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Decisions under Uncertainty in Social Contexts*

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Abstract

This paper theoretically and experimentally studies decision-making in risky and social environments. We explore the interdependence of individual risk attitudes and social preferences in form of inequality aversion as two decisive behavioral determinants in such contexts. Our model and the data demonstrate that individual risk aversion is attenuated when lagging behind peers, whereas it is amplified under favorable income inequality. Moreover, people's choices are not only context-dependent, but are sensitive to their degree of inequality aversion. The majority of our experimental findings cannot be rationalized by rank-dependent utility models or cumulative prospect theory. Our results contribute to the basic understanding of the underlying principles of decision-making in environments like trading at stock markets, the saving patterns of households or charitable giving under uncertainty.

JEL Classification numbers: C91, D03, D63, D81

Keywords: Choice under Uncertainty, Social Comparison, Inequality Aversion, Risk Preferences.

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1 Introduction

Almost all economic decisions involve uncertainty over the outcomes. Importantly, these actions are made in the presence of others to whom people may have social relations. There is strong evidence that individual decision-making is affected by the behavior and the standing of others in subjects' relevant social peer group.¹ As a consequence, subjects' decisions are determined by both individual risk attitudes and social preferences. Think of a neighbor who dislikes driving a smaller car than you. Consequently, he may start to invest in risky assets to catch up with you. This behavior is referred to the "keeping up with the Joneses effect." On the other hand, most people also tend to dislike being too much ahead in their social community to avoid isolation and envy. This might induce a higher degree of conservatism than without social peers. These examples illustrate that risk-taking behavior is affected by the social context. The magnitude of this impact is likely to depend on individuals' sensitivity to social comparison. Despite the apparent interdependencies between individual risk attitudes and social preferences most previous research focused on each motive in isolation. We therefore address the question how social contexts and the heterogeneity in risk and social preferences affect individual risk-taking.

Answering this question requires a unified theoretical framework which incorporates both dimensions. Only recently a few theoretical papers have started to explore the extension of social preferences to uncertain environments (Fudenberg and Levine, 2012; Maccheroni et al., 2012; Saito, 2013). These articles explore the (subtleties of an) axiomatization of such extensions. Inspired by their work we explore the neglected interdependencies of the two central determinants of individual choice in such an environment: *risk attitudes* and *social preferences*. There is little theoretical literature on this topic and mixed evidence from laboratory and field studies.² We review this literature in Section 2.

Of course, there is no relation between risk attitudes and social preferences *per se*. In fact, this depends on the properties of each domain's theories which are brought together. Our introductory examples emphasize the importance of social preferences for social comparison when incomes differ. In the research on other-regarding behavior the seminal papers by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) established inequality aversion as an important dimension of social comparison. In the current paper

¹This is emphasized in Social Psychology (Festinger, 1954) and by numerous studies in Economics which highlight that subjects compare themselves in many domains such as consumption and saving patterns (Duesenberry, 1949; Frank, 1985; Easterlin, 1995; Neumark and Postlewaite, 1998; Luttmer, 2005). Interestingly, Bault et al. (2008) point out in a neuro-economic experiment that social comparison also affects subjects' emotions. For field evidence on social comparison see Ockenfels et al. (2014).

²For laboratory experiments see, for example, Rohde and Rohde (2011), Linde and Sonnemans (2012), or Schwerter (2016). For field data see for example Fafchamps et al. (2015).

we make use of this concept and extend inequality aversion to an uncertain environment incorporating risk preferences. Our unified framework captures subjects' heterogeneity with respect to risk attitudes and their sensitivity to social comparison. This enables us to theoretically explore our research question. Our analysis generates rigorous predictions which we test in a laboratory experiment.

To account for subjects' heterogeneity regarding the two motives we study a parameterized framework which integrates the constant relative risk aversion model and the Fehr and Schmidt (1999) model of inequality aversion. The model generates the following predictions. When individuals lag behind their social peer, they increase risk taking. Whereas risk-aversion is amplified when subjects face a favorable income position. Moreover, the attenuation of risk aversion induced by the social context is higher, the higher subjects' sensitivity to social comparison. Analogously, the more subjects dislike being ahead of their peers, the more they decrease risk taking compared to the individual context. In the experiment we elicit our model parameters measuring individual subjects' aversion toward risk and inequality. We then analyze individuals' lottery choices in two settings of disadvantageous and advantageous income inequality where we explicitly control for peer effects. The data of our laboratory experiment finds strong support for all hypotheses. Finally we discuss whether our experimental findings are rationalizable by two important theories of decision-making under objective risk, i.e., the rank-dependent utility model of Quiggin (1982) and cumulative prospect theory by Tversky and Kahneman (1992). We show that both theories are incompatible with the majority of our findings.

Our theoretical identification how social environments impact on individual decisions contributes to a broad literature in Economics (e.g., Fehr and Schmidt 1999; Charness and Rabin 2002), Social Psychology (e.g., Festinger 1954; Goethals 1986) and other social sciences advocating the social dimension for decision-making (e.g., Wilkinson and Pickett 2009). Our experimental results provide evidence for the importance of recent theoretical attempts aiming to extend standard economic theory on individual decision-making to more realistic settings characterized by both uncertainty and a social context (Fudenberg and Levine, 2012; Maccheroni et al., 2012; Saito, 2013). More narrowly, we also contribute to the Behavioral Finance and Public Economics literature. For instance, the impact of social comparison on risk-taking may not only help to explain investment behavior at stock markets, but also the difference in saving plans across households with different incomes. As a consequence, these insights may, for example, flow into the design of contracts for financial traders or private saving plans.

2 Related Literature

Humans make most decisions under uncertainty and reflect upon the consequences of their actions relative to their social peers. As a consequence, it is apparent that attitudes toward risk and social preferences should be considered simultaneously. Nevertheless, the literature on choice under uncertainty and social-comparison theory developed along separate lines. To study the apparent interdependencies between these two behavioral determinants requires a model of decision-making under uncertainty in a social context.

Standard theories of social preferences (e.g., Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; Charness and Rabin, 2002) consider individual preferences over certain payoffs. There are two straightforward ways how to extend these theories to uncertain environments. One approach is to model subjects' utility with the means of an expected utility function where lotteries are evaluated by their expected values.³ An alternative is to evaluate lotteries according to the expected values of income. The first approach captures ex-post fairness concerns, whereas the latter reflects ex-ante fairness. For instance, the relevance of both motives was demonstrated by Brock et al. (2013). Recently, Fudenberg and Levine (2012) and Saito (2013) analyzed the axiomatic foundation of these approaches. Importantly, these studies point at the incompatibility of ex-ante/ex-post fairness and the standard independence axiom. They suggest a linear combination of these fairness concepts to solve the aforementioned tension.⁴ Inspired by this work our main interest lies on the neglected interdependence of the two central determinants of behavior in such an environment: *risk attitudes* and *social preferences*. In our theoretical analysis we focus on ex-post fairness concerns and demonstrate that our results carry over to the suggested linear combination of ex-ante and ex-post fairness.

An important dimension of social comparison is subjects' aversion to unequal payoffs. In this respect the seminal papers by Fehr and Schmidt (1999) and Bolton and Ockenfels (2000) established important theoretical concepts of income comparison to peers. In our model we make use of this idea of social comparison and extend it to an uncertain environment incorporating risk preferences. We capture subjects' heterogeneity in risk attitudes and their sensitivity to social comparison. Only a few experimental studies apply inequality aversion, or refer to it in risky environments (Bolton and Ockenfels, 2010; Brock et al., 2013; Friedl et al., 2014; Lahno and Serra-Garcia, 2015). However,

³Maccheroni et al. (2012) generalize the standard subjective expected utility model to a social context and derive an axiomatic foundation for such preferences.

⁴The linear combination of both approaches, however, implies a violation of the independence axiom. Saito (2013) provides a representation theorem for such a linear combination in the case of social preferences of the inequality-aversion type.

the approaches of these studies differ very strongly from ours. More precisely, all studies do not incorporate risk preferences. Thus, it remains unclear how to compare subjects' choices in different scenarios where they face social risk. In a pure experimental setting Bolton and Ockenfels (2010) show in a risky dictator game that when a safe option leads to unfavorable inequality, subjects significantly more often prefer a risky choice. The paper argues that this finding may be interpreted by inequality-aversion motives of subjects. However, the study provides no theory modeling the interplay of subjects' heterogeneity in risk and social preferences. The main focus of Brock et al. (2013) is the relative importance of ex ante and ex post fairness. In risky dictator games the authors show that dictators' choices can be best explained by a combination of ex post and ex ante fairness concerns. Friedl et al. (2014) analyze insurance decisions and conclude that social comparison makes insurance less attractive if risks are correlated. Lahno and Serra-Garcia (2015) investigates the tension between imitation and relative payoff concerns. The main finding is that both concepts are relevant for peer effects.

Other papers do not concentrate on inequality aversion. Inspired by Kahneman and Tversky's (1979) Prospect Theory, Schwerter (2016) analyzes ahead-seeking behavior in the presence of social reference points. The paper reports results from experimental treatments, where subjects are either peered with a passive player who owns a low/high endowment. The theoretical analysis focuses on this specific case and neglects the heterogeneity in risk preferences and social preferences. The paper finds for sufficiently social loss averse subjects, that they choose a less risk-averse lottery in the treatment with the high endowment. Gamba et al. (forthcoming) theoretically analyzes a more general prospect-theory setting. Similarly, to Schwerter (2016), the paper focuses on ahead-seeking motives and neglects subjects' heterogeneity in risk preferences and social preferences. In a real-effort labor-market setting the paper finds a treatment effect where subjects are more risk averse in the presence of small social gain than social loss. By contrast, most of the papers on social comparison in uncertain environments neglect a theoretical background and find inconclusive results.

For instance, Rohde and Rohde (2011) find that risk taking is less affected in the presence of multiple peers. An explanation is that peer effects may be washed out in the presence of ten referents.⁵ Linde and Sonnemans (2012) attempt to make peer effects more salient by letting subjects first play a Bertrand game. The paper finds no differences in subjects' behavior, i.e., they become risk averse in contexts of social gains and losses. In a lab in the field experiment with Ethiopian farmers Fafchamps et al. (2015) find that

⁵Gaudeul (2016) studies a similar setting and finds that collective risk is of minor importance.

farmers who earn relatively less than their peers lower risk aversion.

In summary, there is some experimental evidence documenting the relevance of the social context for individual risk taking. However, the majority of these experiments do not build on a theory and report inconclusive results. The non-existence of a theory focusing on the interdependence of these behavioral traits makes it difficult to discriminate among several alternative explanations. The few theoretical results are limited as they are solely restricted to ahead-seeking motives and ex post fairness. Moreover, they ignore subjects' heterogeneity in risk preferences and social preferences. Notably, the diversity of subjects' risk attitudes and social preferences has been confirmed in a bulk of experimental papers (e.g., Fehr and Schmidt, 1999; Fehr and Gächter, 2000; Engelmann and Strobel, 2004; Dohmen et al., 2012; Blanco et al., 2011; Müller and Rau, 2016). To the best of our knowledge, we are the first to model risky decisions in social environments with a parameterized model that unifies risk attitudes and inequality aversion. The parameterization enables us to make rigorous predictions for risky decisions in social environments for subjects with different risk attitudes and social concerns. We specifically designed an experiment to test the derived predictions.

3 Theoretical Framework

There are two straightforward extensions for fairness preferences under certainty to lotteries. The first extension reflects ex-ante fairness concerns by evaluating lotteries by their expected income, the second reflects ex-post fairness by taking the expected utility. As mentioned above there is some theoretical tension between ex-ante fairness, ex-post fairness, and independence. In section 3.1 we demonstrate the basic mechanics of our argument by the means of a parameterized example in an expected utility framework, i.e., a setting which captures ex-post fairness. In this setting the standard independence axiom trivially holds. Recent theoretical literature (Fudenberg and Levine, 2012; Saito, 2013) suggests a linear combination of ex-ante and ex-post fairness to solve the aforementioned tension, which however inevitably violates the standard independence axiom. We will demonstrate in section 3.2 that our results carry over to this generalization. We also show under which conditions our results for the parameterized version also hold for more general functional forms than the specification of Fehr and Schmidt (1999).

3.1 Parameterized Example

Our parameterized example combines two prominent behavioral models: the model of constant relative risk aversion (CRRA) and the Fehr and Schmidt (1999) model of inequality aversion. The latter is given by $\tilde{u}(x, y) = x - \alpha \cdot \max\{0, y - x\} - \beta \cdot \max\{0, x - y\}$ for a given own income x and income y for the relevant peer, i.e., α measures aversion to disadvantageous inequality and β aversion to advantageous inequality. Adding the CRRA-utility function $\tilde{v}(x)$ gives us:

$$u(x, y) = \tilde{v}(x) + x - \alpha \max\{0, y - x\} - \beta \max\{0, x - y\}^6 \quad (1)$$

, where

$$\tilde{v}(x) = \begin{cases} \frac{x^{1-r}-1}{1-r} & r \neq 1 \\ \ln(x) & r = 1 \end{cases}$$

For now we assume that preferences over joint payoff distributions of monetary outcomes for the decision maker and the considered social peer have an expected utility representation with expected utility function $u(x, y)$. We will assume that these risk preferences for the social context are consistent with individual risk preferences. Hence, if we define $v(x) = \tilde{v}(x) + x = u(x, x)$, then $v(x) \in \mathcal{C}^2(\mathbb{R})$ reflects an individual's utility in the absence of inequality concerns.⁷ In other words, $v(x)$ resembles an individual's preferences over lotteries in own income x neglecting inequality concerns. Note that without some consistency of risk preferences between the individual and social context it will be impossible to establish any relation between the two induced by social preferences. The parameterized utility function given by (1) will also function as the benchmark for our laboratory experiment.

The following figure illustrates the relation of risk aversion and inequality aversion for a risk-averse individual. If inequality aversion enters utility linearly, only the effect on the slope of $u(x, y)$ relative to $v(x)$ is decisive for the relation. Figure 1 shows that in the advantageous region the slope of $u(x, y)$ is smaller than the slope of $v(x)$. Thus, since the second derivatives of $u(x, y)$ and $v(x)$ w.r.t. x are identical, the degree of risk aversion according to the Arrow-Pratt measures of absolute and relative risk aversion increases. As a consequence, in line with our introductory motivation, individuals are expected to take less risk when they are ahead of their peers. *Ceteris paribus* this effect

⁶Setting $v(x) = \tilde{v}(x) + x$ instead of $v(x) = \tilde{v}(x)$ ensures positive marginal returns to own income for $\beta \in [0, 1]$.

⁷Note that $v(x) = \frac{x^{1-r}}{1-r} + x$ shows decreasing relative risk aversion. There is empirical support for this by Ogaki and Zhang (2001) who study low income households.

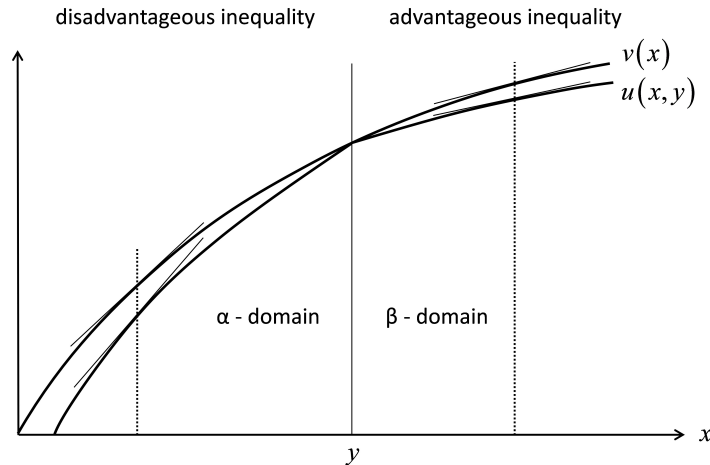


Figure 1: The relation of aversions to risk and inequality for given peer income y .

is more pronounced the higher the degree of inequality aversion. The reverse is true in the region of disadvantageous inequality. The slope of $u(x, y)$ is greater than the slope of $v(x)$ and therefore the Arrow-Pratt measures decrease. Consequently, individuals are expected to take more risk if they are behind relative to their peers. Again, the tendency to take higher risk when lagging behind is *ceteris paribus* more pronounced the higher the level of inequality aversion. Let RA refer to either absolute or relative risk aversion. The following Proposition summarizes these insights.

Proposition. *If an individual's expected utility function is given by (1) and $\alpha, \beta > 0$ we can distinguish two cases. (1) For risk-averse individuals $RA(u(x, y)) < RA(v(x))$ if and only if $x < y$. $RA(u(x, y))$ weakly decreases in α and weakly increases in β . (2) For risk-loving individuals $RA(u(x, y)) > RA(v(x))$ if and only if $x < y$. $RA(u(x, y))$ weakly increases in α and weakly decreases in β .*

Proof. All proofs are given in Appendix A. □

Thus, this example suggests that risk aversion and inequality aversion may be fundamentally related. In particular, the Proposition shows that subjects' individual risk aversion is amplified by their aversion to favorable inequality, whereas an aversion to unfavorable inequality attenuates the individual risk aversion. This captures the intuition behind our introductory example of individuals seeking higher risk to catch up with their peers, the “keeping up with the Joneses effect.” On the other hand, individuals in relatively favorable positions may reduce risk-taking to avoid even higher economic distance to their peers. In the next section we explore to what extent the results for this parameterized model generalize.

Note that this result does not imply that people with high incomes are more risk averse or that people with low incomes are more risk seeking since they are more likely to lag behind their social peer. Indeed, empirical studies suggest that the opposite is the case, i.e., low-income subjects have proven to be more risk averse (e.g., Lawrance 1991; Pender 1996; Haushofer and Fehr 2014). Importantly, the Proposition above only states that risk taking in the social context is more pronounced when lagging behind *relative* to the individual context. In other words, our model predicts a relation between risk taking across contexts but has no implication for the correlation of risk preferences and income.

Finally, the literature on social preferences also discusses the motive of humans to be ahead of their peers (e.g., Fershtman et al. 2012). This type of motivation (ahead-seeking preferences) seems particularly relevant in competitive environments. We discuss this in more detail at the end of section 5.2. However, note at this point that our framework also covers ahead-seeking preferences. In our model this type of preference translates into $\alpha > 0$, and $\beta < 0$. Hence, the predictions for the unfavorable domain remains unaltered. In contrast we reach the opposite conclusion in the domain of favorable inequality. That is, subjects led by ahead-seeking motives would increase their risk taking relative to the individual context also beyond the point of equality. Moreover, this increase is *ceteris paribus* more pronounced the stronger the ahead-seeking preference.

3.2 Generalization

We first analyze to what extent the results presented above carry over to more general functional forms. Consider an individual with a preference relation \succsim_{soc} over joint payoff distributions $F(x, y)$ with own income x and income y for the relevant peer. We assume that these preferences have an expected utility representation, i.e., $U(F) = \int u(x, y)dF(x, y)$, where $u(x, y)$ denotes the function which evaluates the allocation x, y . We again assume the consistency of social risk preferences which in an expected utility framework are captured by the properties of $u(x, y)$ with individual risk preferences. More precisely, we say that social risk preferences \succsim_{soc} are *consistent* with individual risk preferences \succsim_{ind} whenever $u(x, x)$ represents the decision maker's preferences over payoff distributions of own income. In other words, individual and social risk preferences are consistent when an individuals' risk-taking behavior in both contexts is identical as long as the social peer in each state of nature has the same income as the decision maker.

Moreover, we will assume that the preference relation is separable in the sense that $u(x, y) = v(x) - h(x, y)$ ⁸, where $v(x) \in \mathcal{C}^2(\mathbb{R}_{>0})$ and $h(x, y) \in \mathcal{C}^2(\mathbb{R}_{x \neq y}^2)$. The following

⁸See Neilson (2006) for a representation theorem.

assumption captures the idea that $h(x, y)$ measures the aversion to inequality:

$$h(x, y) \geq 0, \quad h(x, y) = 0 \Leftrightarrow x = y, \quad h_x(x, y) = \begin{cases} < 0 & , x < y \\ > 0 & , x > y \end{cases}$$

The positivity of $h(x, y)$ reflects that individuals are assumed to dislike inequality, and $h(x, y)$ vanishes if and only if there is a egalitarian distribution. The assumptions regarding the partial derivatives correspond to the idea that a lower level of inequality increases utility, whereas more inequality implies lower levels of utility. Finally, we assume that the marginal utility for own income is positive, irrespective of the level of inequality, i.e., $u_x(x, y) > 0, \forall x, y$. Note that this setting covers the Fehr and Schmidt (1999) model with $v(x) = \tilde{v}(x) + x$ and $h(x, y) = \alpha \max\{0, y - x\} + \beta \max\{0, x - y\}$. It also allows for any combination of individual risk preferences and the model of Bolton and Ockenfels (2000).⁹ with $v(x) = \tilde{v}(x) + ax$ and $h(x, y) = \frac{b}{2} \left(\frac{x-y}{2(x+y)} \right)^2$.

Since a general function $h(x, y)$ may not only change the slope of $u(x, y)$, but also its curvature, we cannot expect the above results to hold under full generality. It turns out that if the curvature effect is not too strong, then we obtain the same results as for the parameterized model. For the exact condition we refer the reader to Appendix A. Intuitively, for $x > y$ ($x < y$) if the decrease in the marginal disutility from inequality captured by h_{xx} is not too strong, the presence of inequality aversion will sufficiently decrease (increase) marginal utility from own income x such that RA increases (decreases).

Let us now turn to the question to what extent our results also hold for a model which captures both ex-ante and ex-post fairness concerns. Fudenberg and Levine (2012) and Saito (2013) suggest a linear combination of two extensions for fairness preferences under certainty to lotteries. The first extension reflects ex-ante fairness concerns by evaluating lotteries by their expected income, the second reflects ex-post fairness by taking the expected utility. For the sake of exposition we focus on the two-person case. Thus, let social risk preferences \succsim_{soc} over joint payoff distributions F be represented by $U(F) = \delta \cdot u(E_F(x, y)) + (1 - \delta) \cdot \int u(x, y) dF(x, y)$, where $u(x, y) = v(x) - \alpha \max\{0, y - x\} - \beta \max\{0, x - y\}$ and E_F is the expectation operator with respect to F . Saito (2013) offers an important axiomatization for his expected inequality-averse model with multiple peers which implies the above representation with $v(x) = x$.

We will again assume the consistency between social and individual risk preferences.

⁹The two-player version of the Bolton and Ockenfels (2000) model is given by $U(x, y) = a \cdot x - \frac{b}{2} \cdot \left(\frac{x}{x+y} - \frac{1}{2} \right)^2$.

That is, the individual risk preferences \succsim_{ind} over probability distributions F_{ind} on \mathbb{R} of the above decision maker may correspond to the social preferences \succsim_{soc} . This is the case, when the individual risk preferences are limited to lotteries which involve no inequality in payoffs between the decision maker and the peer. More precisely, \succsim_{ind} are represented by the function V on $\Delta(\mathbb{R})$, the set of all lotteries over \mathbb{R} , defined by $V(F_{ind}) = U(\tilde{F})$. The probability distribution \tilde{F} on \mathbb{R}^2 denotes the lottery which in any state assigns the same payoff as F_{ind} for both subjects: the decision maker and the social peer.

To analyze the interrelation between individual and social risk preferences in the presence of fairness concerns for both the equality of outcomes and chances, let us consider the two extreme cases of $\delta = 0$ and $\delta = 1$. For the case of a subject who only cares about equality in outcomes, we are obviously redirected to the framework of our Proposition in Section 3.1. As a consequence, we obtain the same results. In the latter case the subject only cares about equality in chances. Here, we get $V(F_{ind}) = v(E_{\tilde{F}})$ for any $F_{ind} \in \Delta(\mathbb{R})$, i.e., the individual risk preferences reflect only the expected payoff of the lottery. Such a subject is risk neutral and lotteries are ranked according to their expected value. Focusing on social risk preferences this subject also takes into account the expected inequality induced by the lotteries. Of course, the concern for ex ante fairness introduces a trade off between own expected payoff and expected inequality. That is, a lottery with a lower expected payoff for the decision maker could be preferred over a lottery with a higher expected payoff, if the latter is associated with a higher level of expected inequality. To isolate the effect of the presence of a social peer, consider a set of lotteries with a fixed peer income of y . Under the assumption that the decision maker is characterized by a positive marginal utility in his own (expected) payoff then this is essentially equivalent to the situation depicted in Figure 1 with certain payoffs replaced by expected payoffs. In other words the ranking of the lotteries in this set would be the same for both the individual and the social context. The decision maker would in both contexts choose the lottery with the highest expected payoff. Thus, for all $\delta \in [0, 1)$ we obtain the same results as in the Proposition above.

In summary, the results presented in the Proposition above are robust with respect to alternative functional forms representing the preference for equality if the impact on the curvature is not too strong. Moreover, the results also carry over to more general models of inequality aversion suggested by recent theoretical literature capturing not only ex-post fairness but also concerns for equality in chances. Thus, the derived mutual interference of two key motives for decision-making under risk in a social context holds with some generality.

4 Experiment

In this section we introduce our experimental design and demonstrate how we elicit the model parameters: r , α , and β . Finally, we present the experimental procedures.

4.1 Experimental Design

We conduct a within-subjects experiment with six consecutive stages. This paper focuses on stages 1–4, whereas stages 5 and 6 are pilot studies for another project.¹⁰ At the end of our experiment one stage is randomly paid out. The reason for the within-subjects design is that we first elicit subjects’ individual risk and fairness preferences before we test our model. We refrain from using a between-subjects design as we need to take into account a subject’s risk and social preferences to study her risk-taking behavior when being confronted with the scenarios of our model. This approach would be incompatible with a between-subjects design. We are aware of potential carry-over effects in within-subjects designs, i.e., different orders may impact subjects’ decisions. In our design we measure subjects’ risk and social preferences in stages 1–3 and test in stage 4 their risk-taking behavior under disadvantageous (advantageous) inequality. As our outcome variable is the change in risk-taking behavior in social contexts (stage 4), we run a different order where we swap stage 4 with the elicitation of individual risk taking (stage 1). That is, we test the theory in stage 1, whereas we control for individual risk preferences in stage 4.¹¹ We pool these data with the data of the nine sessions with standard order as Kolmogorov-Smirnov tests reveal no conspicuous differences for any of the parameters.¹²

In stages 1–3 of our design, we measure the parameters of subjects’ risk preferences (r), and their aversion to disadvantageous (α) and advantageous inequality (β). We apply these parameters to the utility function presented in equation (1). We use the Fehr and Schmidt (1999) inequality-aversion parameters to resemble subjects’ social preferences. We obtain these parameters experimentally in the modified dictator game (MDG) and the ultimatum game (UG) proposed by Blanco et al. (2011). Although, these methods are stylized there is evidence that social preferences elicited with these methods are very

¹⁰The focus of this project will be on betrayal aversion.

¹¹We also changed the order of the elicitation stages of the Fehr and Schmidt parameters, i.e., β is measured in stage 2, α is elicited in stage 3. In the standard order we first elicited α , followed by β .

¹²That is, β , α , and r_β are never significantly different when compared with the data of the nine sessions (54 pairwise comparisons). For r and r_α 32 of 36 pairwise comparisons are not significantly different. Whereas, four comparisons reveal a moderate difference at the 10% level. See Table 8 in Appendix B for a detailed overview.

stable in the lab and may be good proxies for fairness behavior in the field.¹³ Moreover, lab experiments may be an important tool to better understand underlying mechanisms and evoke empirical puzzles (Levitt and List 2007). The experimental design aims to test our theory in stage 4. Table 1 depicts the timeline of this study.

objective	individual risk preferences	social preferences: aversion to unfavorable inequality favorable inequality		social risk preferences
task	lottery choice with perfectly correlated payoffs	modified dictator game	ultimatum game	lottery choice when ahead or behind a social peer
stage	stage one	stage two	stage three	stage four

Table 1: Timeline of the experiment.

Stage One: Elicitation of individual risk preferences

In this stage we measure the determinants of risk choices in a purely individualistic environment where social concerns are absent. We elicit subjects’ risk aversion (r), given the parameterized version of our model. Subjects are randomly matched with a partner and each of them simultaneously chooses a lottery. Subjects can only choose one of nine lotteries. The lotteries realize under a certain probability either a high payoff (Event A) or a payoff of €0.10 (Event B). Subjects know that at the end of the experiment the computer will randomly determine which player is *active*. The lottery choice of the active players is relevant and determines the payoff of both players. In any case of stage one both players will end up with the same payoff. Thus, lottery choices cannot yield inequality. This enables us to interpret players’ lottery choices, as their individual risk preferences. Table 2 overviews the choice set, i.e., the gambles and their expected payoffs. It also indicates for each choice the corresponding range of r in the function: $u(x) = x^{(1-r)}/(1-r) + x$. The r ranges reflect subjects’ pure risk preferences. We take the mean of this range to estimate individuals’ r . It can be seen that lotteries 1–7 are preferred by *risk-averse* subjects, whereas lotteries 8 and 9 capture *risk-seeking* behavior. At the extremes we set for choice 1, $r = 2.55$, whereas we set for choice 9, $r = -0.75$.¹⁴ In the experiment subjects could only see columns 1–4 of Table 2 (choice, event, probability, payoff (€)).

¹³Normann and Rau (2015) successfully predict the outcome of their step-level public good experiments in Germany using the UK data of Blanco et al. (2011). Further evidence by Benz and Meier (2008) demonstrates that the results of a donation dictator experiment are correlated with donation behavior in the field.

¹⁴However, this simplification will not influence our data as we exclude these border choices for statistical reasons. We comment on this in the first paragraph of Section 5.1.

Choice	Event	Probability (%)	Payoff (€)	Exp. payoff	r ranges
1	A	100	5.00	5.00	$r > 2.55$
	B	0	0.10		
2	A	90	8.05	7.26	$2.00 < r < 2.55$
	B	10	0.10		
3	A	80	10.25	8.22	$1.50 < r < 2.00$
	B	20	0.10		
4	A	70	12.46	8.75	$1.05 < r < 1.50$
	B	30	0.10		
5	A	60	15.15	9.13	$0.64 < r < 1.05$
	B	40	0.10		
6	A	50	18.80	9.45	$0.30 < r < 0.64$
	B	50	0.10		
7	A	40	24.08	9.69	$0.00 < r < 0.30$
	B	60	0.10		
8	A	30	32.07	9.69	$-0.75 < r < 0.00$
	B	70	0.10		
9	A	20	40.88	8.26	$r < -0.75$
	B	80	0.10		

Table 2: Subjects' gamble choices and the corresponding expected payoffs.

Stage Two: Elicitation of subjects' aversion to unfavorable inequality (α)

In stage two we apply the method of Blanco et al. (2011) to derive point estimates of individuals' α for our model of risky choices in a social context. In the ultimatum game of Blanco et al. (2011) subjects have to make decisions in the role of first- and second movers. Subjects know that after the experiment is finished, the computer will randomly pair two players and determine a subject's role (dictator or recipient) and the payoff-relevant decision. At the beginning, all subjects simultaneously act as proposers. They have to decide how much of €19 they are willing to offer to the second mover. Subjects are restricted to integer proposals. Afterwards, all subjects simultaneously make decisions in the role of responders. The responders have to indicate which minimum first-mover offer they would accept. Subjects are given a table with 19 rows of different proposals (for each possible integer proposal between €1 and €19). They have to indicate for each of these 19 proposals whether they would reject or accept it. Therefore, all proposals have to be marked for rejection or acceptance. The goal of this approach is to find out when subjects switch from rejecting an offer to accepting it. Therefore, the table contains 20 buttons which are each located above each proposal. Subjects are told that clicking on a button would mean that all proposals below the button would be marked for acceptance, whereas all proposals above the button would be marked for rejection. For instance, if a subject would be willing to accept all proposals between 1 and 19, she should click on the

first button. Whereas, if a subject would be willing to accept all proposals starting from €5, she would click on button 5. The lowest offer a subject accepts (switching point) determines her α . The parameter is derived as follows.

Suppose x' is the lowest offer a responder is willing to accept. Thus, $x' - 1$ is the highest offer which would be rejected by this responder. A responder with preferences represented by equation 1 will hence be indifferent between accepting some offer $x_{UG} \in [x' - 1, x']$ and getting a payoff of one from a rejection. Therefore, we have

$$v(x_{UG}) - \alpha(19 - x_{UG} - x_{UG}) = v(1) = 1 \Leftrightarrow$$

$$\alpha = \begin{cases} \frac{x_{UG}-1}{2(9.5-x_{UG})} + \frac{x_{UG}^{1-r}-1}{2(9.5-x_{UG})(1-r)} & r \neq 1 \\ \frac{x_{UG}-1}{2(9.5-x_{UG})} + \frac{\ln(x_{UG})}{2(9.5-x_{UG})} & r = 1 \end{cases} \quad (2)$$

For our data analysis, we set $x_{UG} = x' - 0.5$. Note that our qualitative results do not depend on this somewhat arbitrary choice. A rational player will always accept the equal split in the UG and hence have $x' \leq 9$, since subjects are limited to integer offers. For subjects with $x' = 1$ we do not observe a rejected offer. Thus, we cannot infer the point of indifference x_{UG} . Therefore, we set $\alpha = 0$ in this case, although these subjects could actually have negative values for α . For subjects who accept $x' \geq 10$ we can only infer that $\alpha \geq 8 + \frac{9^{1-r}-1}{(1-r)}$. We therefore assign $\alpha = 8 + \frac{9^{1-r}-1}{(1-r)}$ to these subjects. Again, our results are robust to this somewhat arbitrary handling of boundary cases.

Stage Three: Elicitation of subjects' aversion to favorable inequality (β)

In stage three we apply the modified dictator game introduced by Blanco et al. (2011) to measure subjects' β parameters in our model. In the MDG, subjects are given a list with 20 pairs of payoff vectors (see instructions in the Appendix). The participants have to choose one of the two payoff vectors for all 20 cases. Both vectors represent a money split between the dictator and the recipient. The left vector is constant and always (19, 1). If the participants choose this vector they receive €19 and the recipients earn €1. All vectors on the right-hand side resemble increasing equal-money splits: from (1, 1) to (20, 20). The goal is to determine each subject's switching point, i.e., when do dictators switch from (19, 1) to the equal split? The table contains 21 buttons which are each located above all decisions between an unequal and equal split. Subjects are told that clicking on a button has the effect that all equal splits below the button are marked for selection, whereas all unequal splits above the button are also marked for selection. For instance, if a subject would prefer all equal splits from (1, 1) to (20, 20) over the unequal

split, she should click on the first button. Whereas, if a subject only prefers all equal splits starting from (8, 8) she should click on button 8. An individual subject's β is determined by the switching point, i.e., when a subject switches from choosing the selfish split to the egalitarian outcome. Let x' denote the point where a subject switches from (19, 1) to the egalitarian distribution (x', x') . That is, the individual prefers (19, 1) over $(x' - 1, x' - 1)$, but (x', x') over (19, 1). Thus, there is a $x_{MDG} \in [x' - 1, x']$, such that the subject is indifferent between the (19, 1) distribution and (x_{MDG}, x_{MDG}) . From (1) we get $u(19, 1) = u(x_{MDG}, x_{MDG})$. This gives us

$$v(x_{MDG}) = v(19) - 18 \cdot \beta \Leftrightarrow \beta = \begin{cases} \frac{19-x_{MDG}}{18} + \frac{19^{1-r}-x_{MDG}^{1-r}}{18 \cdot (1-r)} & r \neq 1 \\ \frac{19-x_{MDG}}{18} + \frac{\ln(x_{MDG})}{18} & r = 1 \end{cases} \quad (3)$$

For our data analysis we set $x_{MDG} = x' - 0.5$. For an individual who chooses (1, 1) over (19, 1) we do not observe a switching point. We set $1 + \frac{19^{1-r}-1}{18 \cdot (1-r)}$ in this case. This corresponds to the procedure in Blanco et al. (2011) who set $\beta = 1$ for these types of subjects. Anyway, this handling of non-observable switching points is not relevant for our results. There is evidence that individuals may be characterized by a negative β , indicating a preference for favorable inequality.¹⁵ Since our theory implies the reverse prediction for those subjects, we control for negative β 's in our design. We extended the choice set such that subjects can reveal a preference for favorable inequality. These subjects should show a switching point of $x' = 20$ or no switching point at all.

Stage Four: Elicitation of social risk preferences

Stage four serves as our model test. Here, subjects choose under uncertainty in a social context. They are randomly matched into pairs and make a choice among risky lotteries for two states of nature. State one resembles a situation where one of the players (i.e., the active player) will end up in an unfavorable position with certainty. The setting is designed to test hypothesis 1a and 1b. In this scenario one of the matched players has no endowment, whereas the other player is endowed with €15. The player without an endowment is active, has to choose one out of nine lotteries, and ends up in an unfavorable position with certainty. The reason for the latter is that each lottery yields a positive payoff smaller than €15, independently of the realized event. The lotteries are presented in Table 3. Note that we explicitly opted for payoffs which are not round decimals. We

¹⁵See Fehr and Schmidt (1999) and Huck et al. (2001)

had two reasons for this. First, we wanted to avoid that subjects focus on prominent numbers. Second, as we make use of a within-subjects experiment with alike stages we intended to avoid similar payoffs.

Choice	Event	Prob.(%)	Payoff (€)	Exp. payoff	r_α ranges	$\alpha_{k,k+1}$ ($\alpha_{k,k+2}$)
1	A	100	1.50	1.50	$r_\alpha > 2.55$	0.00 (1.61)
	B	0	0.10			
2	A	95	2.57	2.45	$2.00 < r_\alpha < 2.55$	0.64 (2.30)
	B	5	0.10			
3	A	85	3.86	3.30	$1.50 < r_\alpha < 2.00$	0.45 (1.50)
	B	15	0.10			
4	A	75	4.95	3.74	$1.05 < r_\alpha < 1.50$	0.40 (1.15)
	B	25	0.10			
5	A	65	6.11	4.01	$0.64 < r_\alpha < 1.05$	0.34 (1.70)
	B	35	0.10			
6	A	55	7.54	4.19	$0.30 < r_\alpha < 0.64$	0.65 (n.o.)
	B	45	0.10			
7	A	45	9.44	4.30	$0.00 < r_\alpha < 0.30$	n.o.
	B	55	0.10			
8	A	35	12.11	4.30	$-0.75 < r_\alpha < 0.00$	/
	B	65	0.10			
9	A	25	14.95	3.81	$r_\alpha < -0.75$	/
	B	75	0.10			

Table 3: Subjects' gamble choices and the corresponding expected payoffs to test hypotheses 1a and 1b. n.o. – indicates that a switch in lotteries is not observable.

Table 3 also presents information on the mean risk aversion which is associated by a certain lottery choice of a subject when facing disadvantageous inequality. We want to emphasize that the set of lotteries is designed such that subjects with no or weak preferences for equality are expected to choose the same lottery in the social context. That is the range of r for each lottery is the same for the individual and the social context. To distinguish social risk preferences (elicited in this stage) from individual risk preferences (r) (elicited in stage one), we will denote the mean r which corresponds to a subject's lottery choice in an unfavorable position, as r_α . Here, we are interested in the change of subjects' risk aversion between stage one (r) and when faced with disadvantageous inequality (r_α). The table also reports information on the impact of inequality aversion on subjects' risky choice in a social context. In more detail, we derive for each risk level (r) of stage one the maximum α such that subjects would choose the same lottery as in stage one (this would imply: $r_\alpha = r$). The thresholds are derived by using the mean r of an individual's lottery choice (see the Appendix B for more details). We present these data in the last column of the table. Subjects with an α above these thresholds ($\alpha_{k,k+1}$, where $k = 1, \dots, 9$ represents the lottery number) would increase their lottery choice by

one. Whereas, subjects with an α above the values in the parentheses ($\alpha_{k,k+2}$) would increase their lottery choice by two. For the sake of limited space, Table 3 only represents thresholds for switches by one or two lotteries, i.e., $\alpha_{k,k+1}$ and $\alpha_{k,k+2}$. For example, if a subject chooses lottery three in stage one, we set $r = 1.75$. According to equation (1) this subject would choose lottery four (five) for $\alpha > 0.45$ (1.50). In the first case we would set $r_\alpha = 1.27$ for this subject in the second case $r_\alpha = 0.84$.¹⁶ In the experiment subjects could only see columns 1–4 of Table 3 (choice, event, probability, payoff (€)).

In the second scenario the player who will be designated as an active player ends up in a favorable position with certainty. The reason is that each lottery yields a positive payoff, independently of the realized event (see Table 4). The setting is designed to test hypotheses 2a and 2b. In this scenario neither player has an endowment. The active player again has to choose one out of nine lotteries. These lotteries are presented in Table 4. The table also depicts information on the mean risk aversion which is associated by a certain lottery choice of a subject when facing advantageous inequality. Again, the set of lotteries is designed such that subjects with no or weak preferences for equality are expected to choose the same lottery as in individual context. To distinguish social risk preferences (elicited in this stage) from individual risk preferences (r) (elicited in stage one), we will denote the mean r which corresponds to a subject's lottery choice in a favorable position, as r_β . Here, we are interested in the change of subjects' risk aversion between stage one (r) and when faced with disadvantageous inequality (r_β). In the experiment subjects could only see columns 1–4 of Table 4 (choice, event, probability, payoff (€)).

The table also presents thresholds such that subjects with β 's above these thresholds would decrease her lottery choice by one (two) as compared to the choice in stage one. The thresholds are derived analogously to the thresholds for α . We again use the mean r of an individual's lottery choice (see Appendix B for more details). For example, if a subject chooses lottery three in stage one, we set $r = 1.75$. According to equation (1) this subject would choose lottery two (one) for $\beta > 0.30$ (0.75). In the first case we would set $r_\beta = 2.27$ for this subject in the second case $r_\beta = 2.55$.¹⁷ Note, for subjects who choose the safe lottery (lottery one) in stage one, we cannot observe a choice which reflects an even higher degree of risk aversion.

Note that in both scenarios the active player has an endowment of €0. Thus, differences in the lottery choice across scenarios cannot be induced by the fact that subjects start from different income levels. In both states we apply the strategy method (Selten 1967), i.e., all players decide in the role of an active player. There is evidence that ex-

¹⁶At the extremes, we again set for choice 1, $r_\alpha = 2.55$ and for choice 9, $r_\alpha = -0.75$.

¹⁷At the extremes, we proceed as in Tables 2 and 3.

Choice	Event	Prob. (%)	Payoff (€)	Exp. payoff	r_β ranges	$\beta_{k,k-1}$ ($\beta_{k,k-2}$)
1	A	95	4.00	3.81	$r_\beta > 2.55$	n.o.
	B	5	0.10			
2	A	85	7.10	6.05	$2.00 < r_\beta < 2.55$	0.37 (n.o.)
	B	15	0.10			
3	A	75	9.31	7.01	$1.50 < r_\beta < 2.00$	0.30 (0.75)
	B	25	0.10			
4	A	65	11.53	7.53	$1.05 < r_\beta < 1.50$	0.21 (0.63)
	B	35	0.10			
5	A	55	14.28	7.90	$0.64 < r_\beta < 1.05$	0.15 (0.50)
	B	45	0.10			
6	A	45	18.13	8.21	$0.30 < r_\beta < 0.64$	0.22 (0.52)
	B	55	0.10			
7	A	35	23.96	8.45	$0.00 < r_\beta < 0.30$	0.70 (1.10)
	B	65	0.10			
8	A	25	33.50	8.45	$-0.75 < r_\beta < 0.00$	/
	B	75	0.10			
9	A	15	45.45	6.90	$r_\beta < -0.75$	/
	B	85	0.10			

Table 4: Subjects’ gamble choices and the corresponding expected payoffs to test hypotheses 2a and 2b. n.o. – indicates that a switch in lotteries is not observable.

perimental results obtained by the strategy method do not differ when compared to the direct-response method (Brandts and Charness 2011). We opted for the strategy method as we aim to test each subject’s behavior in both scenarios. In our experiment if stage four is chosen to be paid out, a random draw determines which state is paid out. In this case the computer randomly determines the active and passive players and the resulting outcomes. Subjects know in advance that if stage four is selected, they will be informed of their outcome and the outcome of the matched player at the end of the experiment.

Experimental Procedures

Subjects were informed in the instructions that the experiment consists of six separate stages. They also knew that they would receive a new set of instructions after a part was finished. We explicitly explained that the computer would randomly select one of the six stages to be payoff relevant. The experiments were programmed in z-Tree Fischbacher (2007) and conducted in the GLOBE Lab of Göttingen University. In total, 236 subjects (117 men and 119 women) participated in 11 sessions. The majority of our sessions encompassed 24 subjects.¹⁸ Our participants were from different field of studies and were recruited with ORSEE (Greiner, 2015). On average, sessions lasted 70 minutes and

¹⁸In three of the 11 sessions, less than 24 subjects showed up. We also control for session size in robustness checks of our data analysis. It turns out that session size does not affect our results.

subjects' average payment was €14.13.

4.2 Hypotheses

In this section we derive hypotheses based on the Proposition in section 3.1. Since most subjects are expected to be classified as risk averse, the hypotheses are only derived for those individuals. The proposition leads to four testable hypotheses, i.e., two for each domain of inequality.

Hypothesis 1*a* mirrors the intuition that in an unfavorable position social risk aversion may fall below individual risk aversion. Hypothesis 1*b* is derived from the insight that for a given r , RA decreases in α . In other words, for two subjects with the same degree of individual risk aversion (r), the one with the higher α will choose the more risky lottery.

Hypothesis 1. *In an unfavorable position:*

- (a) *Subjects characterized by $r > 0$ and $\alpha > 0$ will take higher risks ($r > r_\alpha$).*
- (b) *On average, subjects' risk-taking will be higher, the higher their level of aversion to unfavorable inequality, i.e., r_α decreases in α .*

Hypothesis 2*a* captures the idea that in a favorable position social risk aversion may exceed individual risk aversion if $\beta > 0$.¹⁹ Analogously to Hypothesis 1*b*, for two subjects with the same individual risk aversion (r), the one with the higher β is expected to choose the less risky option in the social context.

Hypothesis 2. *In a favorable position:*

- (a) *Subjects characterized by $r > 0$ will take lower risks ($r < r_\beta$) if $\beta > 0$.*
- (b) *On average, subjects' risk-taking will be lower, the higher their level of aversion to favorable inequality, i.e., r_β increases in β .*

Beyond the sample restrictions based on theoretical grounds, we need to make one restriction for statistical reasons. For subjects who choose the safe option at stage one, we can only observe the same or a higher degree of risk-taking in the consecutive stage, as they cannot further lower their lottery choice. This biases the tests toward false acceptances of hypotheses 1*a*, 1*b* and toward false rejections of hypotheses 2*a*, 2*b*.²⁰ Hence, we exclude these subjects from the analysis. However, note that our qualitative results hold even under the biased estimation (see 5.1 for a discussion).

¹⁹Note that we obtain the opposite prediction for subjects with $\beta < 0$. Since only a few subjects are expected to show such preferences, we restrict our attention to subjects with $\beta > 0$.

²⁰In the case of the unfavorable domain, the possibility not to decrease the lottery choice may favor hypotheses 1*a*, 1*b*. Whereas, in the case of the favorable domain it may disadvantage hypotheses 2*a*, 2*b*.

4.3 Results

In this section we report the results of our laboratory experiment. The analysis starts with summary statistics of the choices in our multi-stage experiment. Subsequently, to test hypotheses 1*a* and 1*b* we apply non-parametric tests on subjects’ change in lottery choices when peered to unfavorable and favorable positions. Finally, we test the impact of the level of inequality aversion on social risk aversion. We therefore run OLS regressions to test hypotheses 1*b* and 2*b* of our model.

Summary Statistics

We start with social preferences., i.e., Table 5 overviews the choices in the ultimatum game (UG) and the modified dictator game (MDG). For the UG, the table presents intervals of the minimum accepted offers by responders. For the MDG, it reports intervals of the minimum preferred equal split of dictators. These allocations are the first equal splits which are preferred by subjects instead of the selfish allocation (19;1).

min. accepted offer (€)	Stage 2: UG	min. preferred equal split (€)	Stage 3: MDG
1-2	23%	(1;1) - (9;9)	40%
3-10	72%	(10;10) - (18;18)	41%
11-19	5%	\geq (19;19)	19%

Table 5: Distribution of choices in the ultimatum and the modified dictator game.

The data emphasize that the majority of the subjects are inequality averse.²¹ This is confirmed by the UG, where 77% of subjects reject selfish proposals of 1€ and 2€. In the MDG, we find that 81% of the dictators renounce the 19€ and opt for an equal split between (1;1) and (18;18). Only 19% of the dictators do not give up money to equalize the money allocation. A closer look reveals that 8% of these subjects would not even prefer equal distributions of at least (19;19). These subjects have negative betas (Blanco et al., 2011) and can be interpreted to have a preference for “ahead-seeking” behavior. We use subjects’ choices in the UG and MDG to derive near point estimates for our model parameters: α and β (see eq. (2) and (3)).

²¹Our data closely replicate the α - and β -distribution obtained by Blanco et al. (2011). For details, see Table 7 in Appendix C.

Aggregate Risk Choices in Social Contexts

Figure 2 overviews the distribution of lottery choices in individual and social contexts.²² The graph conditions subjects' lottery choices on different intervals: high risk-averse choices (lotteries 1-2), intermediate risk-averse choices (lotteries 3-5), low risk-averse choices (lotteries 6-7), and risk-loving choices (lotteries 8-9). The white bars depict individual risk aversion (r), whereas the black bars represent subjects' social-risk aversion. The diagram considers social-risk preferences in the α -domain (r_α) (left panel) and in the β -domain (r_β) (right panel).

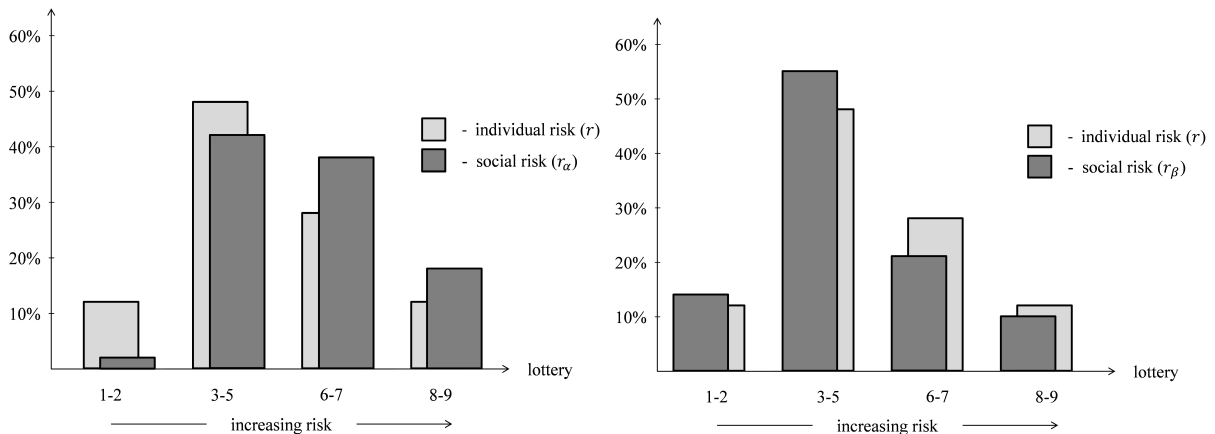


Figure 2: Comparison of individual risk choices with the choices in the α -domain (left panel) and the β -domain (right panel) for subjects with $\alpha, \beta > 0$.

Compared to the individual risk choices we find that in the α -domain the lottery-choice distribution shifts to the right. That is, in the presence of peers, the fraction of subjects who choose higher risks clearly increases. The reverse pattern is observed in the β -domain, i.e., the lottery-choice distribution shifts to the left. That is, in the presence of peers, the fraction of subjects who choose lower risks clearly increases. Hence, Figure 2 demonstrates first aggregate results that risky choices in social environments are affected by inequality aversion. Indeed, both the distribution of r_α and r_β significantly differ from the distribution of r (each comparison yields a significant Kolmogorov-Smirnov test with $p < 0.001$). We depict these differences in Figure 6 of Appendix C. Here, CDF plots on the distributions of lottery choices under individual and social risk can be found. In a next step we explore whether these aggregate findings result from changes in individual choices as predicted by our hypotheses.

²²See Table 9 in Appendix C for a detailed summary of this distributional data.

Individual Risk Choices in Social Contexts – Hypotheses 1a and 2a

According to Hypothesis 1a risk-averse subjects will choose a higher lottery when lagging behind their social peers. By contrast, Hypothesis 2a predicts that subjects will decrease their lottery choice when ahead of their social peers. Figure 3 overviews the percentage of subjects who increased or decreased their lottery choice in stage four compared to stage one. The figure distinguishes between subjects who face disadvantageous inequality (α -domain) and advantageous inequality (β -domain). For each of the domains we not only present the changes in lotteries for the whole relevant sample, but also for the subsamples of subjects with above-median values of α and β , respectively. The reason for this is the discreteness of the set of lotteries. As a consequence, only subjects with sufficiently high levels of inequality aversion are expected to change risk levels between the individual and the social environment (see thresholds in tables 3 and 4).

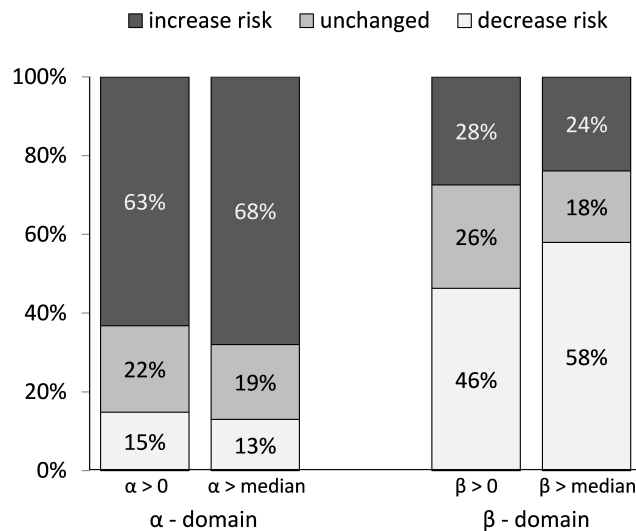


Figure 3: Changes of lottery choices for risk-averse subjects with aversion to disadvantageous inequality (left) and advantageous inequality (right).

In the α -domain the diagram shows that the majority (63%) of the subjects increase the lottery choice. Strikingly, only 15% of the subjects choose a lower lottery. If we restrict our attention to subjects characterized by above-median α 's, we find that 68% of them choose a riskier lottery and 13% choose a less risky lottery in the presence of peers. Thus, the shift in lottery choices is more pronounced among subjects with a higher level of unfavorable inequality aversion. The result that subjects in the α -domain significantly increase their lottery choices is confirmed for both samples by Wilcoxon matched-pair tests ($p < 0.001$). We therefore find support for Hypothesis 1a. The finding that the

risky shift is more pronounced for above-median α 's is a first support for Hypothesis 1b.

Turning to the β -domain, the highest fraction (46%) decreases the lottery choice. Again, if we restrict our attention to subjects with an above-median β , it turns out that 58% of them choose a less risky lottery and 24% choose a riskier lottery in the presence of peers. Thus, the shift in lottery choices is more pronounced among subjects with a higher level of favorable inequality aversion. The finding that subjects in the β -domain significantly decrease their lottery choices is confirmed for both samples by Wilcoxon matched-pair tests ($p = 0.089$, and $p < 0.001$). Hence, we find support for Hypothesis 2a. Again, the more pronounced findings for above-median β 's are a first indication in favor of Hypothesis 2b.

In summary, our findings confirm the interdependence of individual risk preferences and social preferences. We demonstrate that disadvantageous and advantageous income inequality to social peers affects the risk-taking behavior of inequality-averse subjects. That is, subjects increase risk-taking when they are behind their social peers. Whereas, they decrease risk-taking to avoid additional distance in income to their peers. Note that, we do not claim that poor subjects with low income automatically behave risk seeking. Besides we also do not conclude that rich subjects necessarily behave risk averse. Instead, we highlight that subjects generally care about relative income comparison to a social peer when facing risky decisions. Next, we analyze whether this interdependence between risk-taking motives and inequality aversion is affected by the strength of social preferences as predicted by hypotheses 1b and 2b.

Individual Risk Choices in Social Contexts – Hypotheses 1b and 2b

In this section we control for the impact of different magnitudes of inequality aversion on subjects' social risk-taking. Therefore, we run several OLS regressions to test hypotheses 1b and 2b. These estimations analyze whether, on average, higher levels of inequality aversion translate into a higher discrepancy between individual and social risk aversion. Recall that risk aversion when lagging behind the peer (measured by r_α) is expected to depend negatively on the degree of aversion to unfavorable inequality (α). The opposite is expected in the domain of favorable income, i.e., r_β depends positively on β .

Model (1) analyzes subjects' risk aversion in the α -domain, i.e., r_α is the dependent variable. Whereas model (3) concentrates on subjects' risk aversion in the β -domain, i.e., r_β is the dependent variable. Models (1) and (3) aim to test hypotheses 1b and 2b, respectively. Both models only encompass the measure for individual risk aversion (r) and the respective measures for subjects' degree of inequality aversion (α , β). In models

	r_α		r_β	
	(1)	(2)	(3)	(4)
r	0.378*** (0.066)	0.390*** (0.070)	0.586*** (0.077)	0.584*** (0.081)
α	-0.025** (0.011)	-0.023** (0.011)		-0.012 (0.013)
β		0.114 (0.114)	0.271** (0.132)	0.264** (0.133)
<i>loss aversion</i>		0.025 (0.034)		0.034 (0.039)
<i>trust in stranger</i>		0.063 (0.063)		-0.091 (0.073)
<i>2D:4D - LH</i>		0.144** (0.059)		0.084 (0.069)
<i>2D:4D - RH</i>		0.072 (0.062)		-0.070 (0.072)
<i>age</i>		0.005 (0.010)		0.004 (0.011)
<i>econ</i>		0.157* (0.090)		0.184* (0.105)
<i>female</i>		-0.015 (0.095)		0.010 (0.111)
<i>constant</i>	0.245** (0.100)	-0.674 (0.411)	0.288** (0.136)	0.402 (0.479)
N	193	193	193	193
R^2	0.20	0.24	0.23	0.28

Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 6: OLS regressions on subjects' gamble choices in an unfavorable position (r_α) and in a favorable position (r_β).

(2) and (4) we apply a set of control variables to test the robustness of these results. The control variables are: *loss aversion* which measures subjects' sensitivity to losses. The variable was elicited with the task of Gächter et al. (2007) after the main experiment (see Appendix C for detailed procedures). *Trust in stranger* focuses on subjects' trusting behavior. After the experiment subjects have to state their trust level to strangers, on a 1-4 Likert scale. Higher numbers indicate higher trust levels. The question is adapted from Dohmen et al. (2012). We also include subjects' digit ratio for their left hand (*2D:4D-LH*) and their right hand (*2D:4D-RH*).²³ *Age* controls for participants' age in years, *econ* is

²³We follow Buser (2012) and ask subjects in a post-experimental questionnaire for the ratios of the lengths of their index finger and their ring finger. In the economic literature the 2D:4D finger ratio is used as a proxy for prenatal testosterone exposure. This literature emphasizes that subjects' 2D:4D ratios are

a dummy to control for subjects' field of study (1 = econ students; 0 = other students). The role of gender is captured by (*female*), a dummy which is positive for women.

The regression results present clear evidence in favor of Hypothesis 1*b*. When controlling for individuals' pure risk preferences, we find in models (1)–(2) that the coefficient of subjects' α is always negative and significant. That is, the higher the degree of inequality aversion to unfavorable inequality, the lower the social risk aversion. Hence, we accept Hypothesis 1*b*. Model (2) highlights that the finding is robust when incorporating our control variables. The data reveal that most of the other control variables have no explanatory power. Importantly, model (2) emphasizes that subjects' aversion to favorable inequality (β) has no effect for risk-taking in an unfavorable position.

We also find strong support for Hypothesis 2*b*. When controlling for individual's pure risk preferences, the data show in models (3)–(4) that the coefficient of subjects' β is always positive and significant. That is, the higher the degree of inequality aversion to favorable inequality, the higher the social risk aversion. This confirms Hypothesis 2*b*. It can be seen that aversion to unfavorable inequality (α) has no explanatory power in model (4) as most of the other control variables.

To summarize, we find clear evidence in our data for attenuated risk aversion under unfavorable income inequality and amplified risk aversion in the favorable domain (Hypotheses 1*a* and 1*b*). Additionally, we find strong support for Hypotheses 2*a* and 2*b* which highlight the relevance of subjects' sensitivity to social comparison.

As outlined in section 3.1 recent findings suggest that subjects may also be driven by “ahead-seeking” motives (e.g., Fershtman et al., 2012). In our data less than 10% of the subjects show spiteful preferences ($\beta < 0$). If we focus on these subjects, we find that risk-averse subjects in a favorable position increase risk taking as predicted by our model. However, this result needs to be taken with caution because of the limited statistical power (see section 5.1 for further discussion).

5 Discussion

This section focuses on the robustness of our findings. We first concentrate on the sample restrictions, the effect size of inequality aversion reported in the regressions, and on the parameterized approach in section 5.1. Thereafter, in section 5.2 we will discuss alternative explanations of our findings.

related to their risk-taking behavior (e.g., Garbarino et al., 2011).

5.1 Sample restriction, Effect Size and Parameterization

In the data analyses we applied only one sample restriction which was based on statistical grounds. As previously argued, the inclusion of subjects who choose the safe option at stage one biases the estimates of our inequality-aversion parameters (α, β) . In the α -domain incorporating these subjects would cause a biased estimation of our hypotheses toward a false acceptance. Whereas in the β -domain it would bias the estimates toward a false rejection. This is confirmed in the data. If we include these subjects in model (1), we find that the significance level of α increases from $p = 0.025$ to $p = 0.014$. By contrast, in the β -domain (model (3)) the significance is decreased from $p = 0.042$ to $p = 0.076$.

Turning to effect size we observe in models (3)–(4) that the coefficients of β are more than 10 times higher than the coefficients of α (models (1)–(2)). However, this is put into perspective by the fact that the average α in the considered sample is around six times higher than the average β . Thus, the effect size of average inequality aversion is similar in both domains. According to our estimation results we observe that the statistically significant coefficients for α and β are also significant in economic terms. In case of unfavorable inequality, a subject with an average above-median²⁴ α shows a degree of social risk aversion which is 24.4% below the level of subjects with $\alpha = 0$. In contrast, in the favorable position a subject with an average above-median β shows a degree of social risk aversion of 25.1% above the level of subjects with $\beta = 0$.²⁵ Hence, a sufficient level of inequality aversion strongly impacts risk-taking behavior in social contexts.

As an additional robustness check we test Hypotheses 1*b* and 2*b* in a setting which is not based on the elicited model parameters r, α , and β . Instead, the analysis concentrates on the actual choices of subjects. That is, risk-taking is measured by the chosen lottery number in stage one of the experiment. Here, higher lottery numbers correspond to lower risk aversion, according to the Arrow-Pratt measures. Moreover, we use subjects' minimum acceptance levels in the Ultimatum Game (stage two) as a measure for their aversion to unfavorable inequality. Analogously, we take the data on subjects' switching points in the modified Dictator Game (stage three) to control for their aversion to favorable inequality. Consistent with the notion of inequality aversion subjects who switch later show a lower degree of aversion to favorable inequality. Note that, the non-parameterized

²⁴The average above-median α equals the mean of the α 's for those subjects with an α above the median. The average above-median β is defined analogously.

²⁵The estimates of model (1) give us: $\hat{r}_\alpha = 0.245 + 0.378 \cdot \bar{r}$ and $\hat{\hat{r}}_\alpha = 0.245 + 0.378 \cdot \bar{r} - 0.025 \cdot \bar{\alpha}$, where \bar{r} denotes the average r , and $\bar{\alpha}$ the average above-median α . Thus, $\frac{\hat{\hat{r}}_\alpha - \hat{r}_\alpha}{\hat{r}_\alpha} = -\frac{0.162}{0.665} \approx -24.4\%$. Model (3) predicts $\hat{r}_\beta = 0.288 + 0.586 \cdot \bar{r}$ and $\hat{\hat{r}}_\beta = 0.288 + 0.586 \cdot \bar{r} + 0.271 \cdot \bar{\beta}$, where $\bar{\beta}$ denotes the average above-median β . Thus, $\frac{\hat{\hat{r}}_\beta - \hat{r}_\beta}{\hat{r}_\beta} = \frac{0.235}{0.938} \approx 25.1\%$. Note that, $\bar{r} = 1.110, \bar{\alpha} = 6.463, \bar{\beta} = 0.867$.

method causes a bias on the measurement of inequality aversion, as we do not correct for individual risk preferences. Based on subjects’ pure choices, we estimate models (1) and (3).²⁶ Notably, the data of this non-parameterized approach also supports the hypotheses. For the case of subjects’ aversion to disadvantageous inequality, model (1)’ shows that the coefficient of subjects’ “minimum acceptance” level is positive and significant ($p = 0.044$). Thus, subjects with higher minimum acceptance levels choose higher lotteries when lagging behind. When turning to subjects’ aversion to favorable inequality, we find in model (3)’ that the coefficient of “switching-point” is positive and significant ($p = 0.099$). Thus, subjects who switch early (characterized by a high degree of aversion to favorable inequality) choose lower lottery numbers when ahead. Note that, according to R^2 and the Akaike’s information criterion (AIC), the fit of both models decreases when we make use of this non-parameterized set of variables.²⁷ Taken together, this indicates that the adjustment of α and β based on the individual risk aversion r (see eq. (2) and (3)) is indeed necessary and appropriate such that our parameterized model yields a better fit of the data.

5.2 Alternative Explanations

In this section we explore alternative explanations for our findings which are not based on the interaction of individual risk attitudes and social preferences. In other words, we neglect social preferences and analyze whether the inherit properties of the different lottery-choice sets in terms of objective probabilities and payoffs can induce the observed behavior. For this purpose we concentrate on two important models of decision-making under objective risk as alternatives to expected utility theory (EUT).²⁸ We start with the discussion of the rank-dependent utility (RDU) model of Quiggin (1982). Thereafter we explore the implication of cumulative prospect theory (CPT) of Tversky and Kahneman (1992) for our choice environment. We focus on these two model as they received the most theoretical attention and proved their empirical relevance for human risk-taking behavior.²⁹ In a nutshell, the difference between EUT and the RDU model is that the latter extends EUT by not only allowing for an aversion to variability of earnings but

²⁶See Table 10 in Appendix C for a detailed presentation of these regressions.

²⁷ R^2 decreases to 0.19 in model (1) and 0.22 in model (3). Moreover, the AIC increases from 352.65 to 354.36 for model (1). For model (3), the AIC increases from 411.66 to 415.05.

²⁸Note that social concerns kept aside, by construction of the lotteries, EUT predicts no change in lottery choices across the individual and the social contexts, i.e., $r = r_\alpha = r_\beta$.

²⁹For a intriguing and methodological rigorous experiment to test alternative theories of decisions under risk we refer the reader to Harrison and Swarthout (2016). They find strong support for the RDU model in their data. For a survey regarding CPT, see Barberis (2013).

also allows for a weighting of probabilities. Finally, CPT extends the RDU model by an aversion to losses and adds the assumption that individuals evaluate gross gains and losses rather than net values.

As a first insight, note that neither the RDU model nor CPT can motivate our hypotheses 1*b* and 2*b* which highlight the importance of the degree of inequality aversion for the addressed relation between individual risk attitudes and social preferences. We therefore concentrate on the analysis whether the two theories can offer an alternative explanation for the amplified risk aversion under favorable inequality and the attenuated risk aversion in the unfavorable domain.

For a clear point of reference we apply the probability weighting function suggested by Tversky and Kahneman (1992), i.e., $\omega(p) = p^\gamma / (p^\gamma + (1-p)^\gamma)^{1/\gamma}$, $p \in [0, 1]$ for both theories. Note that we come to similar conclusions if we apply the weighting function originally suggested by Quiggin (1982) or the one from Prelec (1998). We set γ equal to the median values reported in Tversky and Kahneman (1992), i.e., $\gamma = 0.61$ (0.69) for gains (losses). To avoid biases resulting from different value functions, we will use the same function $v(x)$ from equation (1) as in our theoretical framework. In the case of CPT we apply $v(x)$ for gains and $-\lambda v(-x)$ for losses, where λ measures a subject's degree of loss aversion.

We will first study the implications of the RDU model for subjects' choices in the individual and social context. In our case of a lottery choice with two outcomes rank-dependent utility of lottery k is given by $RDU_k = \omega(p_{A,k})v(x_{A,k}) + (1 - \omega(p_A))v(x_{B,k})$, where $p_{A,k}$, $x_{A,k}$, and $x_{B,k}$ denote the probability of state A and the payoffs for the two states A and B for lottery k . Given that $\gamma = 0.61$ choices will be determined by subjects' degree of risk aversion, measured by r . Figure 4 presents the lottery choices as a function of r as predicted by the RDU model for each of the domain separately. A subject with a risk aversion measure $r = 0.4$, for instance, is predicted to choose lottery nine in all three situations. In contrast, a subject with $r = 2.0$ is predicted to choose the safe option in the individual context and in an unfavorable social context, but a slightly more risky alternative (lottery two) in a favorable social context. Risk-seeking subjects ($r < 0$) are expected to select the most risky alternative in all domains, whereas sufficiently risk-averse subjects ($r > 2.3$) would always opt for the safe option.

With respect to the overall distribution of choices, the model predicts for the individual context (stage one) that subjects either choose the safe option or a risk-seeking lottery (lotteries eight and nine), i.e., it can account for only 18% of the choices observed in our experiment. More importantly, Figure 4 illustrates that the effect of probability

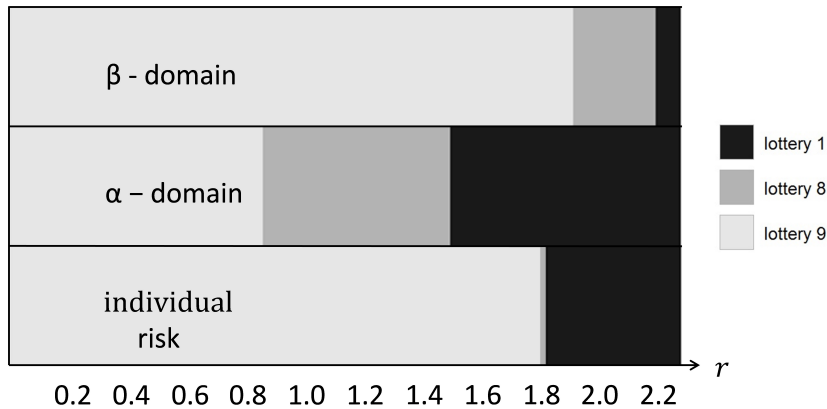


Figure 4: Predicted lottery choices according to the RDU model.

weighting as captured by the RDU model leads to exactly the opposite predictions. That is, subjects are expected to weakly decrease their risk taking in a unfavorable position, whereas the opposite is predicted for favorable situations. As a consequence, the RDU model is incompatible with our findings of attenuated risk aversion in the α -domain and amplified risk aversion in the β -domain.

We now turn to the implication of CPT for subjects' choices in the different domains. Exploring whether CPT offers an alternative explanation for the different risk-taking behavior between the individual and the social context, requires the fixation of reference points for each context. In applications of (cumulative) prospect theory where subjects can choose among a set of lotteries it is commonly assumed that the safe option serves as a reference point. In our case this translates into a reference point of €5 for the choice in stage one. In the social context (stage four) we set for the same reason €1.5 as the reference point in case of unfavorable inequality and €4 when subjects are faced with favorable inequality. Given these reference points the utility assigned by CPT to lottery k is $CPT_k = \omega(p_{A,k})\tilde{v}(x_{A,k} - rp) - \lambda\omega(p_{B,k})\tilde{v}(rp - x_{B,k})$, where rp denotes the aforementioned points of reference in the different contexts.³⁰

The CPT model has two degrees of freedom in terms of individual parameters. One corresponds to the measure of subjects' risk aversion r , the other refers to the individual degree of loss aversion as captured by λ . Figure 5 depicts the combinations of risk aversion and loss aversion such that a subject would choose a particular lottery in accordance with

³⁰Although CPT is not a theory of social reference points but integrates individual reference points in terms of income, wealth or intended incomes, one might argue that incomes of social peers could also serve as reference points. Note that we obtain similar results if we set the points of reference equal to the fixed income level of the social peers, i.e., €15 in the α -domain and €0 in the β -domain. In this case CPT predicts for both domains the choice of the most risky lottery.

CPT. The various combinations are depicted for each of the domains separately. The left panel focuses on the individual context (stage one), the middle (α -domain) and the right (β -domain) on the social contexts. Note that in each of the pictures the degree of individual risk aversion is again measured on the horizontal axis, whereas the inverse of the individual level of loss aversion λ is measured on the vertical axis. Since loss aversion is captured by the condition of $\lambda > 1$ the inverse of λ has the unit interval as range. We observe that, as expected, CPT predicts for a given level of risk aversion that higher degrees of loss aversion are associated with the choice of less risky lotteries. This is because the (constant) loss in state B is increasingly likely for more risky lotteries. Analogously, for a given level of loss aversion, a higher degree of risk aversion (r) is associated with the choice of less risky lotteries.

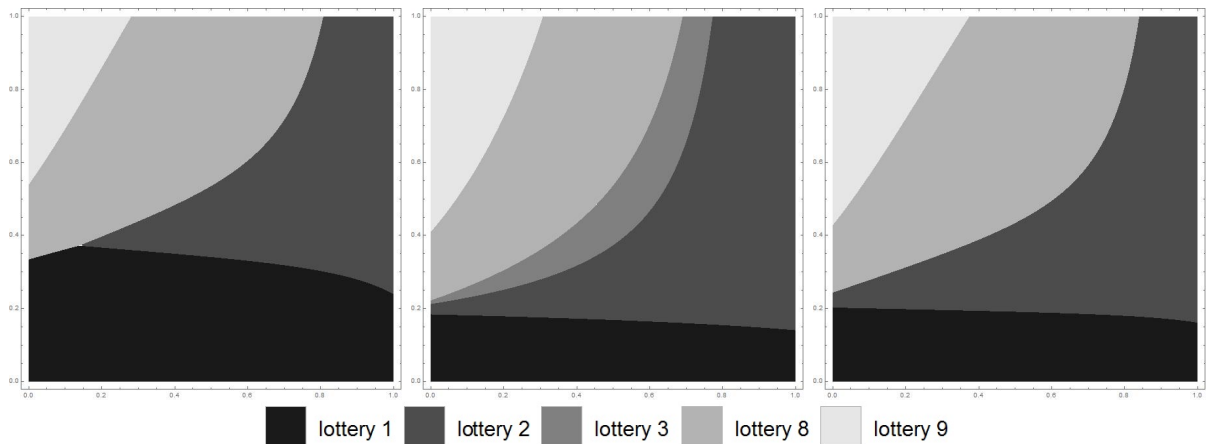


Figure 5: Predicted lottery choices according to CPT for the individual context (left panel) and for the social context (middle panel: α -domain, right panel: β -domain). Vertical axis: $1/\lambda$, Horizontal axis: r .

Note that similarly to the RDU model only choices at the boundary of the lottery set are rationalizable with CPT. That is, in the individual context only lotteries 1–2 and 8–9 are consistent with this model. Furthermore, in an unfavorable situation CPT predicts for most parameter combinations no change in behavior. However, for some pairs of risk aversion and loss aversion subjects are expected to choose slightly riskier lotteries. In the favorable social context CPT predicts for all combinations of parameters weakly increasing risk taking. Thus, for a fraction of subjects CPT could account for the increased risk taking for individuals lagging behind their peer, whereas it is not able to provide an explanation for the decreased risk taking for subjects being ahead of their peers.

Taken together, among the RDU model and CPT only the latter can partially account for one of our four hypotheses. That is, only CPT is consistent with amplified risk taking

when subjects are in a unfavorable position. None of the theories is compatible with amplified risk aversion for subjects in a favorable position as observed in our data and predicted by theory. Moreover, neither of them predicts a relation between the social preferences revealed in the UG/MDG and the level of change in risk-taking induced by the social context.

We want to close our discussion with a general remark on social comparison. As mentioned before most human decisions are made under uncertainty in a social context. However, their motives and the set of relevant peers are likely to vary across different decisions problems. Subjects at work might be led by competitive motives with their colleagues as peers, whereas in private environments subjects are likely to be motivated by more prosocial motives with friends and relatives as social peers. Our theoretical framework is general enough to cover these different types of motives and environments. However, the focus of this paper is clearly on prosocial motives. In our laboratory experiment we have control over social peers. Moreover, social preferences were elicited in neutral to prosocial environments (ultimatum and modified-dictator games). Our data provide strong support for our hypotheses. For future research, we leave it open to explore different social contexts which vary, for instance, in their degree of competitiveness.

6 Conclusion

Naturally, human decision-making takes place in an uncertain and social environment and is led by different potentially conflicting motives. Despite the possible interdependencies of different behavioral drivers, research commonly focused on a single motive in isolation.

In the current paper we theoretically and experimentally explore the interdependencies of the two central behavioral determinants for such environments: *individual risk attitudes* and *social preferences*. We focus on the question how a social context and subjects' sensitivity to social comparison impacts individuals' risk-taking behavior. It turns out that subjects' risk preferences and social concerns in the form of inequality aversion are indeed fundamentally related. In unfavorable positions subjects increase their risk to catch up with peers. Whereas, subjects behave more risk-averse when ahead. Importantly, in line with our theoretical predictions we establish that the differences in risk-taking across contexts (individual vs. social) are not only domain-dependent (favorable vs. unfavorable position), but are also affected by subjects' sensitivity to social comparison. The latter provides clear evidence that it is subjects' social preferences which induce the accommodation of risk-taking across the individual and the social contexts. Importantly, we rule

out alternative explanations like rank-dependent utility models or cumulative prospect theory as they are incompatible with the majority of our experimental findings.

Our findings demonstrate that the isolated view of risk attitudes or social preferences as behavioral determinants offers an incomplete picture and may miss important interferences between the two. Our results are of importance as most individual decisions are made in risky contexts and humans evaluate the outcome of their decisions in relation to their social environment. Moreover, it is known that subjects differ in their sensitivity of other-regarding behavior. Hence, for a better understanding of most real-life decision-making contexts, it is necessary to study a unified framework which incorporates risk attitudes and social preferences accounting for subjects' heterogeneity.

Our theoretical identification how social environments impact on individual decisions contributes to a broad literature in Economics, Psychology and other social sciences advocating the social dimension for decision-making. Our experimental results provide evidence for the importance of recent theoretical attempts aiming to extend standard economic theory on individual decision-making to more realistic settings characterized by both uncertainty and a social context. We also contribute to more applied research in the domains of financial economics and public economics. The findings of this paper may lead to a better understanding of the saving patterns of private households or social acts of giving under uncertainty. The corresponding insights might impact the design of incentive contracts, policy measures regarding the public pension scheme or public insurance concepts for social projects.

We are confident that our paper will spur the research on the interrelation of existing behavioral models, ultimately leading to a better understanding of individual decision-making in a real-life context. There are numerous ways to go from here. A particular interesting approach would be the generalization of our theory to a more general model of choice under uncertainty which may capture aspects like ambiguity aversion or loss aversion. For future research, we leave open the question of how our results extend to non-cooperative games characterized by strategic uncertainty and distributional consequences of individual actions.

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A Proofs

Proof of Proposition. By definition of relative risk aversion:

$$RRA(u(x, y)) = \begin{cases} -\frac{v''}{v' + \alpha}x < -\frac{v''}{v'}x = RRA(v(x)) & , x < y \\ -\frac{v''}{v' - \beta}x > -\frac{v''}{v'}x = RRA(v(x)) & , x > y \end{cases} \quad (\text{A.1})$$

Let us first consider case of a risk-averse subject, i.e., an individual with $v'' < 0$. In a unfavorable position the utility depends on α , but not on β . For $\alpha > 0$ we have $RRA(u(x, y)) < RRA(v(x))$ because $u' = v' + \alpha > v'$. Moreover, $RRA(u(x, y))$ decreases in α . In a favorable position the utility depends on β but not on α . For $\beta > 0$ we have $RRA(u(x, y)) > RRA(v(x))$ because $u' = v' - \beta < v'$. Moreover, $RRA(u(x, y))$ increases in β .

Let us now consider case of a risk-loving subject, i.e., an individual with $v'' > 0$. In a unfavorable position the utility depends on α , but not on β . For $\alpha > 0$ we have $RRA(u(x, y)) > RRA(v(x))$ because $u' = v' + \alpha > v'$. Moreover, $RRA(u(x, y))$ increases in α . In a favorable position the utility depends on β but not on α . For $\beta > 0$ we have $RRA(u(x, y)) < RRA(v(x))$ because $u' = v' - \beta < v'$. Moreover, $RRA(u(x, y))$ decreases in β . Obviously, the relations also hold for the measure of absolute risk aversion. \square

$$\textbf{Assumption (*)}: h(x, y) \geq 0, h(x, y) = 0 \Leftrightarrow x = y, h_x(x, y) = \begin{cases} < 0 & , x < y \\ > 0 & , x > y \end{cases}$$

Proposition. If $u_x(x, y) > 0, \forall x, y$ and if Assumption (*) is satisfied, then (1) for $x < y$: $RA(u(x, y)) < RA(v(x))$ if and only if $\frac{h_{xx}}{h_x} > \frac{v_{xx}}{v_x}$, (2) for $x > y$: $RA(u(x, y)) > RA(v(x))$ if and only if $\frac{h_{xx}}{h_x} > \frac{v_{xx}}{v_x}$.

Proof. Let us first consider the case $x > y$, by Assumption (*) this implies $h_x > 0$. Hence,

$$RA(u(x, y)) > RA(v(x)) \Leftrightarrow -\frac{v_{xx} - h_{xx}}{v_x - h_x} > -\frac{v_{xx}}{v_x} \Leftrightarrow \frac{h_{xx}}{h_x} > \frac{v_{xx}}{v_x}. \quad (\text{A.2})$$

Case (2) works analogously. For $x < y$ Assumption (*) implies that $h_x < 0$. Hence,

$$RA(u(x, y)) < RA(v(x)) \Leftrightarrow -\frac{v_{xx} - h_{xx}}{v_x - h_x} < -\frac{v_{xx}}{v_x} \Leftrightarrow \frac{h_{xx}}{h_x} > \frac{v_{xx}}{v_x}. \quad (\text{A.3})$$

If h_{xx} is positive or has small negative values then the inequality $\frac{h_{xx}}{h_x} > \frac{v_{xx}}{v_x}$ will be satisfied for risk-averse subjects. The reverse holds for risk-seeking subjects if h_{xx} is negative or has small positive values. Thus, the results of Proposition in the main text fully generalize to this setting if the supremum norm of h_{xx} is sufficiently small. \square

B Derivation of the α, β thresholds

Let L_k denote lottery $k \in \{1, \dots, 9\}$ and $EU(L_k)$ denote subject's expected utility from choosing this lottery. Then Lottery L_k yields a payoff $x_{k,A}$ with probability $p_{k,A}$ and $x_{k,B}$ with $p_{k,B} = 1 - p_{k,A}$ for event A and B , respectively. Then given the different outcomes and probabilities of lotteries L_k and L_{k+1} ,

$$EU(L_k) < EU(L_{k+1}) \Leftrightarrow \text{(B.1)}$$

$$p_{k,A} \left(\frac{x_{k,A}^{(1-r)}}{1-r} + x_{k,A} - \alpha(15 - x_{k,A}) \right) + p_{k,B} \left(\frac{x_{k,B}^{(1-r)}}{1-r} + x_{k,B} - \alpha(15 - x_{k,B}) \right) < \text{(B.2)}$$

$$p_{k+1,A} \left(\frac{x_{k+1,A}^{(1-r)}}{1-r} + x_{k+1,A} - \alpha(15 - x_{k+1,A}) \right) + p_{k+1,B} \left(\frac{x_{k+1,B}^{(1-r)}}{1-r} + x_{k+1,B} - \alpha(15 - x_{k+1,B}) \right) \text{(B.3)}$$

$$\Leftrightarrow \alpha > \alpha_{k,k+1} \text{(B.4)}$$

where $\alpha_{k,k+1}$ denote the thresholds which equalize expected utilities $EU(L_k)$ and $EU(L_{k+1})$ such that subjects with $\alpha > \alpha_{k,k+1}$ who choose L_k in the individual context would choose lottery L_{k+1} in the social context. In order that a subject would switch from L_k to L_{k+2} we need $EU(L_k) < EU(L_{k+1})$ and $EU(L_{k+1}) < EU(L_{k+2})$. Thus, $\alpha_{k,k+2} = \max\{\alpha_{k,k+1}, \alpha_{k+1,k+2}\}$. Of course, subjects could also switch by more than two lotteries. However, risk-averse subjects should never choose a risk-loving lottery, i.e., L_8 - L_9 . For this reason, we should not observe that subjects would switch from L_6 to L_8 . For the same reason we do not report a threshold for subjects with lottery choice L_7 in stage one. Note that a subject who chooses the most risky lottery can earn the maximum outcome of €14.95, which is less than the partner's endowment.

The derivation of $\beta_{k,k-1}$ and $\beta_{k,k-2}$ works analogously. That is,

$$EU(L_k) < EU(L_{k-1}) \Leftrightarrow \text{(B.5)}$$

$$p_{k,A} \left(\frac{x_{k,A}^{(1-r)}}{1-r} + x_{k,A} - \beta(x_{k,A}) \right) + p_{k,B} \left(\frac{x_{k,B}^{(1-r)}}{1-r} + x_{k,B} - \beta(x_{k,B}) \right) < \text{(B.6)}$$

$$p_{k-1,A} \left(\frac{x_{k-1,A}^{(1-r)}}{1-r} + x_{k-1,A} - \beta(x_{k-1,A}) \right) + p_{k-1,B} \left(\frac{x_{k-1,B}^{(1-r)}}{1-r} + x_{k-1,B} - \beta(x_{k-1,B}) \right) \text{(B.7)}$$

$$\Leftrightarrow \beta > \beta_{k,k-1}, \text{(B.8)}$$

where $\beta_{k,k-1}$ denote the thresholds which equalize expected utilities $EU(L_k)$ and $EU(L_{k-1})$ such that subjects with $\beta > \beta_{k,k-1}$ who choose L_k in the individual context would choose lottery L_{k-1} in the social context. Finally, for the same reason as above we set $\beta_{k,k-2} = \max\{\beta_{k,k-1}, \beta_{k-1,k-2}\}$.

C Tables, Figures, and Elicitation of Loss Aversion

Tables

α	BEN	Data	β	BEN	Data
$\alpha < 0.4$	31%	42%	$\beta < 0.235$	29%	25%
$0.4 \leq \alpha < 0.92$	33%	14%	$0.235 \leq \beta < 0.5$	15%	17%
$0.92 \leq \alpha < 4.5$	23%	23%	$0.5 \leq \beta$	56%	58%
$4.5 \leq \alpha$	13%	21%			

Table 7: Distribution of α and β in our data and the data of Blanco et al. (2011).

stage	session	(1)	(2)	(3)	(4)	(7)	(8)	(9)	(10)	(11)
1 (r)	(5)	0.837	0.577	0.984	1.000	0.837	0.984	0.996	0.996	0.385
	(6)	0.342	0.089	0.577	0.183	0.089	0.342	0.285	0.917	0.385
2 (MDG)	(5)	0.577	0.577	1.000	0.577	0.577	0.837	1.000	0.214	0.385
	(6)	0.577	0.837	1.000	0.837	0.837	0.984	0.825	0.214	0.234
3 (UG)	(5)	0.837	0.577	0.984	0.577	0.577	1.000	0.825	0.474	0.385
	(6)	0.577	0.577	0.837	0.577	0.577	0.984	1.000	0.825	0.959
4a (r_α)	(5)	0.577	0.577	0.183	0.837	0.342	0.342	0.214	0.058	0.134
	(6)	0.837	0.984	0.342	0.984	0.577	0.577	0.371	0.082	0.806
4b (r_β)	(5)	0.837	0.837	0.342	0.837	0.342	1.000	0.371	0.710	0.587
	(6)	0.837	0.837	0.837	0.837	0.342	0.577	0.371	0.371	0.587

Table 8: P -values for Kolmogorov-Smirnov tests between the sessions with reversed order (5–6) and the sessions with standard order (1–4 and 7–11).

Risk aversion	Lottery choices	Individual RA (r)	Social RA (r_α) α -domain	Social RA (r_β) β -domain
high	1–2	12%	2%	14%
intermediate	3–5	48%	42%	55%
low	6–7	28%	38%	21%
risk loving	8–9	12%	18%	10%

Table 9: Distribution of subjects' risk aversion (RA) in different contexts. ($\alpha, \beta > 0$)

	r_α		r_β	
	(1)'		(3)'	
<i>lottery choice (individual risk)</i>	-0.171***	(0.027)	-0.226***	(0.032)
<i>minimum acceptance</i>	-0.025**	(0.013)		
<i>switching-point</i>			-0.015*	(0.009)
<i>constant</i>	1.527***	(0.154)	2.289***	(0.182)
<i>N</i>	193		193	
<i>R²</i>	0.19		0.22	

standard deviation in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table 10: OLS regressions on subjects' gamble choices in an unfavorable position and in a favorable position.

Figures

Figure 6 illustrates the distribution of the CDFs under individual risk (dashed line) and social risk under disadvantageous (black line) and advantageous (grey line) inequality.

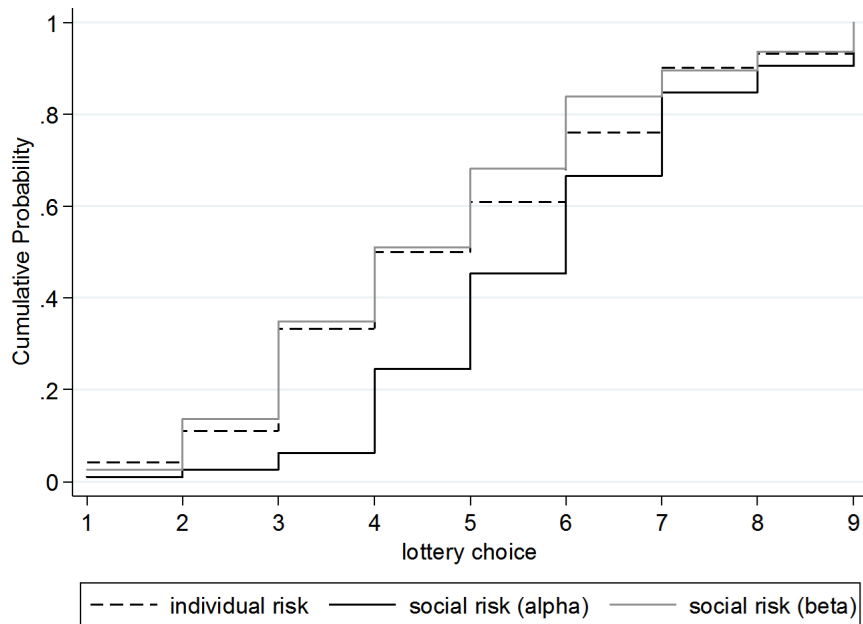


Figure 6: CDFs of the lottery choices under individual risk and for both income domains.

Elicitation of Loss Aversion

Subjects' loss aversion was elicited with the method used by Gächter and Johnson (2010). After our participants completed stage six, they were presented with the loss-aversion task. In this regard, subjects received on-screen instructions and knew that this part was only hypothetical. In our version, 10 different lottery choices existed. The lotteries were framed in such a way that a certain amount of money is lost if a coin landed on "heads," whereas subjects would win €10 if the coin lands on "tails." Subjects knew that for each lottery that they would have to choose whether to "accept" or "reject" it. The lottery choices were as follows:

No.	Lottery	Decision
1	If the coin lands on heads you lose €2; if it lands on tails you win €10.	accept/reject
2	If the coin lands on heads you lose €3; if it lands on tails you win €10.	accept/reject
3	If the coin lands on heads you lose €4; if it lands on tails you win €10.	accept/reject
4	If the coin lands on heads you lose €5; if it lands on tails you win €10.	accept/reject
5	If the coin lands on heads you lose €6; if it lands on tails you win €10.	accept/reject
6	If the coin lands on heads you lose €7; if it lands on tails you win €10.	accept/reject
7	If the coin lands on heads you lose €8; if it lands on tails you win €10.	accept/reject
8	If the coin lands on heads you lose €9; if it lands on tails you win €10.	accept/reject
9	If the coin lands on heads you lose €10; if it lands on tails you win €10.	accept/reject
10	If the coin lands on heads you lose €11; if it lands on tails you win €10.	accept/reject

Table 11: Hypothetical lottery choices of the loss-aversion task.

The task focuses on the case when subjects stop accepting the lotteries (switching point). Based on that, we calculate the loss-aversion coefficients (λ). It follows: $\lambda = V(G)/V(L)$, where $V(G)$ and $V(L)$ represent the potential gain/losses of the lottery which is rejected. Lambda is defined between: 0.91 and 5.