between lotteries. Data about the strength of preferences between lotteries is used to get a more detailed representation of subjects' preferences.

An important issue is whether the Becker-DeGroot-Marschak mechanism is incentive compatible in this setting (Horowitz, 2006). Indeed, preferences between lottery A and B may not be monotonic in p, meaning that a subject who prefers B to A may still wish to pay p and obtain the resulting lottery between lottery B and lottery A. Appendix 2 shows that if subjects have social concerns of a type that can be modeled with utility functions of the type presented in Fehr and Schmidt (1999), then the issue comes up only for rather improbable values of the parameters measuring sensitivity to comparisons of social outcomes.[1]

25 lottery pairs were presented in total, first 19 lottery pairs that involved social outcomes (social lotteries), second 6 lottery pairs that showed outcomes only for oneself (individual lotteries). Each lottery comparison pair (L_1, L_2) was presented twice, first with L_1 to the left then with L_1 to the right, so that whether L_1 or L_2 was preferred, the strength of that preference could be expressed through a price. This means subjects had to make 50 decisions (price input). In the case in which they preferred lottery A, subjects were helped in their expression of the price p that made them indifferent between A and B as the bar representing their payoff under A was adjusted downwards by an amount equal to their expressed price p. In the case where they preferred B rather than A, they were expected to input a price $p = 0$.[2]

Subjects may respond to a demand effect whereby they always express a positive price for getting lottery A. This effect was reduced by showing lottery pairs in the reverse order directly after they were presented in the initial order so that subjects noticed each pairwise choice was presented twice and were therefore more aware of the irrationality of expressing a positive price in both cases. The instructions also stated that if B was preferred to A then subjects should express a price of 0. An alternative design would present a pair of lotteries only once while allowing subjects to state a negative price for lottery A. However, this introduces a concept – negative prices – that is difficult for most subjects to understand. This design is also better than soliciting certainty equivalent for lotteries, which is subject to reversal of preferences (Lichtenstein and Slovic, 1971). Agents were indeed ***not*** asked to convert lotteries into a certainty equivalent and then compare lotteries based on that certainty equivalent. They were asked to perform the arguably simpler and more intuitive task of comparing lotteries directly, with lottery A changing as they changed their willingness to pay to obtain it.

One choice situation from social lotteries and one choice situation from individual lotteries was drawn at random at the end of the experiment for the determination of payoffs. Roles in the assignment of payoffs (decision-maker or recipient) were then determined at random. While a subject did not know what role he would play in the final outcome (decision-maker or recipient), he knew that with probability half his decision would determine the outcome. Subjects were expected to choose their preferred lottery by taking into account its consequences for themselves as decision maker even though there was only probability one half they were decision makers. Indeed, with the complement probability, they were recipients, in which case their decision had no influence on the outcome. Individuals were therefore not put in the "original position" of Rawls (1971) with its "veil of ignorance" whereby decisions are the result of a *collective* choice that is made knowing neither one's social position nor the probability with which it obtains. Here, decision was individual and subjects knew with what probability they took one or the other role. This design does not either correspond to experiments whereby subjects are asked to choose among lotteries on behalf of someone else – for example future generations as in Carlsson et al (2005) – or where groups rather than individuals are asked to choose among lotteries where all receive the same outcome (Shupp and Williams, 2008; Masclet et al, 2009).

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[1] Thanks to Alena Otto for making this point.

[2] Asking first which lottery they prefer and then asking them how much they are ready to pay for it does not work as subjects are then better off lying about their preference and then stating they are ready to pay only $p = 0$ for their disfavored lottery so as to be sure to obtain their preferred one. Thanks to research assistant David Füßler for the observation! Similarly, it is not advisable to present price fields under both lotteries A and lottery B with the subject inputting his willingness to pay to obtain A rather than B in the field under lottery A and vice-versa. Indeed, the subject is then better off paying a small price for his least preferred lottery, which then occurs with low probability. Thanks to research assistant Albrecht Noll for pointing this out!

As mentioned before, a price for lottery A was assigned at random, unknown to subjects, and took a value between 0 and 15. A upper limit of 15 ECU for the price p was chosen to correspond to the maximum price a buyer was expected to be willing to pay to obtain lottery A rather than lottery B, as recommended in Bohm et al (1997). As *per* the Becker-DeGroot-Marschak mechanism (Becker et al, 1964), decision-makers received the first payoff in lottery A if their willingness to pay to receive A rather than B exceeded that random price, and paid the random price in that case. The recipient received the second payoff in that case but did not pay anything. If the payoffs of the lottery obtained were subject to uncertainty, then the realization of payoffs was drawn as per the announced probabilities.

Subjects might not understand correctly the Becker-DeGroot-Marschak incentive mechanism, especially how a random number is taken off their payoff, not the price selected, a problem mentioned p. 56 in Harrison and Rutström (2008). The instructions therefore explained clearly why it was in their best interest to express their choice truthfully (see appendix 5) and control questions checked that they understood what price they paid for the lottery (see appendix 6).

Social lotteries that were compared in the experiment, along with their label and description, are shown in table 1:

Table 1 List of social lotteries

	Label	Description	Payoffs 1 me	you	Probability	Payoffs 2 me	you	Probability
Social lotteries	*a*	Own risk only	15	45	50%	75	45	50%
	b	Positively correlated risk	15	15	50%	75	75	50%
	c	Other's risk only	45	15	50%	45	75	50%
	d	Negatively correlated risk	15	75	50%	75	15	50%
Safe social outcomes	*e*	Fair safe outcome	45	45	100%			
	f	Unfavorable safe outcome	45	60	100%			
	g	Favorable safe outcome	60	45	100%			

Subjects were presented with all possible comparisons between lotteries *a* to *g*, except those involving comparisons between safe outcomes for the decision maker. The payoffs were randomized with a random variable taken from a uniform distribution between -5 and 5 which was added to payoffs in table 1, independently across each comparison. This was done to prevent subjects losing interest in the exercise and not thinking about each choice independently of the other choices – for example, having calculated the expected value of the standard lottery (45 ECU), subjects may have then applied the decision they reached using that value to all lotteries, irrespective of the payoff of the other, so as to simplify their decision making. With randomized payoffs, that type of simplified decision making procedure is more difficult to apply so that subjects pay more attention to each comparison on its own term. Options with perfect equality in payoffs between decider and receiver were also avoided as those can serve as a focal point. The order in which lotteries were presented to subjects was also randomized.

A graphical representation of all comparisons involving social lotteries is shown in figure 3, along with their label. Pairs 1 to 3 involve comparisons with a fair safe social outcome and are repeated as pair 10 to 12 *vs.* an unfavorable safe social outcome and pair 13 to 15 *vs.* a favorable safe social outcome. Pair 4 to 9 involve comparisons between social lotteries.

Subjects were also shown pairs involving safe social outcomes as shown in table 5. Those were designed on the model of Murphy et al (2011) to evaluate the social value orientation of our subjects in the absence of risk. Individual lotteries that were shown in a second part of the experiment (table 4) were obtained by removing the outcome for the other in pairs *1, 4, 7, 10, 13* and *15* of figure 3.

There were therefore three sets of comparisons, those showing safe social outcomes (4 pairs), those involving individual lotteries (6 pairs), and those involving social lotteries (15 pairs).

While some comparisons subjects were asked to make can appear rather complex, subjects were expected to take account of the expected outcomes from their choice, the risk borne by themselves, the level of inequality resulting from the draw of outcomes as well as whether a lottery is fair (each have an equal chance to obtain given outcomes) or unfair.

3 Related literature and hypotheses

A first part of the literature review discusses how standard social utility functions can be adapted to a risky setting, as well as their implications in terms of preferences among social lotteries. A second part discusses experimental findings and concludes with considerations on the debate regarding *ex-ante vs. ex-post* assessments of social situations.

3.1 Experimental and theoretical work on social preferences

Most experimental and theoretical work on social preferences does not deal with uncertainty. However, utility functions that individuals are deemed to maximize under certainty can be adapted to a context with uncertainty by considering a utility functions $u(\cdot)$. Utilities $(u(m), u(y))$, with m **m**y payoff and y **y**our payoff, are then transformed into an index

$$s(u(m), u(y)) \tag{1}$$

that takes account of social preferences. The workhorse in this paper is the model in Fehr and Schmidt (1999) (hereafter "F&S"), whereby individuals care about the difference in payoff between themselves and others. F&S postulate that individuals feel envy if their payoff is lower than others but also dislike having more than others. The index $s(u(m), u(y))$ is then of the form:

$$s(m, y) = u(m) - \alpha \max(u(y) - u(m), 0) - \beta \max(u(m) - u(y), 0) \tag{2}$$

with $\alpha > 0$ and $\beta > 0$. This is a flexible function that can accommodate a range of different social preferences beyond those postulated in F&S, as done for example in Charness and Rabin (2002). Rewriting the F&S utility function as

$$\begin{aligned} s(m, y) &= (1 + \alpha)u(m) - \alpha u(y) \text{ if } y > m \\ s(m, y) &= (1 - \beta)u(m) + \beta u(y) \text{ if } m > y \end{aligned} \tag{3}$$

helps interpret parameters α and β as weights placed on the outcome of others depending on whether one is ahead or behind them in terms of utility.

Table (2) shows how different combinations in the value of the parameters α and β can be reconciled with a variety of different social value orientations. $\alpha < 0$ and $\beta > 0$ results in subjects enjoying a rise in aggregate payoffs whether this rise goes to them or to someone else. $\alpha = 0$ and $\beta < 0$ corresponds to pride without envy, *i.e.* enjoying having ever more than the other but feeling no envy if the other has more. $\alpha > 0$ and$\beta < 0$ is rivalry, whereby one not only enjoys having more than other but suffers from having less.

Table 2 Different combinations in Fehr and Schmidt (1999)

	$\alpha < 0$	$\alpha \approx 0$	$\alpha > 0$
$\beta < 0$	preference for inequality	downward envy, pride	competition, rivalry, malevolence
$\beta \approx 0$	self-denial	self-interest, egoism	spite, envy, behindness aversion
$\beta > 0$	altruism, efficiency concerns, social welfare orientation	compassion, charity	inequality aversion, egalitarianism

In a two-person setting, the model in Bolton and Ockenfels (2000) is a special case of Fehr and Schmidt (1999). Taking equation (2) of Bolton and Ockenfels (2000) and rewriting it as $s(m,y) = u(m) - \beta(\frac{u(m)-u(y)}{u(m)+u(y)})^2$ shows it is equivalent to constraining $\alpha = \beta$ in Fehr and Schmidt (1999). Equation 2 then becomes

$$s(m,y) = u(m) - \alpha|u(y) - u(m)| \tag{4}$$

Cappelen et al (2007) consider a further extension whereby $s(m,y) = u(m) - \beta(\frac{(1-f)u(m)-fu(y)}{u(m)+u(y)})^2$, with f denoting the "fairness ideal". f is driven by a sense of entitlement which was not manipulated in this experiment so this extension is not relevant here. Extensions that take account of intentions such as Charness and Rabin (2002) are also not relevant to the present setting since there was no way for individuals to observe the behavior of their pair. However, their finding whereby individuals tend to have quasi-maximin preferences is relevant: subjects care most about others when others are behind and are otherwise mainly driven by efficiency concerns. In the notations of F&S, subjects exhibit social preferences such that $\beta > 0$ and $\alpha \approx 0$. Engelmann and Strobel (2004) also find that "a combination of efficiency concerns, maximin preferences, and selfishness can rationalize most of (their) data". However, as pointed out in Engelmann (2012), significant issues with identification appear when attempting to combine too many different types of social concerns.

Another special form of the F&S utility functions allows only either altruism or spite to motivate decisions. Models of altruism include Andreoni and Miller (2002) who identify individuals with selfish and egalitarian preferences as well as individuals who seek to maximize total payoff. Their approach is similar to Levine (1998) where altruism is a function of one's own altruism and the expected altruism of others. The egocentric other-regarding preferences in Cox and Sadiraj (2007) and Cox et al (2007) are readily translatable to an environment with uncertainty. They take the form:

$$s(m,y) = u(m) + \theta u(y) \tag{5}$$

with θ the weight that is put on the utility of others. This corresponds to a F&S model with the constraint that $-\alpha = \beta$.

We wish to measure the extent to which preferences under risk can be explained with standard social utility functions as introduced above in order to define what aspects of social situations are specific to risky settings. Consider the two graphs in figure 2:

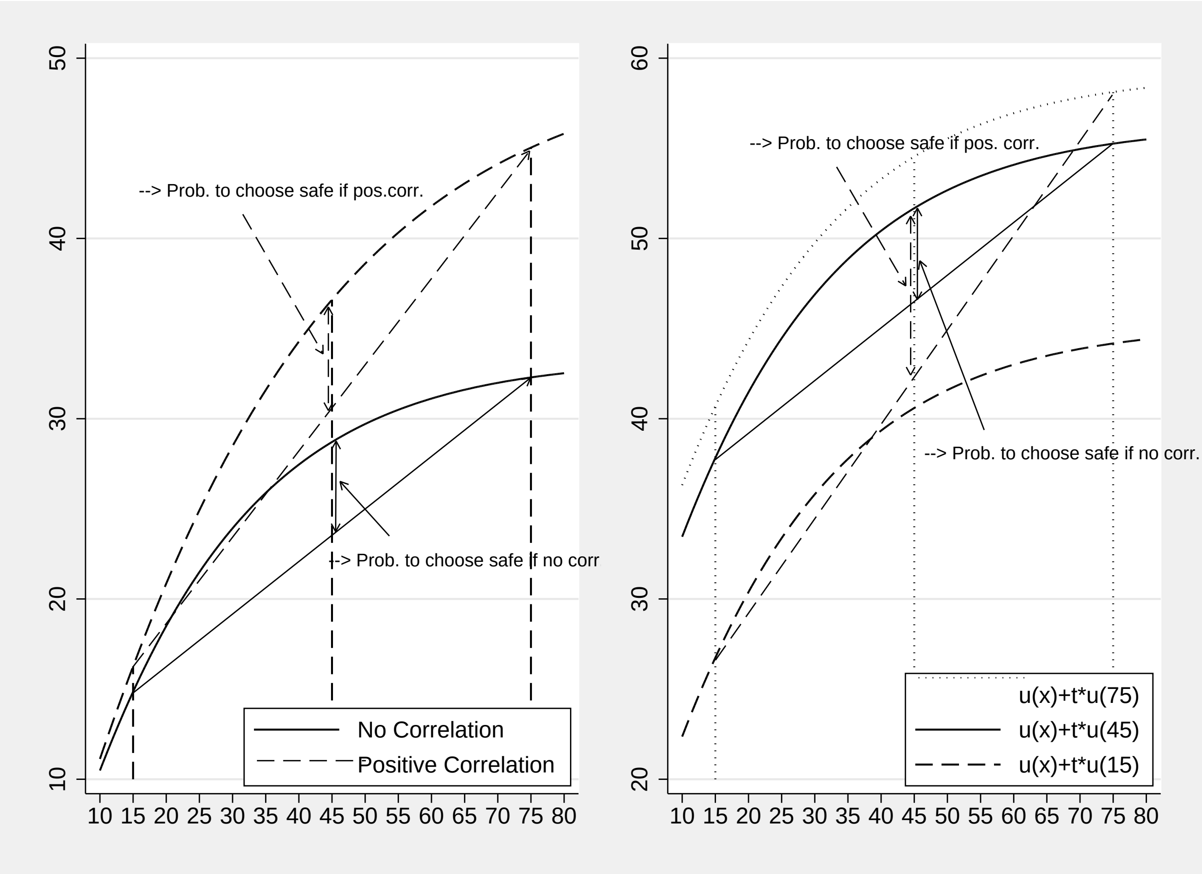

Fig. 2 Two alternative interpretations of a dislike for positively correlated lotteries.

In the graph to the left, changes in the characteristics of a social lottery translate in changes in the curvature of the utility function. Those translate in changes in the difference in utility between a safe payoff of 45 ECU and a social lottery that promises a payoff of 15 with probability half and a payoff of 75 with probability half. If preferences are affected by randomness, due for example to mistakes in assessing the expected utility of a lottery, then the larger that difference, the higher the probability with which the safe outcome is chosen. If parameters of the utility function for positively correlated social outcomes differ from those for uncorrelated social lotteries, then one obtains differences in the difference between the utility of a safe payoff and a lottery in the two settings. This determines differences in the probability to choose the safe social outcome in both cases. In the graph to the right, social utility changes depending on how the outcome of the other varies. The utility of a (m, y) outcome is $u(m) + \theta u(y)$ with θ an altruism parameter. There are three utility functions, one if the other obtains 15 ECU, the next if he obtains 45 ECU, the last if he obtains 75 ECU. The expected utility of an uncorrelated social lottery $L = ((15, 45), \frac{1}{2}; (75, 45), \frac{1}{2})$ is compared with that of a positively correlated lottery $L = ((15, 15), \frac{1}{2}; (75, 75), \frac{1}{2})$. The later one is lower, meaning it is less likely to be chosen *vs.* the safe social outcome of $(45, 45)$. Note how the risk parameters, *i.e.* the curvature of the utility function, remains constant. The comparison between the two graphs shows that what appears to be responses in terms of higher or lower risk aversion depending on lottery characteristics may be driven by considerations of the other's payoff, keeping risk aversion constant. We want to see if what has been observed so far in terms of like or dislike for lotteries depending on their social characteristics can be explained by either altruism or inequality aversion, or a combination of the two.

As shown in table 3, the ranking of the social lotteries of table 1 differs depending on the type of social utilities agents exhibit. If agents are inequality averse, they prefer positively correlated lotteries to those without correlation in outcomes, which themselves are preferred to negatively correlated lotteries. If they are altruistic, they dislike negatively correlated lotteries as much as positively correlated lotteries and prefer uncorrelated lotteries as they are then the only ones to bear risk.

3.2 A small experimental literature dealing with social concerns under uncertainty

We present below the state of experimental work on the topic of preferences among social lotteries. A large literature deals with modified ultimatum games, whereby recipients are readier to accept a low offer when there is uncertainty over the size of the pie than is consistent with how they behave when the size of the pie is known (Mitzkewitz and Nagel, 1993; Straub and Murnighan, 1995; Rapoport and Sundali, 1996; Rapoport et al, 1996; Croson, 1996; Pillutla and Murnighan, 1996; Güth and Huck, 1997; Huck, 1999). This led us to consider whether uncertainty makes fairness considerations less prevalent, as put forward in Güth et al (2008). Among the works that deal explicitly with this topic, the most closely related to this paper is Bolton and Ockenfels (2010), hereafter "B&O", which implements a design that is similar to the one in this paper as they offer menus of lottery pairs that are designed to cover a range of possible situations in terms of risk for the decision maker and risk for the recipient.

3.2.1 Response to a social context

B&O determine that there is less risk taking when the risk also affects the payoff of the recipient, unless the alternative safe outcome is weighted against the decision-maker. Confirming this, Bolton et al (2012) find that social context makes risk taking more conservative and homogeneous. B&O explain their findings with a responsibility-alleviation effect, also, blame avoidance, *i.e.* a reluctance to take risks on behalf of others (Charness, 2000; Charness and Jackson, 2009). However, Brennan et al (2008) as well as Harrison et al (2013) find that behavior is only influenced by the riskiness in one's own payoffs and not by the riskiness of the payoffs of others. Rohde and Rohde (2011) confirm that "risk attitudes are not so much affected by the risks others face". Güth et al (2008) moderate this finding as their subjects display other-regarding preferences when the risk is borne by others and not themselves, though not otherwise. Güth et al (2008) think this is due to a crowding-out effect "in the sense that own risky (...) problems tend to crowd out concerns toward others' problems, possibly due to some cognitive and emotional overload." We will compare social preferences under certainty with those under uncertainty to test whether social concerns are indeed weakened in risky settings, or whether, as Bradler (2009) suggests, they bear little relation with each other.

Other work using hypothetical scenarios solves the crowding-out problem by separating the risk and inequality aspects of income distribution. Carlsson et al (2005) present subjects with hypothetical distribution of incomes in a society. They measure risk aversion by keeping distribution of income constant and making outcomes more or less variable, and measure inequality aversion by keeping outcome constant and varying inequality. Similar work using hypothetical scenarios includes Kroll and Davidovitz (2003) and Abásolo and Tsuchiya (2013). This work shows that people are sensitive both to inequality and to risk in social lotteries even though they may not be able to take account of both at the same time.

3.2.2 Response to unfair safe outcomes and to inequality in expectation

B&O find that risk taking depend on the degree of inequality in the safe alternative. They find that there is more risk taking when the safe alternative is unfavorable to the decision maker. Taking a risk gives a way for those with lower payoffs in the safe alternative to challenge the status-quo (see note 2 in B&O). B&O also find that there is more risk taking when the alternative is a favorable safe outcome, meaning perhaps that favored individuals wish to give a chance to others rather than safeguard their advantage. Going against this result, Linde and Sonnemans (2012) find that agents are more risk averse if the lottery does not allow them to obtain more than a referent than if the lottery guarantees them as much as the referent.

3.2.3 Response to correlation in outcomes

Table 3 shows that the effect of correlation in outcomes depends on whether agents are altruistic or inequality-averse in a risky social setting. Another possibility is that socially minded agents consider the sum of their outcome and that of the other rather than their own expected utility and that of the other. Such socially minded agents consider negatively correlated outcomes as preferable to positively correlated lotteries as they induce less risk at the social level since the sum of payoffs is less variable. Positively correlated lotteries on the other hand are disliked since a bad outcome means a bad outcome for both.

B&O find that whether payoffs resulting from risky choices are positively or negatively correlated does not influence risk taking, a finding that goes against inequality aversion and altruism. However, Rohde and Rohde (2011) find that subjects "prefer risks to be independent across members of the population rather than correlated". Krawczyk and Lec (2010) also find that correlation in outcomes matters since in their experiment agents are less altruistic in a dictator game when outcomes from the draw of prizes are negatively correlated rather than independent.

3.2.4 Procedural aspects of risk taking in a social context

Many of the works above mention the possibility that agents respond to a mix of procedural and consequentialist motives when it comes to choice under uncertainty. Krawczyk and Lec (2010) find that neither motives can fully explain subjects' choices. Brock et al (2013) also find that subjects' choices cannot be explained based only on *ex-ante* or only *ex-post* social considerations. B&O postulate that unequal outcomes resulting from a fair process are more acceptable than if they are imposed *ex-ante*.

What criteria to consider when faced with issues of fairness under uncertainty regarding final allocations has been the subject of extended normative theoretical work. Rawls (1971) suggests maximizing the minimum of the payoffs received by each party. This solution is reasonable under a veil of ignorance whereby one's position in society is uncertain and one does not know the probability of one or the other outcome happening. That principle leads however to improbable decisions when, as in this experiment, the probability of outcomes is specified. Indeed, the principle implies that any safe alternative is preferable to any lottery that risks offering less than the safe alternative for one of the parties, even if that is with very low probability. This principle is however useful in the context of a debate over fair social allocations if the outcomes of lotteries can be changed *ex-post* through redistribution — see Cappelen et al (2010) for an experiment allowing such redistribution. In our context with no *ex-post* redistribution, such a principle probably cannot properly describe the decisions subjects take.

Unlike Rawls, Harsanyi (1955) recommends utility maximization as a guide to choice in social situations. However, the issue then moves to what utility individuals maximize when making decisions that involve considerations of social welfare under uncertainty. Indeed, individuals who are very averse to inequality would make decisions that are close to those recommended by Rawls. In a two person society, for example, they accept the introduction of a difference in welfare among subjects only if it is efficient and the added efficiency goes towards improving the payoff of the least well-off.

In this experiment, subjects are not asked to make normative decisions. Indeed, they are not asked to justify their choices beyond simply basing them on their own preferences. However, they are expected to consider criteria of justice, such as that of fair opportunity, in their utility, or to value social welfare or equality. Their individual choices may therefore not differ to a great extent from choices achieved after deliberation with others, under a veil of ignorance, or as an impartial observer.

An issue then comes up if this is so, as shown most clearly in Fudenberg and Levine (2012): *ex-ante* and *ex-post* fairness cannot be reconciled as guides for decision since *ex-ante* fair lotteries may be very unfair *ex-post* while *ex-post* fair situations may be the result of unfair procedures. This leads Fudenberg and Levine (2012) to offer a mix of *ex-ante* and *ex-post* utility as a criterion for choice. Preferences can then be represented using the utility function:

$$S(L) = \lambda E(s(m, y)) + (1 - \lambda)s(E(m), E(y)) \quad (6)$$

The parameter λ measures the extent to which concern for *ex-ante* utility, which considers only whether a lottery is fair or not, matters relative to *ex-post* utility, *i.e.* the utility of the outcomes of the lottery. Parameter λ in equation 6 measures the importance of procedural *vs.* consequentialist thinking. We will test the extent to which agents decisions reflect a consideration of the utility of expected outcomes – assess expected payoff from the lottery and whether that is more or less than the other's expected payoff – rather than the utility of expected outcomes – weighing *ex-post* utilities by their probability.

3.3 Hypotheses

The literature study leads to the following list of hypotheses:

1. Agents are more risk averse in a social context (Bolton and Ockenfels, 2010; Bolton et al, 2012 *vs.* Brennan et al, 2008; Güth et al, 2008; Harrison et al, 2013; Rohde and Rohde, 2011). Risk taking in individual lotteries will be compared with risk taking in the equivalent social lotteries.
2. Agents are less risk averse if the alternative to risk is a situation with unequal payoffs (Bolton and Ockenfels, 2010 *vs.* Linde and Sonnemans, 2012). In other words, agents dislike safe outcomes that give them less than the other as well as safe outcomes that give them more than the other. Risk taking when the safe outcome is advantageous or detrimental to the decision-maker will be compared to risk taking when the safe outcome guarantees equality.
3. Agents are indifferent to whether their outcomes are negatively correlated or positively correlated with the other (Bolton and Ockenfels, 2010 *vs.* Krawczyk and Lec, 2010; Rohde and Rohde, 2011). Risk taking when outcomes in a lottery are positively or negatively correlated will be compared to risk taking when outcomes are not correlated.
4. Agents are sensitive to social concerns under risk (Bolton and Ockenfels, 2010; Bradler, 2009 *vs.* Brennan et al, 2008; Güth et al, 2008; Rohde and Rohde, 2011) but behavior in social lotteries can only partly be explained by an analysis of their outcomes (Brock et al, 2013; Krawczyk and Lec, 2010). This hypothesis will be tested by estimating the sensitivity to comparisons of social outcomes when faced with social lotteries, and comparing predictions from such a model to what is observed in the data.
5. Agents care less about inequality in risky settings than when considering certain outcomes (Güth et al, 2008). Fairness parameters when choosing among safe social outcomes will be compared with fairness parameters when choosing among social lotteries.
6. A weight is attached to procedural fairness, that is, agents value both *ex-ante* and *ex-post* fairness in outcomes (Brock et al, 2013; Cappelen et al, 2010; Krawczyk and Lec, 2010). Parameter λ in equation 6 will be estimated to see if subjects favor fair but risky lotteries *vs.* safe but unfair outcomes.

4 Conduct of the experiment

The experiment was carried out in the laboratory of the Max Planck Institute of Economics in Jena, Germany, on the 24^{th} and 25^{th} of January 2013. A total of 96 subjects took part in 4 experimental sessions. Recruitment was carried out using ORSEE (Greiner, 2004) on the Jena subject pool, which is mainly composed of undergraduate students at the Friedrich Schiller University. The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). Upon arrival in the lab, subjects were given some time to read printed out instructions (Appendix 5). A recording of the instructions was then played to ensure common knowledge, *i.e.* so that all participants knew that all others had the same instructions as themselves. Subjects then answered some control questions and were given the opportunity to ask questions individually. The experiment began only once all subjects had answered all control questions correctly. Subjects then went through the main part of the experiment as explained in Section 2 after which they were given instructions on-screen for the second part of the experiment which deals with risk aversion in an individual setting. Once finished with both tasks, payoff was determined and communicated to the subjects. The Experimental Currency Unit ("ECU") was converted into euros at the rate of 1ECU=€0.20 for the main part of the experiment (social lotteries) and 1ECU=€0.10 for the second part of the experiment (individual lotteries). €2.50 was also paid for showing up on time.[3] Subjects were then asked to answer a short questionnaire including demographic controls (age, gender, field of study) as well as feedback on their understanding of the experiment and ways in which they reached their decisions. Subjects were then individually called to receive their payoff in cash. Subjects obtained €16.1 on average, ranging from €6 to €25.8, for an experiment that lasted about 1 hour and 15 minutes on average.

5 Analysis of the data

5.1 Descriptive analysis of the data

With 96 subjects making choices among 25 lottery pairs, with each lottery pair presented twice, 4800 observations were obtained. Let us consider all pairs that involved a comparison between a safe social outcome and a social lottery. Subjects appear to have responded adequately to differences in expected value between lotteries, choosing the safe social outcome in 93% of the cases when the difference in favor of the safe social outcome was more than 5 ECU, compared to 77% of the case when the difference was less than 5 ECU. When the difference in expected value between lotteries was less than 5 ECU, subjects chose the safe social outcome in 77% of the case, compared with 76% of the cases when considering individual lotteries. This percentage was therefore not responsive to whether the payoffs in the lottery were expressed alongside the payoffs of another (social lotteries) or on their own (individual lotteries). However, this percentage was responsive to whether the outcomes of the social lottery were positively, negatively or not correlated with those of the other. If the social lottery imposed risk on themselves but not on the other, meaning there was no correlation in outcomes, then the subjects were quite likely to take risks, choosing the safe social outcome in 72% of the cases only. When outcomes were negatively correlated then the subjects chose the safe social outcome in 78% of the cases, and if outcomes were positively correlated, then they chose it in 81% of the cases. Subjects may thus be less sensitive to risk in a social environment than in an individual environment if the risk involves only themselves but more sensitive to risk if the risk also involves others. As evoked previously, subjects chose the safe social outcome in 92% of the cases when that outcome provided them with more than 5 ECU than the social lottery, which also corresponds to cases where the safe social outcome provided them with an advantage *vs.* the other. It is not possible to know if that is more or less than if that safe social outcome did not provide them with an advantage since there are no lottery pairs where both the decision maker and the other can obtain equal and higher expected payoffs under the safe alternative than in the social lottery. In the case where the safe social outcome imposed lower payoffs for the subject than for the other, subjects chose the safe social outcome in 77% of the cases, which is the same as when it guarantees them a payoff equal to the other. Subjects did not therefore appear to be responsive to inequality in payoffs against them.

5.2 Econometric estimation

The preliminary analysis above gives indications, such that for example subjects may be less risk averse in some social contexts and may wish to avoid imposing risk on the other by avoiding positively and negatively correlated social lotteries more often than they avoid uncorrelated social lotteries. However, response in terms of risk taking when the safe alternative provides them with an advantage is mainly driven by the difference in

[3] Entry to the laboratory was by order of arrival. Subjects who were invited and arrived on time but were in excess of the required number were turned away and paid this fee. We never invited more than four subjects in excess of the required number. Subjects who arrive late by more than 5 minutes were turned away and not paid anything.

payoff *vs.* the social lottery. In order to know whether their choice in that case is influenced by their relative position, we need to have an idea of the characteristics of their utility function. Furthermore, results above could be driven by the randomization that was applied to payoffs as explained in the description of the experiment (section 2). Individual aspects of choice are also not controlled for, such as whether some subjects choose in a more random way than others. The strength of preferences for one or the other lottery, as expressed through the willingness to pay for the preferred lottery, is also not taken into account. Finally, it is not possible to determine the extent to which preferences under risk are driven by motivations modeled through standard social utility functions, and it also not possible to see whether choice is responsive to inequality in terms of expected payoffs between lotteries. This is why a method to estimate the parameters of the utility functions of individuals is introduced below. Those parameters are shown to be responsive to various characteristics of the social lotteries under consideration.

Parameters of $s(m,y)$ in equation (1) are therefore estimated econometrically. Estimation is performed along procedures exposed in Hey and Orme (1994) with the help for programming of Harrison (2008).

A first likelihood function takes account only of elicited pairwise preferences between lotteries A and B and is of the form:

$$LL(\theta|Y_i, C_i) = C_{i,A}\ln(f(U_A - U_B)) + (1 - C_{i,A})\ln(f(U_B - U_A)) \tag{7}$$

θ is a vector of parameters to be estimated, C_i are the decisions of individuals (which lottery they chose at what price) and Y_i is a vector of individual and lottery characteristics. $C_{i,A}$ is equal to 1 if the price expressed by subject i for lottery A is strictly positive, equal to 0 if the price expressed for B is equal to 0 and lottery B is preferred when the order between A and B is reversed, and equal to 1/2 when the expressed price is also equal to 0 when the order of lotteries is reversed. Link function f is either the cumulative standard normal distribution (probit specification) or the inverse of the logit function (logit specification). A specification as in Holt and Laury (2002) and Andersen et al (2008) whereby $LL(\theta|Y_i, C_i) = C_{i,A}\ln\frac{U_A}{U_A+U_B} + (1-C_{i,A})\ln\frac{U_B}{U_A+U_B}$ was also considered but performed very poorly in maximizing log-likelihood compared to the probit and logit specifications.

In a first step, U_L is assumed to be of the expected utility form, that is, the utility of lottery $L = (a, \frac{1}{2}; b, \frac{1}{2})$ is $U_L = \frac{1}{2}u(a) + \frac{1}{2}u(b)$. $u(\cdot)$ is either the power function $u(x) = x^{1-r}/1-r$, which displays constant relative risk aversion or the expo-power function $u(x) = 1-e^{-ax^{1-r}}/a$ which is flexible enough to accommodate either increasing, decreasing or constant relative risk aversion (Saha, 1993).[4,5]

A second likelihood function takes account of the expressions of indifference between lottery A and lottery B and takes the form:

$$LL(\theta|Y_i, C_i) = \sum_{p=0}^{15}[C_{i,A-p}\ln(f(U_{A-p} - U_B)) + (1 - C_{i,A-p})\ln(f(U_B - U_{A-p}))] \tag{8}$$

Lottery $A - p$ is the lottery obtained from lottery A by reducing own payoff by price p. The sum is over p taking value from 0 and 15, as was allowed under the price elicitation mechanism. This likelihood function is based on the consideration, given the expressed willingness to pay to obtain lottery A, of what the decision of the subject would have been for any price between 0 and 15 for lottery A. For example, if the subject expressed a willingness to pay 7 ECU to obtain lottery A, then he chooses lottery A for any price less than 7 ($C_{i,A-6} = 1$ for example), expresses indifference at price 7 ($C_{i,A-7} = 1/2$) and chooses lottery B for prices higher than 7 ($C_{i,A-p} = 0$). In the special case where a willingness to pay of 15 was expressed then we assumed that he chose lottery A at that price. This extended log-likelihood does not correspond to actual choices made by the subjects. However, many subjects tried a range of prices before taking their decisions, at least in the first few

[4] Utility for negative values of x, which can occur in this context after transformation of payoffs via $s(\cdot)$, is $u(x) = -\frac{|x|^{1-r}}{1-r}$ for the power function, and $u(x) = -(1-e^{-a|x|^{1-r}})/a$ for the expo-power function

[5] The exponential function $u(x) = 1 - e^{-ax}$, which exhibits constant absolute risk aversion, is not be considered as tests using the expo-power function reject the hypothesis of constant absolute risk aversion.

periods. They may also have considered several prices in their head, rejecting some, accepting others, before taking their decision. We therefore infer from their expression of a willingness to pay what they would have done for prices higher or lower than that price.

Ex-post vs. ex-ante social concerns will be tested as *per* equation (6), so utility for lottery $L = (a, \frac{1}{2}; b, \frac{1}{2})$ takes the form $U_L = \lambda(\frac{1}{2}u(a) + \frac{1}{2}u(b)) + (1-\lambda)u(\frac{1}{2}a + \frac{1}{2}b)$.

In all the results shown, we report cluster-robust standard errors, with each clusters defined as an individual. The robustness of the estimates of standard errors was also tested by performing bootstrap estimation. The z-statistic (coefficient / standard error) was then sometime lower than reported in the tables, but reported significance levels were preserved.

6 Test of the hypotheses

Hypothesis 1 is tested by running regressions to estimate whether the coefficient of risk aversion depends on whether a lottery determines only one's own payoffs (individual) or also determines the other's payoff (social). Hypothesis 2 is tested by determining whether the coefficient of risk aversion depends on whether the comparison includes a lottery that is unfair in favor of the decision maker or against him. The parameters are allowed to vary depending on whether the safe outcome guarantees equality in terms of expected payoffs for both, disadvantage for the agent, or advantage for the agent. Hypothesis 3 is tested by considering whether the comparison includes a lottery where outcomes are positively or negatively correlated with those of the other.[6][7]

The coefficients of risk aversion are those of a power and of an expo-power utility specification and we focus on the results for the logit specification as it proves to always obtain lower likelihood than the probit specification while parameter estimates are very similar. The first two columns in Table 6 take account only of whether lottery A was preferred to lottery B as in equation (7). The next two columns take account of the price at which the subject expressed indifference between A and B as in equation (8). As can be seen, estimates are very similar when using one set of decisions or the other. Table 7 shows the results in the probit specification.

(Insert table 6 here)

Estimates were rather accurate. Tjur's R-square or "coefficient of determination" (Tjur, 2009) measures the difference between the predicted choices when C_A is 0 and when C_A is 1. In the expo-power specification and considering only pairwise choices among social lotteries, the average predicted C_A in social lotteries is 0.11 when C_A is 0, and 0.73 when C_A is 1, resulting in a Tjur's R-square of 63%. In individual lotteries, Tjur's R-square is even higher at 75%. Performance is not as good when considering the extended set of choices of equation (8), as Tjur's R-square is then 51% for social lotteries and 57% in individual lotteries. This is because the extended set of choices takes account of situations where the individuals are close to indifference between lottery A and lottery B, comparing for example the utility of lottery A minus price 6 to the utility of lottery B when willingness to pay for lottery A is 8.

6.1 Are agents more risk averse in a social context?

In order to compare decisions in a social context with those in an individual context, estimates of the utility parameters are used to compute the probability with which a safe social outcome of $(45, 45)$ is chosen when put against baseline social lottery $L = ((15, 45), \frac{1}{2}; (75, 45); \frac{1}{2})$ which involves risk on the decision maker only.

[6] Note that because payoffs were randomized around their origin compared to the initial "model" lotteries, there is no lottery that does not exhibit correlation in payoff. The measure of correlation is therefore based on the model lotteries, meaning that all lotteries derived from *a* or *c* are deemed to exhibit zero correlation between one's own and the other's payoff.

[7] Note that in each comparison, either only one lottery positively or negatively correlated, or, in the case of lottery pair 5 in figure 3, one lottery was negatively correlated and the other positively correlated. There were no lottery pairs that involved two negatively or two positively correlated lotteries.

This is compared with the probability with which a safe individual outcome of 45 is chosen when put against an individual risk lottery $L = (15, \frac{1}{2}; 75; \frac{1}{2})$.

The probability to choose the safe option is

$$f(u(45) - (\frac{1}{2}u(15) - \frac{1}{2}u(75))) \tag{9}$$

with $f(\cdot)$ either the inverse of the logit function (logit specification) or the cumulative standard normal distribution (probit specification). The risk parameters to be applied in the social setting and in the individual setting are given in tables 6 (logit specification) and 7 (probit specification).

Confirming hypothesis 1, individuals appear to be more risk averse in a social context, whereby they choose the safe social outcome $(45, 45)$ more often than in an equivalent individual lottery comparison where the safe payoff is 45. This effect is not very robust however, appearing only in the power specification of utility. This tendency seems to go against the hypothesis that agents are altruistic in a risky social setting. Indeed, if that were the case, and as long as both payoffs are not equal under all contingencies, then the impact of a low outcome for oneself is at least partially compensated by utility derived from the payoff that goes to the other. Total utility derived by an altruist in a social setting is therefore more stable than utility derived from his own outcome, so that an altruist perceives less risk from a lottery in a social setting than from the same lottery in an individual setting. This is all a matter of what referent a subject considers when choosing among individual lotteries. He may still think as much about the other's outcome, which is not correlated with his, in that setting. This would explain why the decisions do not differ significantly in both settings in some specifications.

6.2 Does taste for the social lottery depend on the level of inequality present in the safe alternative?

In order to determine whether advantage in the safe option influences the probability with which the decision-maker chooses the risky option, the probability with which advantageous social outcome $(60, 45)$ is chosen *vs.* the standard social lottery $L = ((15, 45), \frac{1}{2}; (75, 45); \frac{1}{2})$ is compared with the probability with which social outcome $(60, 60)$ is chosen *vs.* that same standard social lottery L. The probability to choose the safe option is

$$f(u(60) - (\frac{1}{2}u(15) - \frac{1}{2}u(75))) \tag{10}$$

with $f(\cdot)$ either the cumulative standard normal distribution (probit specification) or the inverse of the logit function (logit specification). The risk parameters to be applied to the utility comparison between the advantageous safe outcome and the lottery is different from the one to be applied to the comparison between the fair safe outcome and the lottery, as shown for example in the first column of table 6 where the dummy associated with a situation of advantage is positive and significantly different from 0.

Table 6 shows the probability to choose $(60, 60)$ *vs.* lottery L, and compares it with the probability to choose $(60, 45)$ *vs.* lottery L. Similarly, the probability to choose $(45, 45)$ *vs.* lottery L is compared with the probability to choose $(45, 60)$ *vs.* lottery L.

Results show that individuals are less risk averse if the alternative to risk is a situation where they are advantaged. They are less likely to choose the safe alternative if it provides them with an advantage, thus confirming hypothesis 2. They are predicted to choose safe social outcome $(60, 60)$ with probability close to one, while they choose safe social outcome $(60, 45)$ with probability between 81 and 88% only. This is higher than the probability with which they choose safe social outcome $(45, 45)$ but lower than if they did not care about inequality in payoffs. This result can be seen to mean that agents dislike obtaining more than others or prefer the other having as much as themselves. This may be a sign of altruism, that is, agents enjoy the other having higher social outcomes, or it may be that they dislike inequality in payoffs when that inequality is to their advantage. This could be out of a feeling that they do not deserve that advantage, or it may be they prefer fair procedures, so they prefer a fair but risky social lottery to an unfair but safe social outcome.

Agents appear not to be affected in a consistent way by whether the safe alternative imposes on them a disadvantage. Subjects are not consistently shown to be less risk averse if the alternative to risk is a situation where they are disadvantaged – see results in the last columns of table 6 and 7. This also means that agents are probably not altruistic when the other is ahead of themselves. They are indeed not consistently keener to choose a safe alternative which lets the other obtain more than themselves at no direct cost to themselves than a safe alternative that gives both the same low payoff. They do not therefore seem to internalize the benefit that the other gains in terms of expected payoff when they choose a safe social outcome that gives more to the other than he gets from the lottery in expected terms. However, since the effect is not reliably different from zero, agents are not necessarily averse to inequality in payoffs *per-se*, *i.e.* they do not punish the other by choosing more often the social lottery.

Those finding can also be interpreted as favoring maximization of social welfare if one is ahead – choose $(60, 60)$ with higher probability than $(60, 45)$ – while not considering social welfare when one is behind. In terms of the F&S social utility function, the results imply $\beta > 0$ and $\alpha \approx 0$ as suggested in Charness and Rabin (2002).

6.3 Does correlation in outcomes affects the level of risk aversion?

We compute the probability with which the safe social outcome is chosen *vs.* positively and negatively correlated lotteries. Sensitivity to correlation in outcomes is what others refer to as sensitivity to a social context while we make the distinction between the effect of a social setting, with no risk on the other, and the effect of risk on the other, which we further decompose as positively and negatively correlated risk.

Unlike predicted in hypothesis 3, agents appear to be slightly more risk averse if outcomes are negatively or positively correlated than if they are not correlated. The effect is of about the same magnitude in both cases. While the effect is small, it is consistent under all logit specifications. Dislike for correlation in outcome is consistent with altruistic preferences, whereby agents prefer the other agent not to bear risk along with themselves. It is however not consistent with either inequality aversion, whereby the positively correlated lottery would be chosen more often than the uncorrelated lottery, and it is also not consistent with preference for safe social outcomes (the sum of both payoffs), whereby the positively correlated lottery would be chosen less often than others as it imposes more social risk. In terms of the F&S social utility function, choices are consistent with $\beta > 0$ and $\alpha < 0$ which is different from the parameter values that are consistent with choice between lotteries that have unequal payoffs (see previous section).

The following part explores whether social preferences under uncertainty can explain the findings so far. We directly assess whether agents dislike inequality or rather are altruistic, and whether those preferences are consistent with preferences against correlated lotteries and against unequal but favorable safe social outcomes.

6.4 Can social preferences explain choice under uncertainty?

This part specifies social preferences in a risky setting so as to test hypothesis 4. We consider both inequality aversion and altruistic motivations as possible drivers in the behavior of the subjects. To the difference of the previous parts, therefore, we first try to determine if agents respond to the standard types of social motivations that were evidenced in the literature on choices between safe allocations of payoffs. Only in a second step do we consider how those preferences affect preferences among different types of lottery comparisons. We then compare results derived from the determination of social preferences with the results from estimating directly preferences depending on, for example, whether a lottery is positively correlated or negatively correlated.

Suppose social preferences can explain preferences among social lotteries. The question is then whether this corresponds to the reality of how subjects make choice. This depends on whether social preferences are a good way to model preferences among different type of social risks, or if rather preferences among different type of social risks depend on factors that cannot be accounted for by social utility functions and therefore need original explanations that are specific to that type of risk. That is, individuals, when making their choices, may consider, for example, first correlation in outcomes with the other, or they may rather consider first inequality in end-outcomes and reason backward based on this. Altruism requires the subjects to put themselves in the place of the other, evaluate his utility, and then give a weight to that criterion when making a choice. It is perhaps more realistic to think that subjects react more immediately to the characteristics of a lottery in a way that may be consistent with altruism but not driven by it. Furthermore, not all individuals make all their choices in the same way: some reason consequentially, others consider only their own payoffs, and social lotteries trigger unmediated emotions in some. The goal here is to find out whether, in the aggregate, individual decisions fit a pattern that is consistent with one or the other types of social motivations, without necessarily implying that those motivations are the drivers of each individual decisions.

We estimate a F&S social utility function, associating parameters α and β to differences in payoff. Results of regressions using the F&S utility functions are shown in table 8. Table 9 shows the results of the equivalent probit regressions.

(Insert table 8 here)

Confirming the first part of hypothesis 4, agents are found to be sensitive to the inequality in payoffs that result from their choices *ex-post*, *i.e.* after realization of a random outcome. $\beta > 0$ and $\alpha < 0$ is consistent with altruism. The hypothesis that $\alpha = -\beta$ is not accepted under the power specification but is accepted under the expo-power specification. A more parsimonious model than the one by F&S could therefore be used, with a utility function of the form shown in equation 5.

Estimates of α and β are used to predict preference among different type of lotteries. Those predictions are then compared with findings of the previous sections.

Social lottery $L = ((15, 45), \frac{1}{2}; (75, 45); \frac{1}{2})$ is first compared with individual lottery $L = (15, \frac{1}{2}; 75; \frac{1}{2})$, with the utility of the first of the form in equation 2 and the utility of the second assuming $(\alpha, \beta) = (0, 0)$. Estimates of α and β imply lower risk aversion in a social setting, which is not consistent with results from table 6.

Our estimates however imply that a safe social outcome of $(60, 45)$ is chosen less often than a safe social outcome of $(60, 60)$, though the effect is much smaller than evidenced in table 6. A β parameter equal to about 0.5 is necessary to explain the observed level of aversion to obtaining a higher but unequal safe social outcome.

Altruistic agents choose a safe social outcome of $(45, 60)$ more often than a safe social outcome of $(45, 45)$, which is not consistent with results in table 6 except for those in the last column. A α parameter equal to about 0.1 is necessary to explain the observed level of aversion to letting the other obtain a higher but unequal safe social outcome.

Results in terms of preference against negatively and positively correlated related lotteries are however consistent both in terms of sign and magnitude with results in table 6.

While social preferences of the type conjectured in hypothesis 4 appear to play a role, those preferences do a rather bad job of explaining choice patterns. Agents indeed appear to be altruistic, which goes against observed higher risk aversion in a social setting and dislike of safe advantageous options for the other. We therefore probably need to go beyond standard social utility functions to explain choices. Section 6.6 shows that *ex-ante* considerations of inequality can help close the gap between observations and theory. Alternative explanations also include the responsibility alleviation effect (Charness and Jackson, 2009). This cannot explain higher risk aversion in a social setting, as defined here as risk taken when the other does not take risks, since indeed, the other is not exposed to risk, but it can explain higher risk aversion when the other takes risk as well. Furthermore, when safe social outcomes are unequal, agents may not feel responsible or guilty when denying the other a safe high payoff by choosing the risky option because there is some potential with the risky option for the other to get a high payoff nonetheless. Finally, high levels of aversion to *ex-ante* inequality is perhaps due to this inequality resulting from a decision of the subject – choosing to obtain the safe but unequal social outcome –, while *ex-post* inequality is perhaps more acceptable as it is the result of random draws. Subjects are therefore perhaps ready to pay more to avoid *ex-ante* inequality than to avoid *ex-post* inequality.

6.5 Do agents care more about payoffs for others in safe or in risky settings?

Choices of subjects among lottery pairs of table 5 are used to estimate $(\alpha_{safe}, \beta_{safe})$. Hypothesis 5 is tested by comparing parameters α and β in social situations involving risk $(\alpha_{risk}, \beta_{risk})$ with those in safe social situations $(\alpha_{safe}, \beta_{safe})$. Tables 10 and 11 show the results.

(Insert table 10 here)

The parameters of the utility function differ between the risky social setting and the safe social setting. Table 10 shows the probability with which a safe social outcome giving both 50 is preferred to a safe social outcome giving both 45 using estimates of the utility parameters in a risky social setting and in a safe social setting. Subjects are more sensitive to differences in payoffs in a safe social setting: they are much more likely to choose the higher payoff than in a risky setting. This difference in sensitivity to payoff differences could also be modeled using a Fechner index which differentiates how strongly subjects react to a stimuli (the differences in expected utility between options) across different situations (parameter κ in the Weber-Fechner law, variously named parameters in Hey and Orme, 1994; Holt and Laury, 2002; Goeree et al, 2003).[8] This result illustrates how subjects decisions are easier to predict when there is no risk than when there is risk as subjects are better able to compare safe social outcomes with each other than they are able to compare a safe social outcome with a lottery.

Subjects appear to have the same type of social concerns under both risky and safe social situations, meaning that in both cases, $\alpha \approx -\beta$ (table 10). The level of concern for others when behind (α) or when ahead (β) does not seem to differ significantly between safe social situations and risky social settings. Those results can be compared to those in table 6 of Charness and Rabin (2002), who find $\alpha \approx 0$ and $\beta \approx 0.4$ in a safe social setting. According to their results, people ignore the payoffs of those who are ahead of them, while we find they care and prefer, everything else equal, that the other have a higher payoff.

Overall, hypothesis 5 is not verified, that is, social situations involving risk do not make subjects less sensitive to social concerns, *i.e.* they do not appear to be overwhelmed by the complexity of social considerations under risk, and do not appear either to react first and foremost to risk considerations rather than to social considerations.

6.6 How do ex-ante considerations enter the evaluation of social lotteries?

Hypothesis 6 is tested by redoing all the regressions that were done in section 6.4 while integrating a parameter λ as in equation 6 so as to take into account the possibility that agents care about *ex-ante* utility as well as about *ex-post* utility when dealing with risk in a social context.

λ small could help explain aversion for unequal social outcomes. Indeed, consider a comparison between a safe but unequal social outcome $(60, 45)$ and a risky but fair social lottery $L = ((15, 45), 1/2; (75, 45), 1/2))$. The expected utility of the safe social outcome is

$$u(60) - \beta(u(60) - u(45)) \tag{12}$$

while the expected utility of the social lottery is

$$\lambda(\frac{1}{2}(u(15) - \alpha(u(45) - u(15))) + \frac{1}{2}(u(75) - \beta(u(75) - u(45))) + (1 - \lambda)u(45) \tag{13}$$

[8] This index is named after Gustav Theodor Fechner who refined the Weber law determining the relation between a physical stimulus and the human response to it. Introducing such a parameter in the regressions, we maximize

$$LL(\theta|Y_i, C_i) = C_{i,A}\ln(f(\frac{U_A - U_B}{\mu})) + (1 - C_{i,A})\ln(f(\frac{U_B - U_A}{\mu})) \tag{11}$$

Doing so leads either to no rejection of the hypothesis that $\mu = 1$ or, when $\mu < 1$, to no improvement in the log-likelihood.

The higher $1-\lambda$, the smaller is the effect of inequality aversion on the fair lottery, while its effect remains constant in the safe social outcome. High inequality aversion therefore lowers the probability to choose the safe unequal outcome. The same effect also works in the case of a safe but disadvantageous alternative. Therefore, part of the observations could be explained if we found $\alpha > 0$ and $\beta > 0$ with $1-\lambda$ high.

Table 12 and 13 presents estimates of $1-\lambda$ in the logit and probit specifications respectively, along with estimates of F&S social utility parameters.

(Insert table 12 here)

Results show that parameter $1-\lambda$ is significantly greater than zero, meaning that agents do not behave as expected utility maximizers when faced with social prospects under uncertainty. The same regressions when run over individual lotteries also obtain values of λ in the same range as in social lotteries, which means that differences in expected value explains a large part of choice among lotteries. However, in social lotteries, this fact implies that aversion to inequality expresses itself mainly with respect to differences in expected value, rather than with respect to differences in *ex-post* realizations of payoffs.

As anticipated, there is some added power of prediction from assuming that agents take account both of whether lotteries give them equal opportunities and of whether end outcomes ensure equal outcomes for both agents. Results go in the right direction, with high estimates of $1-\lambda$ and increases in the values of α and β compared to regressions shown in table 8 and 9. This results in no difference between risk aversion in a social setting and in an individual setting, while only negatively correlated lotteries are predicted to be disliked. Aversion to a safe and advantageous social outcome increases compared to previous modeling, but a disadvantageous safe social outcome is still predicted to be favored. There is therefore some limited improvement in the fit between theorized social preferences and observations from table 6 and 7, but not to an extent that is sufficient to validate the theory.

Further experiments are needed to test whether aversion to inequality extends as well to comparisons featuring social lotteries with unequal expected payoffs for both agents. In the meantime, we cannot state with certainty that considerations of *ex-ante* social outcomes are prominent in social lotteries. It may indeed be that subjects are simply more sensitive to inequality for sure than to inequality in expectation.

7 Discussion and conclusion

We elicited the social preferences under uncertainty of a sample of 96 individuals who were presented a range of lotteries that determined both a payoff for themselves and for an anonymous other. The experimental design was original in that we not only elicited the direction of the preferences of subjects (the frequency with which they chose a lottery over another), but also the intensity of their preferences, which they could express through a price which determined the probability with which they received their preferred lottery. We used both the expressed direction of preferences and their intensity to estimate the parameters that determine how much utility subjects appear to derive from the lotteries in this experiment. This allowed us in a first step to find out how subjects reacted to changes in the characteristics of social lotteries that were presented to them.

We largely confirmed the findings in Bolton and Ockenfels (2010) as subjects were found to be more risk averse when choosing both for themselves and an other than when choosing only for themselves, and were reluctant to choose a safe but unfair social outcome rather than a fair but risky social lotteries. When their payoff in the safe situation was high and the other's payoff was low, they chose the safe situation less often than if both themselves and the other obtained the high payoff, although they still chose the safe high payoff more often than if both themselves and the other obtained the low payoff. When it was the other who obtained a high payoff in the safe situation while they received a low payoff, they chose the safe situation, if not less often, at least not more often than if the other had a low payoff as well, meaning that they did not seem to take the welfare of the other into account. Unlike Bolton and Ockenfels (2010) however, we found that subjects preferred social lotteries that did not impose risk on the other to those that did impose risk on the other, whether that risk resulted in payoffs for the other that were positively or negatively correlated with theirs.

We then tested whether subjects' preferences could be explained through a social utility function of the form proposed in Fehr and Schmidt (1999), generalized to allow for a range of social preferences and for risk aversion. The behavior of subjects was best described as altruistic, which clashed with their apparent dislike for unfavorably unequal safe social outcomes, and also failed to explain higher risk aversion in social lotteries *vs.* individual lotteries. Social preferences under uncertainty did not seem to differ either in their characteristics or intensity from social preferences under certainty, meaning that risk considerations did not appear to crowd out social concerns as hypothesized in Güth et al (2008).

In an attempt to better account for aversion to inequality in safe social outcomes, we tested a social utility function that captures both procedural and consequentialist aspects of risk taking in a social setting. That function takes into account how fair a lottery is in terms of expected social outcome as well as the utility derived from its outcomes. Subjects' choices were consistent with a high weight given to *ex-ante* comparisons of expected social outcomes. A theory in which agents consider both *ex-ante* expectations and *ex-post* outcomes in their choices among social lotteries resulted in a better fit with observations. This theory did not however fully account for the extent of *ex-ante* inequality aversion.

This leads us to conclude that agents' social preference differ *ex-ante* and *ex-post*, that is, individuals are inequality averse *ex-ante*, in the sense that they wish to avoid unequal safe social outcomes, and altruistic *ex-post*, in the sense that they prefer the other not to be exposed to risk. Moreover, aversion to *ex-ante* inequality is specific to social lotteries in the sense that subjects did not display such aversion when facing choices between safe social outcomes, whereby they turned out to be altruistic and cared about the other's payoff as much when behind as when ahead. The question is therefore why agents dislike inequality to such a high extent when it is set against the option of a fair social lottery. We believe that choosing the option of a social lottery alleviates the burden of taking responsibility for an allocation by letting chance decide on the outcome (Charness and Jackson, 2009). This works to limit opportunism when offered an advantageous safe option and also to excuse spite when denying the other an advantageous safe option. This means in particular that individuals are more risk loving when the alternative to risk is a situation of inequality than when the alternative is a situation in which all are equal. They dislike safe but unequal situations even when that situation makes one of them objectively better-off than the risky alternative without hurting the other, *i.e.* even when this safe situation appears to be a Pareto improvement over the risky alternative. We plan further work to test the robustness of the present findings and to explore whether aversion to *ex-ante* inequality also applies to unfair social lotteries rather than simply to unfair safe social outcomes as in this experiment.

Acknowledgements I wish to thank Anna Conte, Paolo Crosetto, Werner Güth, Ivan Soraperra, and especially Alena Otto for their comments and suggestions. Thanks also go to David Füßler for research assistance.

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1 Ranking of social lotteries depending on the nature of social concerns.

Assume utility is increasing in outcomes and agents are risk averse. An altruistic agent has utility of the form $u(m, y) = u(m)+\theta u(y)$ while an inequality averse agent has utility of the form $u(m, y) = u(m)-\alpha|u(m)-u(y)|$. We consider the ranking of lotteries a to d in table 1.

Denote $u(E) = u(\frac{x+z}{2})$ the utility of the expected value of lottery $(x, \frac{1}{2}; z, \frac{1}{2})$, with $z > x$, EU the expected utility of this lottery and $\Delta U = u(z) - u(x)$ the difference in utility between the two outcomes. α^* is equal to $\frac{u(E)-EU}{\Delta U}$, that is, the risk premium divided by the difference in utility.

1. Ranking if altruistic agent.

Description	Utility if altruistic	$\theta < 0$	$0 < \theta < 1$	$\theta > 1$
(a) Own risk only	$EU + \theta u(E)$	3	2	1
(b) Positively correlated risk	$(1+\theta)(EU)$	2	3	3
(c) Other's risk only	$u(E) + \theta EU$	1	1	2
(d) Negatively correlated risk	$(1+\theta)EU$	2	3	3

2. Ranking if inequality averse

Description	Utility if inequality averse	$\alpha < -2\alpha^*$	$-2\alpha^* < \alpha < 0$	$0 < \alpha < 2\alpha^*$	$\alpha > 2\alpha^*$
(a) Own risk only	$EU - \alpha/2 \Delta U$	3	3	3	3
(b) Positively correlated risk	EU	4	4	2	1
(c) Other's risk only	$u(E) - \alpha/2 \Delta U$	2	1	1	2
(d) Negatively correlated risk	$EU - \alpha \Delta U$	1	2	4	4

Table 3 Ranking of lotteries depending on the nature of social concern.

2 Continuity of preferences among social lotteries

Consider safe social outcome $A = (m, y)$ and social lottery B. Let function $s(L)$ be the social utility derived from L by the decision maker, with utility of outcomes taking the form

$$s(m,y) = (1+\alpha)u(m) - \alpha u(y) \text{ if } y > m$$
$$s(m,y) = (1-\beta)u(m) + \beta u(y) \text{ if } m > y \quad (14)$$

while decision makers consider only expected utility in their decision. Assume as well that $u(x)$ is monotonically increasing in its argument and positive for any positive value of x.

Define C the lottery that results from a choice of a price p to obtain lottery A, that is, $C = (A', \frac{p}{15}; B, \frac{15-p}{15})$ with A' a lottery over all realization of r, the random price the subject pays if $p > r$, when he obtains A. The issue is whether there are situations in which a subject pays a price p to obtain C and yet prefers B to A.

Suppose therefore that $p > 0$ and $B \succ A$, so that $s(B) - s(A) > 0$. Utility for lottery C is

$$s(C) = \frac{15-p}{15}s(B) + \frac{p}{15}\int_0^p s(A-r)dr \quad (15)$$

.

1) Suppose $m < y$ so that $m - r < y$ for any r. Then $s(A-r) = (1+\alpha)u(m-r) - \alpha u(y)$. If $1+\alpha > 0$, then $s(A-r) < s(A)$ and since $s(A) < s(B)$ by assumption, then $s(C) < s(B)$ by equation 15. However, if that were the case, then the subject would have paid $p = 0$ to have a guarantee to obtain B rather than pay $p > 0$ to obtain lottery C, a contradiction. Now, if $1+\alpha < 0$ then C might be preferred to B, itself preferred to A. However, this implies that the subject enjoys utility for the other more than he enjoys utility for himself and thus always benefits from obtaining a lower payoff. In that case, he ought to pay $p = 15$, the maximum allowed.

2) Suppose $m - p > y$ so that $m - r > y$ for any r. Then $s(A-r) = (1-\beta)u(m-r) + \beta u(y)$. If $1-\beta > 0$, then $s(A-r) < s(A)$ and since $s(A) < s(B)$ by assumption, then $s(C) < s(B)$ by equation 15. However, if that were the case, then the subject would have paid $p = 0$ to have a guarantee to obtain B rather than pay $p > 0$ to obtain lottery C, a contradiction. Now, if $1-\beta < 0$ then C might preferred to B, itself preferred to A. This possibility is likelier than in the previous case since the decision maker is ahead of the other. However, this implies that the decision maker always benefits from obtaining a lower payoff at least up to the point where it is equal to y. In that case, the decision maker ought to choose a price such that either $m - p = y$ or $p = 15$, the maximum allowed.

3) Suppose now $m - p < y < m$. Either one of the two conditions above on α or β must be verified, or both, in order to support the possibility that $C \succ B \succ A$.

Note that the argument also extends to the case where A is a lottery, where either one of the two conditions above on α or β must be verified, or both, in order to support $C \succ B \succ A$.

From the above, conditions that support some subjects expressing a positive price even though they prefer lottery B to lottery A are beyond the normal range of preferences observed in previous research on the topic. There are some indications of what decisions a subject with such preferences ought to take, that is, he either chooses $p = m - y$ when $m > y$ and $m - y < 15$, or chooses $p = 15$ when either $m - y > 15$ or $m < y$.

There were 22 decisions where A was a safe payoff such that $m < y$ and p was equal to 15 (5 cases for comparison pair 3 of figure 3, and 4, 6 and 6 cases for comparison pair 10, 11 and 12 respectively). The case of comparison pair 3 is difficult to explain, but in the case of comparison pairs 10, 11 and 12, the expected value of the safe payoff for the other was higher than from the alternative lottery. Individuals who paid a high price may thus have sacrificed their own payoff to ensure a higher payoff for the other, from which they benefit as altruists, without having to resort to the explanation that $1 + \alpha < 0$. Alternatively, they may also have had high levels of risk aversion.

There were 67 decisions where A was a safe payoff such that $m - y > 15$ and p was equal to 15. 30 of those were comparisons involving social lotteries (15 cases for comparison pair 13, 15 cases for comparison pair 15), in which case those prices could simply be explained through own self-interest since in those cases $m - 15$ was still larger than the expected value of lottery B. 37 of the comparisons were comparisons between safe social outcomes, of which 35 cases concerned lottery 2 of table 5, in which case agents were ready to sacrifice 15 ECU to prevent the other having a low payoff of 19. Again, extreme values of α and β are not necessary to explain this phenomenon since expected welfare was higher when payoffs were more equal.

Finally, there were 39 cases where $m - p = y$, of which 28 cases concerned social lottery pair 14, in which case those subjects may have paid price 7 out of a preference for having a payoff equal to the other, and did not wish to pay more even though they ought to have done so if they were risk-averse. This behavior can be explained through a high level of inequality aversion (α high) rather than by a parameter $1 - \beta < 0$.

3 Individual lottery pairs, safe social outcomes comparisons and social lotteries pairs in the experiment

Table 4 List of individual lottery pairs

	Lottery A				Lottery B			
Label	Payoff 1	Probability	Payoff 2	Probability	Payoff 1	Probability	Payoff 2	Probability
1	44	100%			14	50%	80	50%
2	42	50%	44	50%	11	50%	76	50%
3	13	50%	74	50%	20	50%	70	50%
4	45	100%			12	50%	80	50%
5	62	100%			11	50%	76	50%
6	61	100%			18	50%	79	50%

Table 5 List of safe social outcome comparisons

	Lottery A				Lottery B			
Label	Payoff 1	Probability	Payoff 2	Probability	Payoff 1	Probability	Payoff 2	Probability
1	(49,46)	100%			(32,78)	100%		
2	(50,19)	100%			(43,44)	100%		
3	(42,15)	100%			(26,73)	100%		
4	(46,29)	100%			(46,46)	100%		

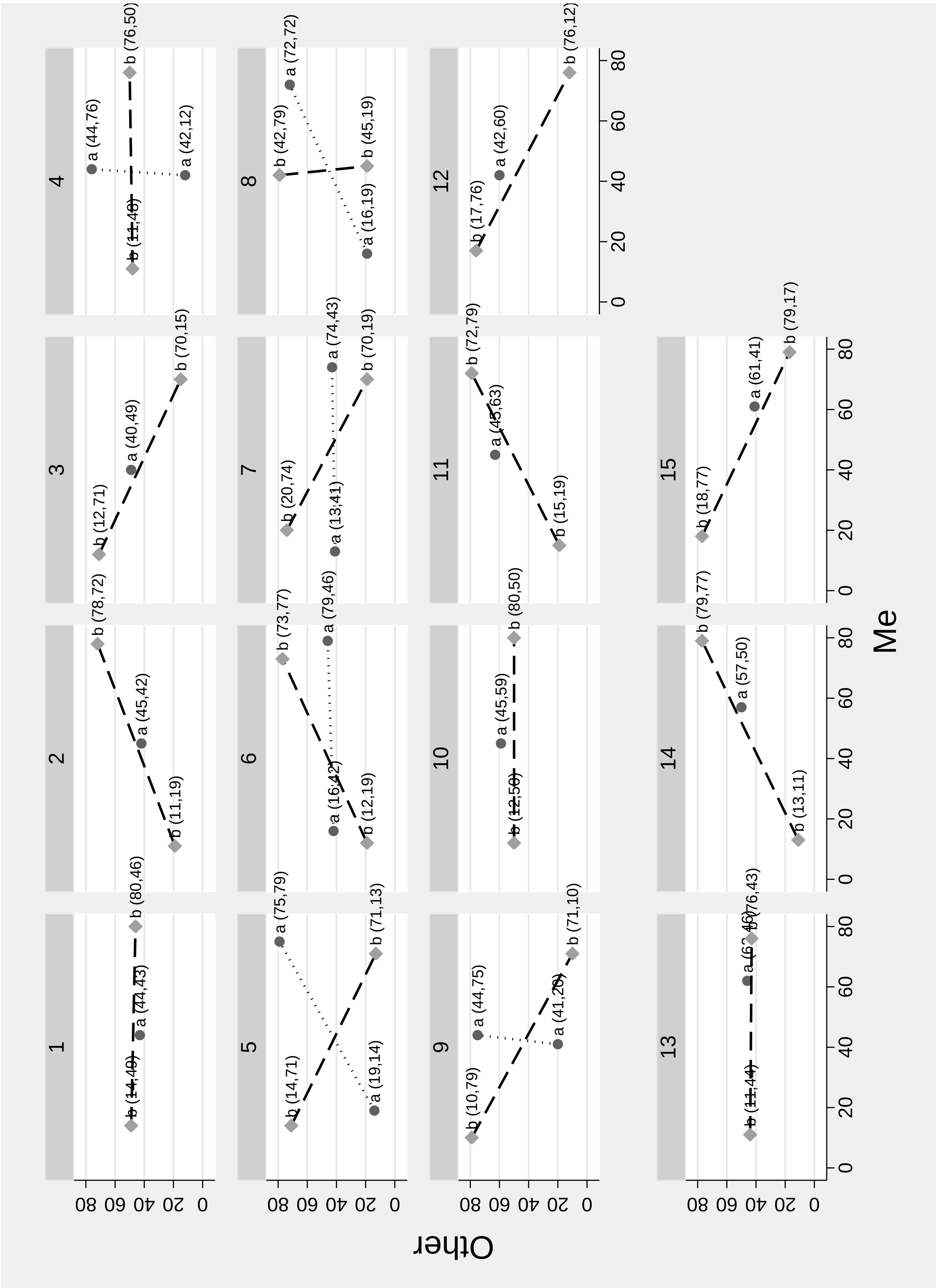


Fig. 3 Graphical representation of social lottery pairs in the experiment

4 Regression tables

Table 6 Utility parameters as a function of correlation and relative position *vs.* the other, logit specification. Sample: Social and individual lottery pairs.

	power	expo-power	power	expo-power
r	0.382^{***}	0.220	0.399^{***}	0.329^{***}
	(13.69)	(1.45)	(17.17)	(14.32)
Δindividual	0.132^{***}	0.0615	0.0840^{***}	0.0337
	(3.97)	(0.42)	(3.34)	(1.48)
Δadvantage	0.248^{***}	0.577	0.322^{***}	0.337^{***}
	(11.06)	(0.28)	(10.66)	(17.96)
Δdisadvantage	0.251^{***}	-1.636^{**}	0.0963^{***}	-0.0331
	(8.37)	(-3.04)	(7.55)	(-1.40)
Δpos corr	-0.0640^{**}	-0.00889	-0.0635^{***}	-0.106^{***}
	(-2.99)	(-0.07)	(-4.34)	(-9.96)
Δneg corr	-0.0587^{**}	-0.0200	-0.0608^{***}	-0.129^{***}
	(-2.58)	(-0.18)	(-4.06)	(-9.92)
a		0.0120^{*}		-0.00188
		(2.06)		(-0.26)
Δindividual		0.0360^{***}		-0.00207
		(3.39)		(-0.26)
Δadvantage		-1.126		-0.325^{***}
		(-0.08)		(-14.75)
Δdisadvantage		-0.00180		0.0137^{***}
		(-0.15)		(5.59)
Δpos corr		-0.00433		0.00887^{*}
		(-1.60)		(2.10)
Δneg corr		-0.00568		0.0171^{***}
		(-1.48)		(3.59)
Pr(45,45)/L	0.738^{***}	0.766^{***}	0.734^{***}	0.670^{***}
	(130.49)	(7.63)	(141.94)	(32.66)
ΔPr(45)/L	-0.0346^{***}	-0.0184	-0.0218^{***}	-0.0130
	(-3.74)	(-0.20)	(-3.40)	(-0.77)
Pr(60,60)/L	0.987^{***}	0.993^{***}	0.984^{***}	0.971^{***}
	(197.30)	(42.66)	(198.72)	(149.27)
ΔPr(60,45)/L	-0.113^{***}	-0.115	-0.175^{***}	-0.152^{***}
	(-6.54)	(-1.52)	(-10.89)	(-8.88)
Pr(45,45)/L	0.738^{***}	0.766^{***}	0.734^{***}	0.670^{***}
	(130.49)	(7.63)	(141.94)	(32.66)
ΔPr(45,60)/L	-0.0714^{***}	-0.256^{**}	-0.0253^{***}	0.0419^{**}
	(-7.71)	(-2.75)	(-5.58)	(2.96)
Pr(45,45)/L	0.738^{***}	0.766^{***}	0.734^{***}	0.670^{***}
	(130.49)	(7.63)	(141.94)	(32.66)
ΔPr(45,45)	0.00996^{*}	-0.0134	0.0115^{**}	0.0716^{***}
vs. pos corr	(2.38)	(-0.12)	(3.13)	(4.88)
ΔPr(45,45)	0.00940^{*}	-0.0149	0.0112^{**}	0.124^{***}
vs. neg corr	(2.11)	(-0.12)	(2.93)	(10.80)
N	4032	4032	64512	64512
ll	-1961.9	-1930.4	-23585.4	-22672.2
ll (social lotteries)	-1430.0	-1403.5	-16663.9	-15829.4

z statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The notation Pr(45,45)/L means "probability to choose safe payoff $(45, 45)$ over uncorrelated lottery $L = ((15, 45), \frac{1}{2}; (75, 45), \frac{1}{2})$"

Table 7 Utility parameters as a function of correlation and relative position *vs.* the other, probit specification. Sample: Social and individual lottery pairs..

	power	expo-power	power	expo-power
r	0.696^{***}	0.354^{***}	0.551^{***}	0.513^{***}
	(13.36)	(15.23)	(18.11)	(21.05)
Δindividual	0.0115	0.0351	0.150^{***}	0.0453
	(0.29)	(1.27)	(4.44)	(1.12)
Δadvantage	0.146^{***}	0.646^{***}	0.348^{***}	0.228^{***}
	(4.77)	(27.80)	(12.96)	(10.86)
Δdisadvantage	0.111^{***}	-1.233^{**}	0.102^{***}	-0.0710^{***}
	(4.20)	(−3.02)	(6.95)	(−4.29)
Δpos corr	-0.114^{***}	−0.00000171	-0.0409^{*}	-0.0582^{***}
	(−4.63)	(−0.16)	(−2.08)	(−4.30)
Δneg corr	-0.127^{***}	-0.0000448^{***}	-0.0750^{***}	-0.148^{***}
	(−4.60)	(−4.03)	(−3.81)	(−11.77)
a		0.00575		-0.0703^{**}
		(0.74)		(−2.75)
Δindividual		0.0729^{***}		−0.0348
		(4.99)		(−0.60)
Δadvantage		-9.838^{***}		-0.262^{***}
		(−117.11)		(−7.16)
Δdisadvantage		0.0267		0.0510^{***}
		(1.19)		(4.70)
Δpos corr		−0.0115		0.0212^{*}
		(−1.48)		(2.38)
Δneg corr		−0.0148		0.0688^{***}
		(−1.52)		(4.43)
Pr(45,45)/L	0.728^{***}	0.763^{***}	0.791^{***}	0.650^{***}
	(32.20)	(39.31)	(62.31)	(48.77)
ΔPr(45)/L	−0.00500	−0.0228	-0.0651^{***}	−0.0140
	(−0.29)	(−1.58)	(−4.55)	(−0.98)
Pr(60,60)/L	0.941^{***}	0.998^{***}	0.994^{***}	0.974^{***}
	(30.25)	(516.45)	(233.24)	(138.44)
ΔPr(60,45)/L	-0.106^{***}	-0.138^{***}	-0.203^{***}	-0.199^{***}
	(−6.27)	(−6.54)	(−18.43)	(−10.71)
Pr(45,45)/L	0.728^{***}	0.763^{***}	0.791^{***}	0.650^{***}
	(32.20)	(39.31)	(62.31)	(48.77)
ΔPr(45,60)/L	-0.0462^{***}	-0.231^{***}	-0.0441^{***}	0.0439^{***}
	(−4.08)	(−6.49)	(−6.83)	(4.56)
Pr(45,45)/L	0.728^{***}	0.763^{***}	0.791^{***}	0.650^{***}
	(32.20)	(39.31)	(62.31)	(48.77)
ΔPr(45,45)	0.0498^{***}	-0.0220^{*}	0.0166^{*}	0.0121
vs. pos corr	(4.64)	(−2.07)	(2.03)	(0.84)
ΔPr(45,45)	0.0552^{***}	-0.0303^{*}	0.0296^{***}	0.0954^{***}
vs. neg corr	(4.57)	(−1.99)	(3.45)	(5.20)
N	4032	4032	64512	64512
ll	−1964.1	−1933.1	−24947.8	−23139.7
ll (social lotteries)	−1434.9	−1404.5	−17630.7	−16286.4

z statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The notation Pr(45,45)/L means ”probability to choose safe payoff $(45, 45)$ over uncorrelated lottery $L = ((15, 45), \frac{1}{2}; (75, 45), \frac{1}{2})$”

Table 8 Estimation of F&S utility functions, logit specification. Sample: Social lottery pairs.

	power	expo-power	power	expo-power
r	0.488^{***}	0.280^{***}	0.419^{***}	0.335^{***}
	(15.11)	(10.87)	(26.08)	(16.29)
a		0.0395^{***}		-0.0105
		(4.64)		(-1.17)
α	-0.0948^{***}	-0.105^{***}	-0.0956^{***}	-0.0907^{***}
	(-3.60)	(-3.55)	(-5.98)	(-5.65)
β	0.132^{***}	0.119^{***}	0.0438^{*}	0.0917^{***}
	(6.18)	(5.43)	(2.45)	(6.05)
$\alpha+\beta$	0.0368^{*}	0.0137	-0.0518^{***}	0.000936
	(2.20)	(0.75)	(-3.66)	(0.14)
Pr(45,45)/L	0.709^{***}	0.731^{***}	0.681^{***}	0.637^{***}
	(53.17)	(36.42)	(65.80)	(28.79)
ΔPr(45)/L	0.00204	0.0178	0.0489^{***}	0.0121^{+}
	(0.19)	(1.51)	(4.92)	(1.94)
Pr(60,60)/L	0.955^{***}	0.943^{***}	0.974^{***}	0.974^{***}
	(69.66)	(61.34)	(189.91)	(224.56)
ΔPr(60,45)/L	-0.0139^{***}	-0.0127^{***}	-0.00340^{*}	-0.00811^{***}
	(-4.49)	(-4.20)	(-2.40)	(-4.53)
Pr(45,45)/L	0.709^{***}	0.731^{***}	0.681^{***}	0.637^{***}
	(53.17)	(36.42)	(65.80)	(28.79)
ΔPr(45,60)/L	0.0406^{**}	0.0356^{**}	0.0563^{***}	0.0617^{***}
	(3.08)	(3.01)	(5.48)	(4.88)
Pr(45,45)/L	0.709^{***}	0.731^{***}	0.681^{***}	0.637^{***}
	(53.17)	(36.42)	(65.80)	(28.79)
ΔPr(45,45)	0.00204	0.0178	0.0489^{***}	0.0121^{+}
vs. pos corr	(0.19)	(1.51)	(4.92)	(1.94)
ΔPr(45,45)	0.0383^{***}	0.0289^{***}	-0.0215^{+}	0.0135^{**}
vs. neg corr	(5.22)	(4.63)	(-1.90)	(2.67)
N	2880	2880	46080	46080
ll	-1462.8	-1459.2	-17725.8	-17484.0

z statistics in parentheses

$^{+}$ $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

The notation Pr(45,45)/L means ”probability to choose safe payoff $(45,45)$ over uncorrelated lottery $L=((15,45),\frac{1}{2};(75,45),\frac{1}{2})$”

Table 9 Estimation of F&S utility functions, probit specification. Sample: Social lottery pairs.

	power	expo-power	power	expo-power
r	0.687^{***}	0.391^{***}	0.620^{***}	0.540^{***}
	(23.38)	(12.98)	(36.07)	(13.48)
a		0.0676^{***}		-0.123^{*}
		(4.32)		(−2.05)
α	-0.105^{***}	-0.105^{**}	-0.139^{***}	-0.103^{***}
	(−3.46)	(−3.28)	(−5.51)	(−6.30)
β	0.128^{***}	0.123^{***}	0.00983	0.101^{***}
	(5.37)	(5.19)	(0.42)	(6.51)
$\alpha + \beta$	0.0232	0.0181	-0.129^{***}	−0.00162
	(1.15)	(0.88)	(−7.16)	(−0.23)
Pr(45,45)/L	0.717^{***}	0.726^{***}	0.676^{***}	0.612^{***}
	(51.55)	(37.32)	(47.33)	(31.13)
ΔPr(45)/L	0.0146	0.0176	0.0852^{***}	0.0136^{*}
	(1.28)	(1.43)	(7.83)	(2.28)
Pr(60,60)/L	0.941^{***}	0.935^{***}	0.960^{***}	0.979^{***}
	(55.29)	(56.95)	(93.86)	(204.73)
ΔPr(60,45)/L	-0.0164^{***}	-0.0154^{***}	−0.00111	-0.0108^{***}
	(−4.44)	(−4.27)	(−0.42)	(−4.36)
Pr(45,45)/L	0.717^{***}	0.726^{***}	0.676^{***}	0.612^{***}
	(51.55)	(37.32)	(47.33)	(31.13)
ΔPr(45,60)/L	0.0340^{**}	0.0310^{**}	0.0617^{***}	0.0666^{***}
	(2.95)	(2.85)	(5.63)	(5.55)
Pr(45,45)/L	0.717^{***}	0.726^{***}	0.676^{***}	0.612^{***}
	(51.55)	(37.32)	(47.33)	(31.13)
ΔPr(45,45)	0.0146	0.0176	0.0852^{***}	0.0136^{*}
vs pos corr	(1.28)	(1.43)	(7.83)	(2.28)
ΔPr(45,45)	0.0328^{***}	0.0308^{***}	-0.0548^{***}	0.0113^{*}
vs neg corr	(4.37)	(4.57)	(−4.97)	(2.16)
N	2880	2880	46080	46080
ll	−1463.1	−1464.6	−18827.8	−17555.9

z statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The notation Pr(45,45)/L means "probability to choose safe payoff $(45, 45)$ over uncorrelated lottery $L = ((15, 45), \frac{1}{2}; (75, 45), \frac{1}{2})$"

Table 10 Estimation of F&S utility functions in risky *vs.* safe social settings, logit specification. Sample: Social lottery pairs and safe social outcomes comparisons.

	power	expo-power	power	expo-power
r_{risky}	0.488^{***}	0.280^{***}	0.419^{***}	0.335^{***}
	(15.11)	(10.87)	(26.08)	(16.29)
Δr_{safe}	-0.181^{***}	0.105	-0.117^{***}	0.206^{***}
	(−5.38)	(0.46)	(−5.79)	(11.03)
a_{risky}		0.0395^{***}		−0.0105
		(4.64)		(−1.17)
Δa_{safe}		−0.110		-0.298^{***}
		(−0.62)		(−28.67)
α_{risk}	-0.0948^{***}	-0.105^{***}	-0.0956^{***}	-0.0907^{***}
	(−3.60)	(−3.55)	(−5.98)	(−5.65)
α_{safe}	-0.187^{***}	-0.147^{***}	-0.130^{***}	-0.0987^{***}
	(−11.76)	(−3.94)	(−10.63)	(−9.65)
Δ	-0.0922^{**}	−0.0415	-0.0347^{+}	−0.00793
	(−3.01)	(−0.84)	(−1.95)	(−0.50)
β_{risk}	0.132^{***}	0.119^{***}	0.0438^{*}	0.0917^{***}
	(6.18)	(5.43)	(2.45)	(6.05)
β_{safe}	0.0744^{***}	0.0800^{***}	0.0773^{***}	0.0935^{***}
	(4.52)	(3.72)	(5.45)	(5.90)
Δ	-0.0571^{*}	−0.0388	0.0334	0.00180
	(−2.30)	(−1.36)	(1.61)	(0.09)
$\alpha_{risk} + \beta_{risk}$	0.0368^{*}	0.0137	-0.0518^{***}	0.000936
	(2.20)	(0.75)	(−3.66)	(0.14)
$\alpha_{safe} + \beta_{safe}$	-0.113^{***}	−0.0667	-0.0531^{**}	−0.00519
	(−4.78)	(−1.26)	(−2.83)	(−0.28)
Pr(50,50)/(45,45) (risk)	0.681^{***}	0.656^{***}	0.729^{***}	0.740^{***}
	(33.13)	(32.88)	(60.07)	(68.47)
ΔPr(50,50)/(45,45) (safe)	0.141^{***}	0.160^{***}	0.0970^{***}	0.110^{***}
	(5.76)	(7.13)	(5.67)	(6.07)
N	3648	3648	58368	58368
ll	−1801.3	−1797.7	−21479.4	−21204.3

z statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The notation Pr(50,50)/(45,45) (risk) means "probability to choose safe payoff $(50, 50)$ over safe payoff $(45, 45)$ using parameter estimates from the risky social situation"

Table 11 Estimation of F&S utility functions in risky *vs.* safe social settings, probit specification. Sample: Social lottery pairs and safe social outcomes comparisons.

	power	expo-power	power	expo-power
r_{risky}	0.687***	0.391***	0.620***	0.540***
	(23.38)	(12.98)	(36.07)	(13.48)
Δr_{safe}	−0.248***	−0.245	−0.151***	0.0675+
	(−7.71)	(−0.52)	(−8.42)	(1.81)
a_{risky}		0.0676***		−0.123*
		(4.32)		(−2.05)
Δa_{safe}		−0.0325		−0.220***
		(−1.28)		(−3.76)
α_{risk}	−0.105***	−0.105**	−0.139***	−0.103***
	(−3.46)	(−3.28)	(−5.51)	(−6.30)
α_{safe}	−0.208***	−0.265	−0.145***	−0.117***
	(−14.84)	(−1.21)	(−11.47)	(−10.53)
Δ	−0.104**	−0.160	−0.00619	−0.0142
	(−3.10)	(−0.71)	(−0.23)	(−0.85)
β_{risk}	0.128***	0.123***	0.00983	0.101***
	(5.37)	(5.19)	(0.42)	(6.51)
β_{safe}	0.0692***	0.0631*	0.0747***	0.0883***
	(4.46)	(2.09)	(5.25)	(5.64)
Δ	−0.0586*	−0.0596	0.0649**	−0.0129
	(−2.21)	(−1.64)	(2.64)	(−0.63)
$\alpha_{risk} + \beta_{risk}$	0.0232	0.0181	−0.129***	−0.00162
	(1.15)	(0.88)	(−7.16)	(−0.23)
$\alpha_{safe} + \beta_{safe}$	−0.139***	−0.201	−0.0707***	−0.0287
	(−6.34)	(−0.81)	(−3.63)	(−1.48)
Pr(50,50)/(45,45) (risk)	0.638***	0.630***	0.676***	0.723***
	(42.55)	(39.93)	(62.09)	(70.06)
ΔPr(50,50)/(45,45) (safe)	0.183***	0.197***	0.117***	0.0919***
	(7.85)	(7.10)	(7.52)	(5.03)
N	3648	3648	58368	58368
ll	−1801.6	−1803.2	−22663.6	−21349.1

z statistics in parentheses
$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
The notation Pr(50,50)/(45,45) (risk) means ”probability to choose safe payoff $(50, 50)$ over safe payoff $(45, 45)$
using parameter estimates from the risky social situation”

Table 12 Estimation of *ex-ante* weight parameter, logit specification. Sample: Social lottery pairs.

	power	expo-power	power	expo-power
r	0.488^{***}	-0.395^{***}	0.416^{***}	-0.317^{***}
	(15.11)	(−5.60)	(29.43)	(−7.54)
a		0.0174^{***}		0.0236^{***}
		(5.40)		(10.39)
α	-0.0948^{***}	-0.0977^{*}	-0.0767^{***}	0.0365
	(−3.60)	(−2.09)	(−4.33)	(0.67)
β	0.132^{***}	0.159^{***}	0.0915^{***}	0.157^{***}
	(6.18)	(4.86)	(5.02)	(3.88)
$\alpha+\beta$	0.0368^{*}	0.0610	0.0148	0.193^{**}
	(2.20)	(0.89)	(0.86)	(2.61)
$1-\lambda$	$1.28e-12$	0.900^{***}	0.371^{***}	0.904^{***}
	(.)	(44.70)	(3.86)	(56.21)
Pr(45,45)/L	0.709^{***}	0.743^{***}	0.647^{***}	0.692^{***}
	(53.17)	(39.12)	(39.37)	(40.41)
ΔPr(45)/L	0.00204	0.0203^{+}	0.00513	−0.00838
	(0.19)	(1.69)	(0.59)	(−0.91)
Pr(60,60)/L	0.955^{***}	0.921^{***}	0.971^{***}	0.856^{***}
	(69.66)	(56.12)	(195.43)	(46.78)
ΔPr(60,45)/L	-0.0139^{***}	-0.0177^{***}	-0.00857^{***}	-0.0199^{***}
	(−4.49)	(−4.21)	(−3.82)	(−3.58)
Pr(45,45)/L	0.709^{***}	0.743^{***}	0.647^{***}	0.692^{***}
	(53.17)	(39.12)	(39.37)	(40.41)
ΔPr(45,60)/L	0.0406^{**}	0.0251^{*}	0.0489^{***}	−0.00766
	(3.08)	(2.02)	(4.12)	(−0.71)
Pr(45,45)/L	0.709^{***}	0.743^{***}	0.647^{***}	0.692^{***}
	(53.17)	(39.12)	(39.37)	(40.41)
ΔPr(45,45)	0.00204	0.0203^{+}	0.00513	−0.00838
vs. pos corr	(0.19)	(1.69)	(0.59)	(−0.91)
ΔPr(45,45)	0.0383^{***}	0.0347^{***}	0.0187^{**}	0.0273^{***}
vs. neg corr	(5.22)	(5.14)	(2.85)	(4.30)
N	2880	2880	46080	46080
ll	−1462.8	−1442.1	−17435.9	−16978.1

z statistics in parentheses

$^{+}$ $p<0.10$, * $p<0.05$, ** $p<0.01$, *** $p<0.001$

The notation Pr(45,45)/L means "probability to choose safe payoff $(45,45)$ over uncorrelated lottery $L=((15,45),\frac{1}{2};(75,45),\frac{1}{2})$"

Table 13 Estimation of *ex-ante* weight parameters, probit specification. Sample: Social lottery pairs.

	power	expo-power	power	expo-power
r	0.687^{***}	-0.311^{***}	0.566^{***}	-0.163^{***}
	(23.38)	(−4.19)	(44.16)	(−4.23)
a		0.0255^{***}		0.0394^{***}
		(4.95)		(11.80)
α	-0.105^{***}	-0.0972^{*}	-0.0685^{**}	−0.0156
	(−3.46)	(−2.00)	(−2.96)	(−0.35)
β	0.128^{***}	0.151^{***}	0.154^{***}	0.160^{***}
	(5.37)	(4.48)	(3.32)	(3.94)
$\alpha + \beta$	0.0232	0.0542	0.0851	0.144^{*}
	(1.15)	(0.77)	(1.47)	(2.22)
$1 - \lambda$	0	0.905^{***}	0.613^{***}	0.896^{***}
	(.)	(42.08)	(7.75)	(57.20)
Pr(45,45)/L	0.717^{***}	0.732^{***}	0.631^{***}	0.667^{***}
	(51.55)	(40.41)	(47.26)	(40.11)
ΔPr(45)/L	0.0146	0.0207	−0.0107	0.0000700
	(1.28)	(1.64)	(−0.84)	(0.01)
Pr(60,60)/L	0.941^{***}	0.916^{***}	0.973^{***}	0.868^{***}
	(55.29)	(52.92)	(186.37)	(50.16)
ΔPr(60,45)/L	-0.0164^{***}	-0.0192^{***}	-0.0192^{*}	-0.0249^{***}
	(−4.44)	(−4.05)	(−2.41)	(−3.63)
Pr(45,45)/L	0.717^{***}	0.732^{***}	0.631^{***}	0.667^{***}
	(51.55)	(40.41)	(47.26)	(40.11)
ΔPr(45,60)/L	0.0340^{**}	0.0238^{+}	0.0404^{**}	0.00387
	(2.95)	(1.96)	(3.00)	(0.35)
Pr(45,45)/L	0.717^{***}	0.732^{***}	0.631^{***}	0.667^{***}
	(51.55)	(40.41)	(47.26)	(40.11)
ΔPr(45,45)	0.0146	0.0207	−0.0107	0.0000700
vs pos corr	(1.28)	(1.64)	(−0.84)	(0.01)
ΔPr(45,45)	0.0328^{***}	0.0336^{***}	0.0356^{**}	0.0269^{***}
vs neg corr	(4.37)	(4.61)	(3.19)	(4.12)
N	2880	2880	46080	46080
ll	−1463.1	−1447.7	−17449.4	−17009.8

z statistics in parentheses

$^{+}$ $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The notation Pr(45,45)/L means ”probability to choose safe payoff $(45, 45)$ over uncorrelated lottery $L = ((15, 45), \frac{1}{2}; (75, 45), \frac{1}{2})$”

5 Instructions, translated in English

Welcome and thank you for your participation in this experiment! In this experiment, you can earn an amount of money which depends on your decisions and on those of another participant. It is therefore very important that you thoroughly and completely read through these instructions.

Please raise your hand if you have a question. We will then come to you and answer your question. We will unfortunately be forced to exclude you from the experiment if you violate this rule

Please turn your mobile phone off from now on!

You will make decisions in the course of the experiment. There are no right or wrong decisions, only decisions that appear best to you. All results of this study will be kept strictly confidential and none of the other participants will learn of your decisions.

Your earning will be calculated in terms of ECU (Experimental Currency Unit). 1 ECU corresponds to €0.20 in the main part of the experiment. At the end of today's session, your total earnings will be converted in euros and will be paid to you confidentially and in cash.

€2.50 will be paid to you in addition to the above for timely arrival to the experiment. If you make losses in the experiment, those will be deducted from this base pay. Your overall payout can never be negative however.

Conduct of the session

After you have completely read the instructions, you will be asked some questions to test your understanding of the experiment. The experiment will start only when all participants will have answered the test questions correctly. In the course of the experiment you must decide between several options, with payoffs affecting yourself and another participant. Once the main part of the experiment is complete, we will ask you again to make a few decisions for which you will also be paid, and then you will fill out a short questionnaire.

Explanation of the main part of the experiment

During the main part of the experiment, you will be paired anonymously with another participant, whom we will refer to as your pair in the following. Neither you nor your pair will learn the identity of the other. You must take a number of decisions, which determine what money you and your pair will receive at the end of the experiment. Those decisions do not affect the payoffs of the other participants in this session.

The following describes the different steps of a possible choice situation.

You can see below an example of a choice situation (see Figure 1). Please watch the graphical representation of the choice situation and read the supplementary explanations carefully.

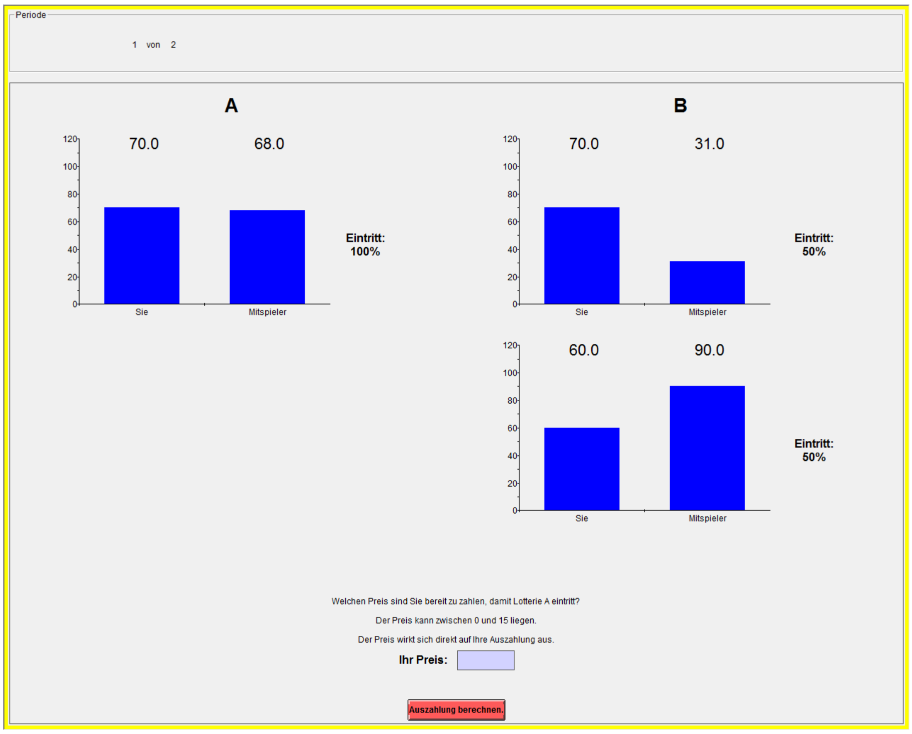


Fig. 1 Screen before entering a price

Two lotteries, A and B can be seen in the above graph. You can see payouts in number above the bar of height the payout specified. The payouts on the left side bar apply to you, the payouts on the right side bar apply to your pair. In lottery A, you receive 70 ECU as decision makers and your pair receives 68 ECU as receiver. The payouts in Lottery B depend on the probability of the occurrence of the relevant amounts. The probability that you will receive the highest amount of 70 ECU as decision maker is 50% for Lottery B (your pair then receives 31 ECU) and the probability that you will receive the lower amount of ECU 60 is 50% (your pair then receives 90 ECU).

Fig. 2 Screen to calculate the payout at a price of 4

You will be asked to enter the highest price you are willing to pay to get lottery A instead of lottery B. This price can range from 0 to 15 ECU.

Please input your proposed price in the field under the lotteries. You can then click the red button to see how many ECU you would get under lottery A if you chose this price (see Figure 2).

Example: If you are willing to pay 4 ECU in order to get lottery A instead of getting lottery B, then you would 70-4 = 66 ECU with lottery A. The payout of your pair is independent of the price you are willing to pay.

The higher the price you input, the higher is the probability that you will receive lottery A. Indeed, for each decision situation, the computer randomly generates a number between 0 and 15. Any number between 0 and 15 can be pulled with equal probability. If your price is higher than the random number, you get the result of Lottery A minus the random number.

If your price is lower than the random number, you will receive the result from lottery B, without however having to pay. You will therefore never pay more than your chosen price, and most likely less than that.

This mechanism is designed to ensure that you cannot benefit from specifying a price that is higher or lower than what you really are willing to pay to get lottery A. If you specify a price that is lower than your actual willingness to pay for the lottery A, then this decreases the probability you will get it while not affecting the price you would pay for it. In the same way, it is not to your advantage to specify an inflated purchase price, as this may cause you to get the lottery A at a higher price than how much you value it relative to lottery B.

You can change the price until you are satisfied with your decision. For example, if you prefer lottery A to lottery B, you increase the price until you are indifferent between receiving the payout from lottery A or that of lottery B. If you prefer the lottery B to the lottery A, then you should be of course not be prepared to pay anything for lottery A and would input a price of 0. Once you are satisfied with your choice, click on 'Confirm'. The next decision situation will then be displayed.

There will be 44 decisions to make. For each decision situation, you must wait until all other participants have come to a decision before the next decision situation is displayed.

Determination of the payouts:

There will be 44 of the above decision rounds in the main part of the experiment as a whole. All situations are different and you should therefore closely examine the payouts for yourself and your pair in each case.

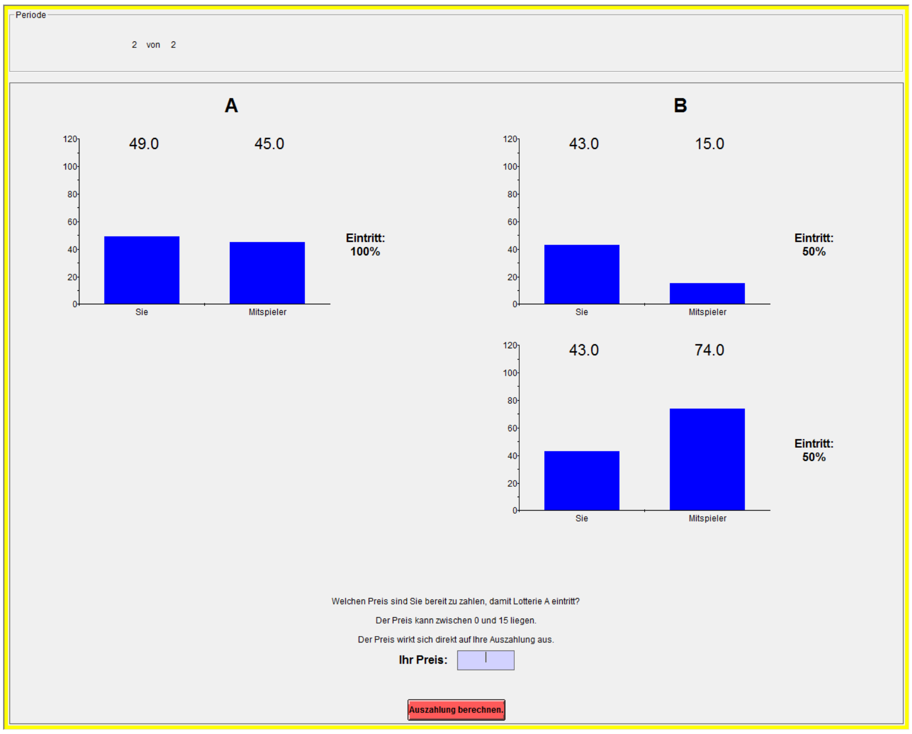
At the end of the experiment the computer will select randomly one of the rounds of the main part of the experiment. Suppose for example that the fifth round is randomly selected. Your decision will determine the payoff in this round with 50% probability. In this case, you will receive the payment you have opted for. With 50% probability however, your pair's decision determines the payout. In this case you receive the amount your pair chose for you. Because you do not know at the time of the decision whether your decision will determine the amount of the payment you will get, you should always act as if your decision was relevant to the payment you will receive.

In addition to the earnings from the main part of the experiment, you will get the payout from a randomly selected decision from the subsequent part of the experiment. The conversion rate in that subsequent part is of 1 ECU = 0.10 €.

Summary:

1: You will be faced with a series of decision rounds.
2: You will be asked to say how much you are willing to pay to get the payout of the lottery A rather than of lottery B.
3: Once having gone through all decision situations, the computer will randomly determine which round will be relevant to the payment, and whether your or your pair's decision will be taken into account.
4: At the end of the main part of the experiment, we will ask you to make a few more decisions, which are not related to the main part of the experiment.

6 Control questions, translated in English



Use the diagram above to answer the following questions.

1. How many ECU do you obtain from lottery A if you are the decision maker?
A: 49 ECU

2. How many ECU does your pair receive from lottery A if you are the decision maker?
A: 45 ECU

3. What is the probability you will get 15 ECU from lottery B if you are not the decision maker?
A: 50%

4. How much should you be willing to pay for lottery A if you prefer lottery B?
A: 0 ECU

5. Suppose you win 70 ECU in the main part of the experiment. What does this amount correspond to in euros?
A: 14 Euros

6. Suppose you prefer lottery A and are willing to pay 10 ECU to receive the amount from that lottery. In which case will you receive the outcome from lottery A?
A: When the randomly drawn number of the computer is less than 10.

7. Suppose your price of 10 ECU is enough to receive the amount from lottery A. What will you pay for lottery A?
A: The randomly drawn number of the computer (less than 10).

8. Suppose you prefer lottery A and are willing to pay 10 ECU to receive the amount from that lottery. How much will you receive when your price of 10 ECU is enough to obtain lottery A?
A: 49 ECU minus the randomly drawn number by the computer (less than 10).