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Munich Discussion Paper No. 2010-37

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Online at https://doi.org/10.5282/ubm/epub.12115

# Responsibility Effects in Decision Making under Risk

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December 15, 2010

**Abstract**

We systematically explore decision situations in which a decision maker bears responsibility for somebody else's outcomes as well as for her own in situations of payoff equality. In the gain domain we confirm the intuition that being responsible for somebody else's payoffs increases risk aversion. This is however not attributable to a 'cautious shift' as often thought. Indeed, looking at risk attitudes in the loss domain, we find an increase in risk seeking under responsibility. This raises issues about the nature of various decision biases under risk, and to what extent changed behavior under responsibility may depend on a social norm of caution in situations of responsibility versus naive corrections from perceived biases. To further explore this issue, we designed a second experiment to explore risk-taking behavior for gain prospects offering very small or very large probabilities of winning. For large probabilities, we find increased risk aversion, thus confirming our earlier finding. For small probabilities however, we find an increase of risk seeking under conditions of responsibility. The latter finding thus discredits hypotheses of a social rule dictating caution under responsibility, and can be explained through flexible self-correction models predicting an accentuation of the fourfold pattern of risk attitudes predicted by prospect theory. An additional accountability mechanism does not change risk behavior, except for mixed prospects, in which it reduces loss aversion. This indicates that loss aversion is of a fundamentally different nature than probability weighting or utility curvature. Implications for debiasing are discussed.

***JEL Codes***: D03, D81

***Keywords***: risk attitude; other-regarding preferences; prospect theory; agency; social norms

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## 1. Motivation

Economic situations in which an agent takes decisions that affect others' outcomes as well as her own constitute a common class of phenomena. For instance, they represent situations in which a decision maker's choices affect not only her own outcomes, but those of her family as well. Another common instance of such decision problems is the one of financial agency contracts in which the incentive structure of the agent coincides with the one of the principal. An example may be the one of executives that are compensated through company shares, or the one of a stock broker whose payoffs are determined by the outcomes of the investments she undertakes.

Given the importance of such phenomena, it may seem surprising that we are only beginning to understand social influences on risk attitudes. Indeed, there is an extensive literature on individual decision making under risk and uncertainty (Abdellaoui *et al.*, 2010; Slovic, 1987), as well as a substantial literature on risk attitude in agency problems and how to influence it through performance-contingent pay (Lefebvre & Vieider, 2010; Wiseman & Gomez-Majia, 1998). What is missing however is a direct comparison of risk attitudes when decisions are individual to situations in which decisions affect others as well as oneself.

We explore the difference in risk attitudes between situations of decision-making for oneself and in situations of *responsibility*, i.e. situations in which the decision maker decides for others as well as herself. We explore such decisions for situations in which an anonymous other (the *recipient*) is affected by any outcomes that obtain in exactly the same way as the decision maker herself. This allows us to study possible changes in behavior in a clean way, excluding issues deriving e.g. from interpersonal relations or preferences over outcome distributions that may cause inequality concerns. Also, by making both the decision maker's outcome and the recipient's outcome dependent on the decision makers choice, the latter will bear an actual cost in terms of her own preferences by accommodating any presumed preferences of the recipient.

To our best knowledge, the only paper that reports results about this issue under equal payoff assumptions is Bolton & Ockenfels (2010), although the authors report these results as an afterthought to their main results about inequality concerns and do not find statistically significant results due to their small sample size. We explore the issue systematically for risky choices in the gain domain, the loss domain, and the mixed domain. Indeed, individual risk attitudes have been found to differ systematically in the different domains (Abdellaoui, 2000; Booij, van Praag, & van de Kuilen, 2010; Schoemaker, 1990). To the extent that individual risk attitudes have been found to differ systematically, it is thus unclear how any increase in risk aversion under responsibility for large probabilities—if it indeed exists—would transfer to different outcome domains or probability levels. By adopting prospect theory (Kahnemann & Tversky, 1979) as a descriptive theory for

behavior under risk, we are able to examine the issue in more detail.

The question of whether and how being responsible for others changes choice behavior also raises interesting questions about rationality concepts, social norms on risk taking, and the perceived acceptability of attitudes towards risks. This in turn has implications for 'debiasing', or simply changing risk attitudes in ways that may seem desirable. By comparing situations of individual decision making to situations of responsibility, and to decision-making under accountability (Lerner & Tetlock, 1999), for different probabilities and in different domains, we are able to examine the perceived acceptability of common individual decision making patterns under risk. To the extent that being responsible for others may act as a cognitive motivator for more careful consideration of the decision alternatives, we can draw conclusions about the perceived normative status of a type of behavior by observing if and in what direction people move from the individual baseline when responsible for others.

We find that in the gain domain, being responsible for others as well as oneself does indeed increase risk aversion for medium to large probabilities, thus showing that Bolton & Ockenfels' (2010) intuition was correct. In addition, we show that for pure loss prospects, risk seeking increases when subjects are responsible for others—thus giving an indication that risk seeking for losses is seen as 'normative', or at least as socially acceptable, in a way paralleling risk aversion for gains. Loss aversion on the other hand, being already strong in individual decisions, does not seem to increase when subjects are responsible for others. Introducing an additional accountability treatment, requiring decision makers to justify their decision in front of the recipient, is however found to *reduce* loss aversion, thus hinting at different mechanisms underlying loss aversion and probability weighting. In a second experiment aimed at exploring social norms on risk taking in the gain domain in more detail, we find that risk aversion further increases for large probabilities. When choices regard small probability prospects however, the overweighting of small probabilities typically found in individual decisions is further accentuated—thus hinting at the perceived normativity of probability weighting rather than a universal norm for risk aversion.

The paper proceeds as follows. Section 2 discusses risk attitudes and how they may be influenced by social contexts. Section 3 describes the first experiment, with section 3.1 describing the methodology and section 3.2 presenting the results; section 3.3 presents results of an additional accountability treatment, and section 3.4 discusses the result of experiment 1 and derives hypotheses for experiment 2. Section 4 introduces experiment 2, with section 4.1 describing the methodology and section 4.2 presenting the results. Section 4.3 discusses the results of experiment 2 as well as the overall results. Section 5 concludes this paper.

## 2. Risk attitudes in social contexts

In recent years, there has been a growing interest in how social factors may influence decision making under risk. Such 'social factors' could take various forms, ranging from whether a decision is observed by somebody else or the decision maker observes somebody else's decision, to whether one's outcome depends on somebody else or one's decision influences the outcome of somebody else (Trautmann & Vieider, 2010). We are interested in the latter category: do preferences over risky choices change when the decision influences somebody else's outcomes as well as the ones of the decision maker? And if so, how?

To date there is very little evidence on this issue with the existing evidence appearing inconclusive. Bolton and Ockenfels (2010) hypothesize that risk aversion will increase under responsibility. However, their result fails to reach statistical significance. Indeed, their main results concern the effect of social comparison, so that they mainly examine choice behavior when outcomes may differ between the decision maker and the recipient. They find an increase in risk taking under conditions of responsibility when the safe options yields unequal payoffs, and particularly when such payoff asymmetry is unfavorable to the decision maker. In contrast, they find that under responsibility risk taking does not depend on whether the risky option yields unequal payoffs.

In a somewhat related study from the game theory literature, Charness & Jackson (2009) have subjects play Rousseau's stag hunting game against each other. They compare conditions in which one subjects simply plays against another, to one in which a second, passive, subject depends on each player. They find that under responsibility for someone else the efficient equilibrium obtains less frequently. While this may again be an indication for increased risk aversion under responsibility, it is not clear where such a risk may actually come from since it is not in the interest of any of the players to deviate from the efficient equilibrium unless they think the other player may deviate. Furthermore, the setup of the study again creates issues of inequality aversion, for while the recipient obtains the same payoffs as the decision maker, the strategic nature of the game implies that the opponent and her recipient may obtain very different payoffs.

We aim to specifically exclude inequality concerns to filter out the pure effect of being responsible for somebody else's payoffs. In order to achieve this, the exact choice that determines the decision maker's payoff also determines the recipient's payoff, resulting in exactly the same outcome. This design thus allows us to isolate the effect of being responsible for somebody else as well as for oneself from any distributional issues (Rohde & Rohde, 2010).

We propose to systematically examine the effect of responsibility on risk preferences throughout the outcome and probability domains. In order to facilitate that task, in what follows we

will adopt a behavioral, and hence theory-neutral, definition of risk aversion. A decision maker will be defined as risk averse whenever she prefers the expected value of a prospect to the prospect itself; conversely, she will be defined as risk seeking whenever she prefers the prospect to a sure amount equivalent to the prospect in terms of expected value (Wakker, 2010). Risk aversion and risk seeking are thus relative terms, such that a decrease in risk aversion can be seen as equivalent to an increase in risk seeking. In our presentation of the results we recur to prospect theory—the prevalent descriptive theory of choice under risk and uncertainty today (Starmer, 2000; Wakker, 2010). Under prospect theory, risk attitudes are described by utility curvature, loss aversion, and probability weighting (Köbberling & Wakker, 2005).

While utility is generally found to be linear for small amounts like the ones used in typical experiments, probability weighting alone nevertheless predicts a fourfold pattern of risk attitudes: risk aversion for medium to large probabilities of gains; risk seeking for small probability gains; risk aversion for small probability losses; and risk seeking for medium to large probability losses (Abdellaoui, 2000; Abdellaoui, l'Haridon & Zank, 2010; Bleichrodt & Pinto, 2000). In addition to probability weighting, for mixed prospects involving both gains and losses, risk attitudes are significantly influenced by loss aversion—the phenomenon according to which monetary losses are usually attributed greater weights than equivalent monetary gains (Abdellaoui, Bleichrodt, & Paraschiv, 2007; Schmidt & Zank, 2005; Tversky & Kahnemann, 1992).

Dissecting risk attitudes into its single elements has the advantage of permitting conclusions on the cognitive mechanisms behind the decision making processes one observes. Understanding the latter is in turn important for policy design and debiasing efforts (Bleichrodt, Pinto, & Wakker, 2001). Arkes (1991) divides typical cognitive biases into there broad categories:

1) *strategy-based errors*; such errors are often due to 'quick and dirty' strategies, that are highly adaptive in environments in which decisions need to be taken quickly; they can generally be eradicated by giving subjects sufficient motivation
2) *association-based errors*; these are errors stemming from the application of decision rules devised for one category of events to events that appear superficially similar, but that are not; debiasing of such errors will generally prove more difficult, and may depend on one's ability to uncover the fundamental differences in the apparently similar events;
3) *psychophysically-based errors*; such errors derive often from low sensitivity to relatively small changes; to the extent that it may be very difficult to acquire an eye for the finer differences, such errors are generally resistant to debiasing.

The above categorization raises interesting issues for decision making under risk. It is generally thought that probability weighting—as well as utility curvature—belongs to the third category, and will thus be resistant to debiasing. Indeed, it has been found that neither probability weighting nor utility curvature are influenced by accountability, i.e. requiring decision makers to justify decision making processes (Vieider, 2008), while accountability requirements are generally effective at reducing biases that fall into the first two categories (Vieider & Tetlock, 2010). Also, higher financial incentives do not typically flatten out the probability weighting curve pushing it closer to linearity, although they do generally result in increased levels of risk aversion over the whole probability spectrum (Binswanger, 1980; Kachelmeier & Shehata, 1992; Lefebvre, Vieider, & Villeval, 2010).

When it comes to loss aversion, however, there is some evidence that it may belong to the first category of biases, which—while being generally strong—also makes it unstable and hence relatively easy to debiase. Indeed, List (2004) found that experienced traders are not usually affected by loss aversion. Plott & Zeiler (2005) showed that the endowment effect could be eliminated by putting in place a number of measures. Vieider (2009) showed that having to justify one's decision in front of the experimenter also reduces the incidence of loss aversion.

Given that we hypothesize different effects of accountability on probability weighting or utility curvature and loss aversion, it may be useful to discuss the issue in the light of Wegener & Petty's (1995) flexible self-correction model. The model postulates that people may shift away from their 'natural' or spontaneous behavior when motivated to do so. The extent to which they correct their behavior however, as well as the direction in which they correct it, will fundamentally depend on their naïve theory of the bias. To the extent that loss aversion may be perceived as a bias, we may thus see people shifting away from it. Probability weighting and utility curvature on the other hand seem to be different inasmuch as they are not generally recognized as decision biases.

Differences in the underlying causes of biases and their consequence for debiasing efforts have important policy implications, inasmuch as probability weighting and loss aversion have been found to be the origin of a host of important real-world biases. Camerer (2000) showed how loss aversion can be used to explain a host of puzzling real-world decision phenomena. Probability weighting explains the simultaneous take-up of insurance and lottery play (Wakker, 2010). It has been used to explain risk-insurance against climate change disasters (Botzen & van den Bergh, 2009). And it seems to be at the origin of reference point effects that have been observed in financial markets (Lefebvre & Vieider, 2010; Wiseman & Gomez-Mejia, 1998) and for investment behavior by firms (Fiegenbaum, 1990; Fiegenbaum & Thomas, 1988).

## 3. Experiment 1: Responsibility for gains, losses, and mixed prospects

### 3.1. Experimental Design

We designed a laboratory experiment in which we asked subjects to take binary decisions between two alternatives, that are presented to them on a computer screen. Payoffs always affect the decision maker and the recipient in a perfectly parallel manner in the responsibility treatment, so as to avoid issues of payoff inequality (Bolton & Ockenfels, 2010; Rohde & Rohde, 2010).

***Subjects***. Overall, 144 subjects were recruited from a subject pool at Ludwig-Maximilian's University in Munich, Germany, via ORSEE (Greiner, 2004). The experiment took roughly 1.5 hours, and average earnings were €22.50. The experiments were run on computers using zTree (Fischbacher, 2007). 46% of subjects were female, and the average age was 24.07 years.

***Task***. Subjects were asked to choose between a safe prospect and a risky prospect. The safe prospect usually consisted in a sure amount of money, and sometimes in a prospect with lower volatility compared to the risk prospect. The risky prospect always gave 50–50 chance to obtain one of two outcomes. The prospects could comprise only positive amounts, only negative amounts, or both positive and negative amounts (see below). Overall, subjects had to make 40 choices, with the order of presentation as well as the position of the two prospects randomized for each subject. Subjects took decisions sequentially and had no opportunity to return to an earlier decision to revise it. All of the above was common knowledge and explained in the instructions.

***Prospects***. The 40 prospects were constructed systematically in the following way:

- *Basic prospect pairs*: We chose 5 different basic prospects with five different stake levels to serve as a foundation from which all other prospects were constructed. These five prospect pairs thus always offered a choice between a safe payment (of 2, 4, 6, 8, and 10 Euros respectively), and a prospect providing a 50% chance to win twice the safe amount or zero otherwise.
- *Pure Loss Prospects*: The mirror image of the base case where every amount was negative instead of positive. These prospects were inserted to directly compare risk taking behavior for gains and losses.
- *Mixed prospects***:** To obtain these prospects, the safe amount in the basic prospects was subtracted from all outcomes, thus obtaining a prospect with an expected value of €0. E.g., the mixed prospect derived from basic prospect pair 2 would be a choice between a sure payment of €0 and a 50% chance to gain €4 and a 50% chance to lose €4.

- *Mean-preserving spread*: To obtain this prospect, the two outcomes of the basic prospect were respectively increased and decreased by 25% of the sure amount. The expected value of the prospect thus remains the same; however, the variance of the prospect increases, and a loss equal to 25% of the sure amount is introduced into the prospect.
- *Lottery choice*: The prospect now remains identical to the basic prospect, but the safe payment is replaced by a prospect with a lower variance than the risky prospect. As an example in stake level 1, the safe payment of €2 would be replaced by a prospect with a 50% chance to gain €3 and a 50% to obtain €1.
- *Sensitivity down*: Compared to the basic choice pair, the safe payment is reduced by 25% to assess the degree of risk aversion of subjects.
- *Sensitivity up*: Similar to "Sensitivity down", but the safe payment is increased by 25%.
- *Positive shift*: Every amount is increased by 50% of the safe payment in the base category. E.g., in stake level 5, the safe payment is €15 and the prospect provides a 50–50 chance of €5 or €25.

The five basic choice pairs, plus seven variations on each basic pair, thus give a total of 40 choices. For a complete overview of all prospect pairs, see Table 1 in the Appendix.

***Treatments***. Subjects were randomly assigned to one of two treatments. In the *individual* treatment, subjects took their decisions only for themselves. In the *responsibility* treatment, half of the subjects were randomly assigned the role of decision maker and the other half to the role of passive *recipient*. The decision maker was told that she had to take the decision on behalf of herself and another subject sitting in the laboratory, whose identity was not disclosed. All other subjects were told that they were in a passive role and that somebody else in the laboratory would take the decisions on their behalf. With a lag of one period, recipients were shown the decision problem and the choice of their corresponding decision maker. They could then indicate whether they were "satisfied" or "not satisfied" with the decision, but this did not affect payoffs nor was it shown to the decision maker.

***Incentives***. 3 out of the 40 decisions were randomly drawn for every subject to be payoff relevant. To make the random mechanism behind lotteries as transparent as possible, we had one participant throw a dice for every lottery that determined what outcome of the lottery obtained. In the responsibility treatment, we implemented the payout procedure such that always three identical decisions were randomly chosen for the two paired subjects.

### 3.2 Results: choices under responsibility

***Prospect Choices: overview***

Before discussing treatment effects, it seems desirable to discuss general risk attitudes and how they change for the different types of prospects employed. In the base lotteries we find a considerable degree of risk aversion, with about 77% of subjects choosing the sure amount over the prospect with equal expected value. As one would expect, choices of the sure amount further increase when the sure amount is higher than the expected value of the prospect, and decrease when the sure amount is lower. When compared to the basic prospect pair all outcomes are moved upward by 50% of the sure amount, we observe increased choices of the prospect. This seems to indicate an heuristic according to which a prospect is deemed more acceptable when it assures at least a minimum amount of money that will be won in any case (Lopes, 1987).

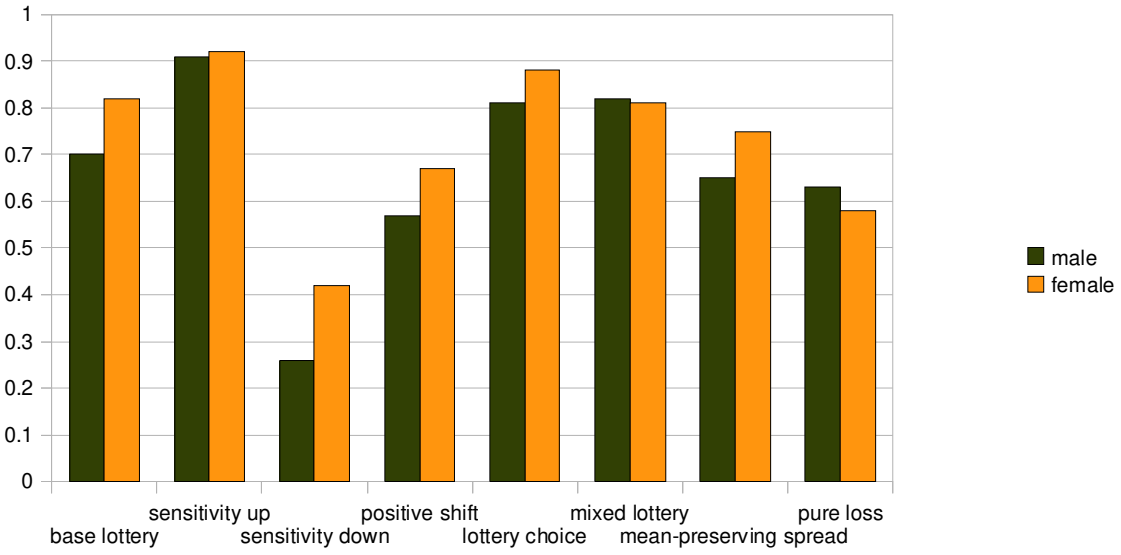



**Fig. 1**: Choice frequency of safe prospect by prospect pair type and gender

When the choice is between two non-degenerate prospects, choice frequencies of the sure prospect are increased, indicating a similar heuristic. For mixed prospects, the choice frequency of the sure amount is only slightly increased compared to the base category. For the mean-preserving spread, choices of the risky prospect increase, thus indicating that the increase in the good outcome more than makes up for the slight loss that has been introduced in the bad outcome. Finally, for pure loss choices, subjects are considerably more risk seeking than for gains, even though in a majority of cases subjects still choose the sure loss over the prospect.

It is also commonly found in the literature that risk attitudes are influenced by stake levels (Binswanger, 1980; Kachelmeier & Shehata, 1992; Lefebvre, Vieider, & Villeval, 2010). We thus

take a look at the influence of the different stake levels on decisions. Figure 2 shows choices for the safe alternative separately for the basic prospect pairs and the pure loss pairs. While the stake effect is clearly visible for the basic gain prospects, with increasing expected values resulting in increased levels of risk aversion, there is no clear trend for pure loss prospects, where risk aversion has only a very slight (and nonsignificant: p=0.43) tendency to increase with absolute stake values. A statistical analysis of these descriptive results can be found in appendix A3.

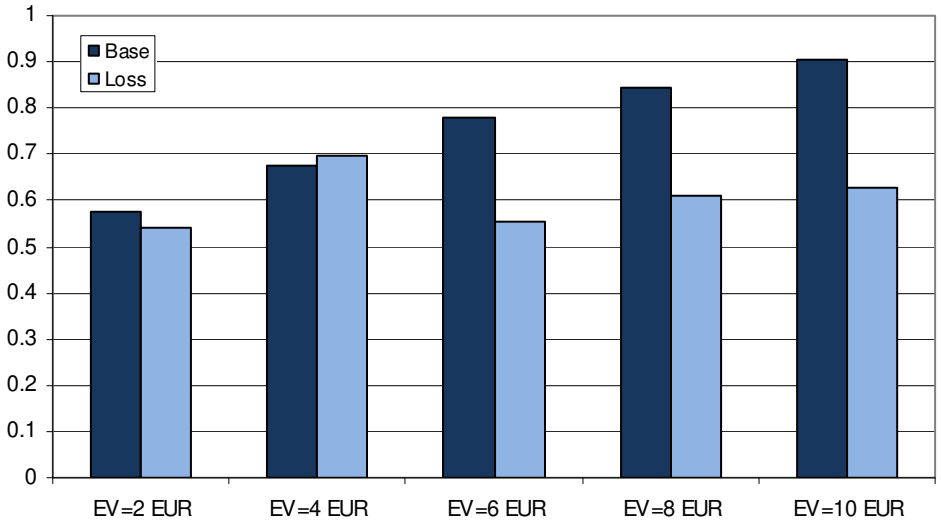



**Fig. 2**: Stake effects for gains and losses

***Individual decisions versus Responsibility***

Figure 3 shows choice frequencies for the safe prospect by treatment, separately for males and females. One can clearly see how for the base choice pair subjects are more risk averse under responsibility than in the individual decisions—this holds both for males and females. The same tendency is visible in all other positive prospect pairs, except for the upward sensitivity choice pair, in which there is no difference. There is only a very slight indication of responsibility inducing more risk aversion in the mixed prospect choice pair, while this tendency is again more pronounced for the mean-preserving spread pair. For pure loss choices however, the tendency is inverted, with responsibility increasing *risk seeking*.

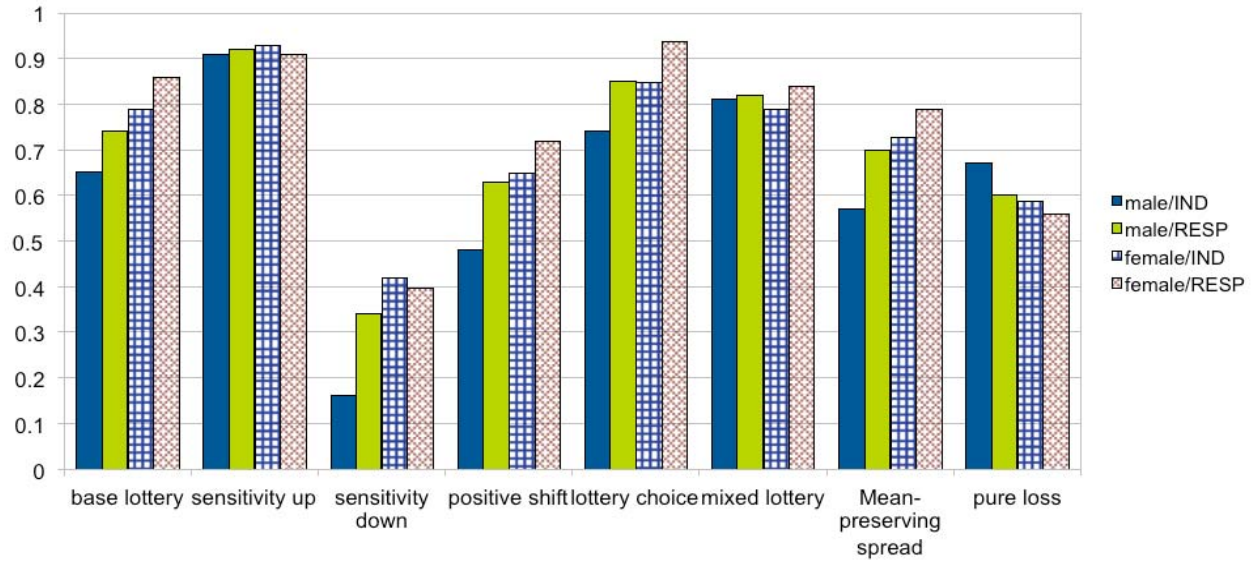



**Fig. 3**: Choice frequency of the safe prospect for different prospect pairs, by treatment and gender

Table 1 presents a random effects Probit model regressing choices for the safe prospect on a variety of explanatory variables. All regressions are hierarchically fully specified in the sense of Jaccard & Turrisi (2003), whose terminology we adopt in what follows. Regression I regresses choices on the treatment dummy, a dummy variable indicating the pure loss prospects, and an interaction term between the latter two.

**Table 1**: Random effects Probit Regression: coefficients show effects relative to choices in the individual treatment; *** represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10

| **Dep. Var.**: choice of safe prospect | **I** | **II** |
|---|---|---|
| responsibility | 0.200*<br>(0.100) | 0.236*<br>(0.113) |
| pure loss | –0.218*<br>(0.091) | –0.256**<br>(0.092) |
| responsibility*pure loss | –0.264*<br>(0.129) | –0.295*<br>(0.131) |
| EV difference | | 0.625***<br>(0.034) |
| SD difference | | 0.068***<br>(0.007) |
| female | 0.245*<br>(0.099) | 0.270*<br>(0.112) |
| constant | 0.397***<br>(0.088) | 0.060<br>(0.017) |
| Nr. Observation<br>(subjects) | 3840<br>(96) | 3840<br>(96) |
| Wald Chi2 | 35.04 | 392.33 |

Being responsible for somebody else's payoffs as well as one's own increases risk aversion relative

to being only responsible for one's own payoffs; the latter is a *simple main effect*, indicating the effect of responsibility for all prospects except the pure loss prospects (i.e., with the pure loss dummy held *constant at zero*). The effect of the pure loss dummy indicates that for pure loss prospects subjects are more risk seeking compared to all other prospects. The interaction between the treatment dummy and the one identifying pure loss prospects indicates that for pure loss prospects the effect of responsibility goes in the opposite direction compared to pure gain prospects, and thus shows that subjects in the responsibility treatment are *more risk seeking* for losses compared to subjects in the individual treatment. Finally, we also find that females are significantly more risk averse than males. Such an effect is commonly found for decision making under risk (Donkers, Melenberg, & Soest, 2001; Eckel & Grossman, 2008).

Regression II keeps the same independent variables as regression I, and adds the difference in expected value (defined as the expected value of the safe prospect minus the expected value of the risky prospect) and the difference in standard deviations (defined as the standard deviation of the risky prospect minus the standard deviation of the safe prospect). For both measures, the higher the difference between the safe prospect and the risky prospect, the more likely subjects will choose the safe prospect. The main treatment effects discussed above are stable, indicating increased risk aversion under responsibility in the gain domain, and increased risk seeking in the loss domain.

***Choice satisfaction of recipients and relative risk preferences***

In the responsibility treatment, recipients saw the decision maker's choice with one period lag and indicated whether they were satisfied with the decision or not. Although this rating was not incentivized, it may nevertheless give an indication of the extent to which decision makers adapted their decision to the commonly acceptable one, or correctly intuited which decision would be deemed more acceptable while doing so.

Table 2 shows a random effects Probit model regressing the recipient's satisfaction with each choice on a number of independent variables. The highly significant effect of the safe prospect being chosen by the decision maker shows that safe choices are deemed more satisfactory in the gain domain (this being a simple main effect measuring the effect of safe choices with the pure-loss dummy held constant at *zero*). While the fact that a prospect offers only negative outcomes per se does not affect satisfaction ratings, choosing the safe amount in pure loss prospects is generally not perceived as satisfactory by recipients. This finding confirms that risk seeking is deemed more acceptable than safe choices under losses.

Regression II confirms the stability of the findings we have just discussed, and adds some more variables. Mixed prospects result in generally lower satisfaction levels overall, providing an

indication that there is more controversy over the correct decision when losses are involved as well as gains. Satisfaction levels are, however, generally higher when the safer option, i.e. a sure amount of €0, is chosen in the mixed prospect pairs, as indicated by the highly significant interaction effect. Choices are deemed more satisfactory the higher the difference in expected value, providing an indication that higher differences in expected value increase the agreement between decision makers and recipients on which choice is the best one. Finally, in keeping with previous findings on gender effects, women generally deem choices of the safe prospect as more satisfactory than choices of the risky prospect.

**Table 2**: Random Effects Probit Regression: coefficient indicate satisfaction levels relative to a choice of the risky prospect; ***represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10.

| **Dep. Var.**: satisfied with decision | **I** | **II** |
|---|---|---|
| Safe prospect chosen | 1.080*** | 0.686*** |
| | (0.081) | (0.114) |
| Pure loss | 0.174 | –0.008 |
| | (0.145) | (0.148) |
| Pure loss * safe prospect chosen | –0.782*** | –0.541** |
| | (0.194) | (0.198) |
| Mixed prospect | | –0.697*** |
| | | (0.216) |
| Mixed prospect * safe prospect chosen | | 1.050*** |
| | | (0.261) |
| EV difference | | 0.250*** |
| | | (0.045) |
| female | 0.048 | –0.058 |
| | (0.096) | (0.148) |
| female*safe choice | | 0.300* |
| | | (0.148) |
| Constant | 0.048 | 0.192 |
| | (0.096) | (0.107) |
| Nr. Observation | 1920 | 1920 |
| (subjects) | (48) | (48) |
| Wald Chi2 | 196.08 | 230.85 |

At the end of the experiment we asked subjects to rate their degree of risk aversion on a scale from being very risk seeking (1) to being very risk averse (6). This self-declared risk aversion correlates strongly with the number of safe choices taken in non-negative prospect pairs during the experiment itself. Self-declared risk attitudes are not significantly different between the two treatments (p=0.26; Mann-Whitney test, two-sided), nor is there a significant difference between decision makers and recipients in the responsibility treatment (p=0.72; Mann-Whitney test, two-sided). Finally, we also asked subjects to rate themselves according to their risk aversion relative to other participants in the experiment. The rating went from 1 (indicating that a subject considered herself to be amongst the four most risk-loving participants to 6 (indicating that a subject considered herself to be amongst

the four most risk averse participants in the experiment). On average, decision makers in the responsibility treatment had a rating of 4.17, indicating that they considered themselves more risk averse than the median participant in the experiment, and thus ruling out that they may have considered recipients on average to be more risk averse than they are themselves. This finding corresponds to existing evidence according to which subjects generally consider others as more risk loving than themselves (Hsee & Weber, 1997).

### 3.3 The effects of accountability

We recruited 96 additional subjects to participate in a third treatment. The average age was 23.50 years and 40% of subjects were female. The *accountability* treatment was constructed in a way identical to the responsibility treatment, except that decision makers were now told that one decision maker in each session (p=1/12) would be extracted at random at the end of the experiment and shown to a different room, where the recipient would be handed an overview of the decisions and given the opportunity to interrogate the decision maker about the reasons behind her choices.

Table 3 shows a random effects Probit regression of choices of the safe prospect on several explanatory variables. Effects of accountability are now measured relative to the responsibility treatment. Overall, accountability does not result in different choices compared to the responsibility treatment. This holds both for gain and loss prospects. The exception to the rule are mixed prospects, for which accountability results in a marked decrease in safe choices, indicating a reduction of loss aversion.

**Table 3**: Random Effects Probit Regression: coefficients show effects relative to choices in the responsibility treatment; ***represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10.

| **Dep. Var.**: choice of safe prospect | **I** | **II** |
|---|---|---|
| accountability | –0.061<br>(0.097) | –0.002<br>(0.101) |
| pure loss | –0.443***<br>(0.091) | –0.388***<br>(0.093) |
| accountability*pure loss | 0.017<br>(0.129) | –0.041<br>(0.132) |
| mixed prospect | | 0.204**<br>(0.077) |
| accountability*mixed prospect | | –0.213*<br>(0.107) |
| female | 0.163†<br>(0.098) | 0.163†<br>(0.099) |
| constant | 0.625***<br>(0.076) | 0.578***<br>(0.078) |
| Nr. Observation<br>(subjects) | 3840<br>(96) | 3840<br>(96) |
| Wald Chi2 | 48.64 | 55.40 |

Taking a closer look at the effects, we thus find no simple effect of accountability. As usual, we find more risk seeking for pure loss prospect pairs compared to gain prospects, but no effect of accountability on choices for the loss prospects. We find however a significant simple effect of mixed prospects, indicating that under responsibility risk averse choices for mixed prospects are more frequent than for pure gain prospects at large. More interestingly, there is a significant interaction effect between accountability and the mixed prospect dummy, indicating that making subjects accountable reduces their choices of the safe alternative in mixed prospects significantly.

### 3.4 Discussion

***Social acceptability of loss aversion***

We start our discussion by considering the effect of responsibility and accountability on loss aversion. We have seen that in general, subjects choose the safe option more often compared to choices in the basic prospect pair when prospects are mixed, i.e. losses can be incurred by choosing the risky prospect. This loss aversion effect is not further increased under conditions of responsibility. However, notwithstanding choice frequencies of the safe prospect of around 80% in the mixed prospect pairs, recipients are generally less satisfied with choices in mixed prospect pairs. Even though this effect is qualified by a higher acceptance for safe choices relative to risky choice in this kind of prospect pairs, overall the satisfaction level is lower for this kind of prospect pairs compared to the base case. This indicates that it seems less clear to subjects what kind of behavior is acceptable for mixed prospects. A further indication in this direction derives from the fact that loss aversion is radically reduced under accountability.

There are also some more subtle implications to be derived from this finding. An important distinction in the social psychology literature is the one between process and outcome accountability (Simonson & Staw, 1992; Vieider & Tetlock, 2010). Vieider (2009) also found loss aversion to be reduced by a process accountability requirement, asking subjects to justify their (individual) decision in front of the experimenter. Baltussen, van den Assem, & van Dolder (2010) on the other hand found accountability to increase loss aversion in individual decision tasks when decisions were observed by bystanders. The latter however use mere observation, where no reasons can be given to justify one's choice. Reason-giving in the spirit of Shafir, Simonson, & Tversky (1993), implicit in process accountability, makes it easy to justify a decision when strong normative principles are there to underscore it, while no such justifications can be given when only outcomes are observed. In the latter case, it seems that attention is rather focused on how stupid one can look if a loss results that could have been avoided (Trautmann, Vieider, & Wakker, 2008).

We thus propose that our finding is explained by the fact that subjects who may have to

explain their decisions to recipients recur to more careful consideration of the options at their disposal, and take the option that they deem normatively more justifiable more often (Tetlock, 1991; Tetlock, Skitka, & Boettger, 1989). Vieider (2009) found that loss aversion in an individual decision making task was reduced by an accountability requirement. Subjects however had to justify their decision in front of the experimenter, were almost exclusively economics students, and the task was not incentivized. Since now the justification is to the recipient, subjects were from a variety of disciplines with economists constituting a minority (28%)[2], and choices were incentivized, the finding seems to have wider implications. Indeed it would seem like subjects, when motivated to consider their decisions more carefully, tend to identify loss aversion as a bias and to move away from it. It thus appears that loss aversion can easily be identified as a bias, such that subjects move away from it when sufficiently motivated to do so, as predicted by flexible self-correction models (Wegener & Petty, 1995). This raises interesting questions about the perceived normative status of typical decision making patterns under risk in general, which we discuss next.

***Decision under responsibility: cautious shift or accentuated probability weighting?***

For gain prospects, we find that responsibility increases risk aversion. This finding is indeed consistent with some early indications in the literature. Bolton and Ockenfels (2010) provided an indication that responsibility for others may induce increased risk aversion under equal payoffs, although their results failed to reach significance. A similar indication derives from one possible explanation of the findings by Charness & Jackson (2009). While the former find this increased risk aversion for large-probability gains, the latter find it for small probability losses (assuming, as they do implicitly and quite plausibly, that the safe amount that can be had by deviating from the efficient equilibrium serves as a reference point). Neither of these findings however helps us answer the question of what may be the reason underlying such an increase risk aversion.

An account based on the assumption that decision makers consider others to be more risk averse than they are themselves seems to be ruled out by the answers to the relative risk attitude ranking questions discussed above. Also, Hsee & Weber (1997) found that in a series of different experimental designs subjects systematically predicted others to be more risk seeking than themselves. One possibility is that subjects comply to an implicit social rule dictating increased caution when responsible for somebody else as well as oneself, thus increasing their risk aversion when responsible for somebody else. Such a *cautious shift* explanation however cannot explain our increased risk seeking for loss prospects. Arguably, different social rules dictating a cautious shift

[2]Adding a dummy for economists and an interaction term for economists*accountability in the regressions does not produce any significant results.

for gains and a 'risky shift' for losses could well exist, but such a hypothesis does have a distinctly *ad hoc* flavor. Given that individual risk attitudes have been established to be much richer than the simple risk-aversion/risk seeking dichotomy implicit in such explanations (Abdellaoui, 2000; Abdellaoui, l'Haridon & Zank, 2010; Bleichrodt & Pinto, 2000), we rather hypothesize that 'natural' risk attitudes found in individual decision making are accentuated under conditions or responsibility.

To be sure, prospect theory would predict risk aversion to prevail both for medium to large probabilities of a gain and for small probabilities of a loss, so that a theory based on the amplification of the fourfold pattern of risk attitudes predicted by prospect theory cannot be separated from an account based on a social rule favoring increased risk aversion under responsibility. Risk seeking, however, seems to appear more acceptable than risk aversion in the loss domain. Evidence in this direction comes both from the behavior of decision makers, who under conditions of responsibility are more risk seeking than in the individual treatment; and from recipients, who are much more likely to be dissatisfied with a decision in the loss domain when the decision maker chose the sure loss rather than the prospect. This, in turn, cannot be explained by a uniform social norm dictating increased caution under conditions of responsibility.

We thus propose that the probability weighting at the base of the fourfold pattern of risk aversion predicted by prospect theory is amplified by responsibility[3]. Arkes (1991) indeed indicated probability weighting (as well as utility curvature) as a psychophysically–based error, which he thus predicted to be extremely resilient to debiasing. Seeing how responsibility seems to accentuate probability weighting, we take this conclusion one step further by hypothesizing that not only probability weighting is not easily identified as a bias by subjects; when sufficiently motivated to do so, subjects will on the contrary construct a naïve theory of bias that indicates their natural inclination to weight probabilities as too feeble, thus inducing them to accentuate their probability weighting when responsible for others. In other words, when pushed to think about it, subjects may see probability weighting—or the more elementary motives behind it—as normative, so that under responsibility they will be induced to accentuate probability weighting. A hint in this direction also comes from the fact that our accountability manipulation had no effect on either increased risk aversion for gains or increased risk seeking for losses under responsibility, which provides an indication that decision makers deem such behavior justifiable.

Notwithstanding the former arguments, the conclusion that responsibility accentuates

[3]This assumes linearity of the utility function, so that any changes in the fourfold pattern of risk attitudes are entirely reflected in the probability weighting function. Utility is indeed generally found to be linear for relatively small amounts such as the ones used in these experiments. However, our results do in no way depend on this assumption. Indeed, the same issue of decreasing sensitivity underlies outcome transformations and probability weighting (Tversky & Wakker, 1995), so that our conclusions do not change. It seems however more convenient to discuss changes in probability rather than "changes in probability weighting and/or utility curvature".

probability weighting is still rather speculative at this point. Indeed, there may be other explanations for the reversal in behavior under responsibility between gains and losses, e.g. the already discussed different social norms for decisions under gains and under losses. There may however be a possibility to disentangle such different explanations. The hypothesis of an accentuated fourfold pattern of risk attitudes as found in prospect theory and the social norm argument make very different predictions for different probability levels in the gain domain. For large probabilities, both prospect theory and the social norm argument predict an increase in risk aversion under conditions of responsibility. For small probabilities, the social norm hypothesis still predicts an increase in risk aversion. Quite to the contrary however, prospect theory and the probability weighting argument laid out above now predict an *increase in risk seeking* under conditions of responsibility. We thus proceed to testing the effect of responsibility on decisions for different probability levels in the gain domain.

## 4. Experiment 2: Disentangling social norm and flexible self-correction explanations

### 4.1 Experimental Design

***Subjects***. Overall, 180 subjects were recruited from a subject pool at Ludwig-Maximilian's University in Munich, Germany, using ORSEE (Greiner, 2004). The experiment was run together with another, unrelated, experiment. 59% of subjects were female, and the average age was 23.88 years.

***Task***. During the experimental session, there were two tasks that were relevant to the current experiment. Task 1 was run at the outset of the experimental session, before any treatments were introduced, and consisted in the elicitation of risk attitudes using an adaptation of the method of Abdellaoui, Bleichrodt, & l'Haridon (2008). Task 2 was run after another, unrelated experiment[4]. In task 2, subjects were asked to choose between a safe option and a risky option in a fashion similar to experiment 1. However, we now only looked at choices in the gain domain. The safe option *always* consisted in a sure amount of money, while the prospect providing a chance of either 10% or 90% to win €10. Overall, subjects had to take 10 choices where the order of presentation was randomized for every subject. Subjects took decisions sequentially and had no opportunity to return to an earlier decision to revise it.

[4]Although the experiment run between to two tasks was unrelated, care was taken to distribute the treatments of the second task orthogonally to the treatments in the other experiment.

***Prospects***. The choice was always between a sure amount of money and a prospect. There were two prospects, one providing a 10% chance to win €10 and zero otherwise; and one providing a 90% chance to win €10 and zero otherwise. The sure amount could take one of five different amounts for each prospect: €0.8, €1, €1.2, €1.5 and €2 for the 10% prospect, and €7, €8, €8.5 €9, and €9.5 for the 90% prospect.

***Treatments***. Subjects were randomly assigned to one of two treatments that exactly mirrored those of experiment 1: an *individual* treatment in which subjects took their decisions only for themselves; or a *responsibility* treatment, in which half of the subjects were randomly assigned the role of decision maker and half the subjects were assigned the role of passive *recipient*.

***Incentives***. One decision from task one was randomly extracted to be played for real pay. Since in the unrelated experiment subjects could obtain at least an approximate knowledge about their payoffs, we decided to fully reveal earnings from task 1 and the unrelated experiment after the latter was finished in order to be able to control for the exact income effect in a regression (rather than having unknown *perceptions* of earnings). After task 2 was finished, one decision from that task was randomly extracted for real pay.

### 4.3 Results

***Individual decisions versus decisions under responsibility***

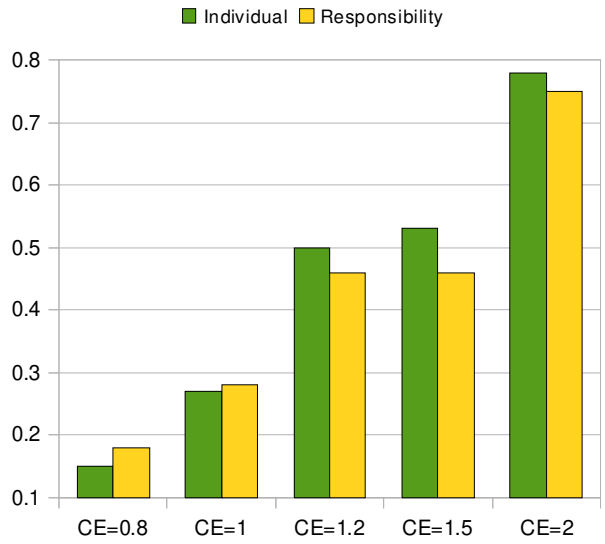



**Fig 4a**: Choice frequency by treatment for p=0.1

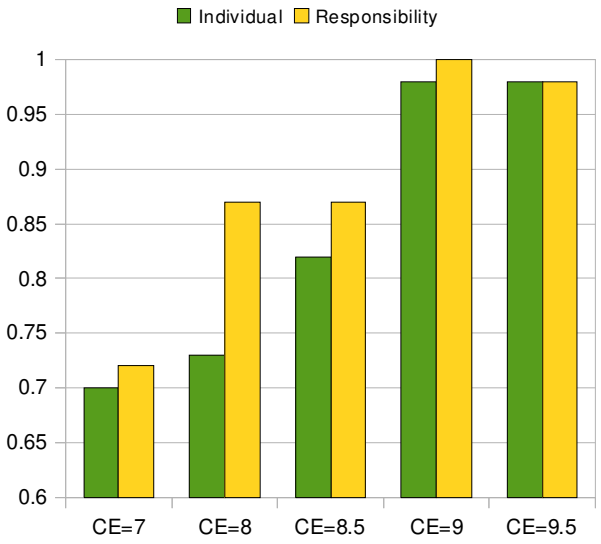



**Fig. 4b**: Choice frequency by treatment for p=0.9

Figures 3a and 3b display the choice frequencies by treatment separately for small and large probabilities. On average we find the typical pattern of risk seeking for small probabilities and risk

aversion for large probabilities. Indeed, when the subjects face a choice between a prospect and a sure amount of equal expected value, only about 27% of subjects choose the sure amount for the 10% probability, while 99% of subjects do so for the 90% probability. For the 10% probability, subjects who are responsible for somebody else choose the sure amount *less often* for all but the smallest two certain amounts. For the 90% probability, responsible subjects always choose the sure amount at least as often as decision makers who only decide for themselves.

Table 4 presents a random effects Probit model regressing choices of the safe alternative on a variety of explanatory variables. The effect of the responsibility treatment dummy now indicates the simple main effect of being responsible when probabilities are large (Jaccard & Turrisi, 2003). Subjects are thus more likely to choose the sure amount for a 90% probability of winning when responsible compared to the individual treatment. Under small probabilities, subjects are significantly more risk seeking than under large probabilities, as indicated by the highly significant effect of the small probability dummy. As shown by the interaction of the small-probability dummy with the treatment dummy, this risk-seeking tendency is further enhanced relative to the individual treatment when subjects are responsible for somebody else. As may be expected, the difference in expected value between the sure amount and the prospect is also highly significant. Finally, we find a significant, if small, income effect, which goes as expected in the direction of increased risk seeking by subjects who have realized higher earnings from the previous experiment.

**Table 4**: Random Effects Probit Regression: coefficients show effects relative to choices in the individual treatment; *** represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10.

| **Dep. Var.**: choice of safe prospect | **I** | **II** |
|---|---|---|
| responsibility | .343† | 0.485† |
| | (0.187) | (0.284) |
| Small probability | –2.414*** | –2.094*** |
| | (0.179) | (0.202) |
| Small probability * responsibility | –0.406* | –0.596* |
| | (0.196) | (0.226) |
| EV difference | 0.943*** | 0.959*** |
| | (0.083) | (0.062) |
| female | 0.224 | 0.621* |
| | (0.138) | (0.191) |
| Past profit | –0.026*** | –0.022* |
| | (0.007) | (0.010) |
| Female * small probability | | –0.631* |
| | | (0.198) |
| Past profit * responsibility | | –0.011 |
| | | (0.015) |
| constant | 1.498*** | 1.939*** |
| | (0.462) | (0.229) |
| Nr. Observation | 1200 | 1200 |
| (subjects) | (120) | (120) |
| Wald Chi2 | 263.90 | 263.57 |

Regression II adds two further interaction terms. Almost all effects can be seen to be stable. The gender effect, which had not been significant in regression I, is now also significant: since this is a simple effect, the positive effect of the female dummy now indicates increased risk aversion by females relative to males for large probability prospects. This effect is qualified by the interaction of the female dummy with the small-probability dummy. The negative effect of that interaction shows that females are significantly *more risk seeking* relative to males for small probabilities.

Examining the certainty equivalents obtained in task 1 before subjects were assigned to treatments, we find that for the prospect giving a 10% probability of winning €10 and zero otherwise the certainty equivalents of subjects that were later assigned to the individual treatment and those that were later assigned to the responsibility treatment are not significantly different ($p=0.94$, two-sided Mann Whitney test). Also for the prospect affording a 90% chance of €10 or else nothing, certainty equivalents are not significantly different ($p=0.41$, two-sided Mann Whitney test). Explanations based on different initial risk attitudes are thus ruled out.

***Satisfaction ratings***

Exactly as in experiment 1, recipients in experiment 2 saw the decisions of their assigned decision maker with a lag of one period, and had to indicate whether they were satisfied with the decision or not. While once again these decisions were not incentivized, the recipients seem to have taken the task seriously—not least because this was their only occupation during the experiment. Table 6 reports the results of a random effects Probit model regressing the satisfaction dummy on a number of explanatory variables.

The first dummy indicates the simple main effect of choosing the safe amount: choosing the safe amount for large probability prospects is deemed much more satisfactory in general than choosing the prospect. The dummy indicating the simple main effect of a small probability choice is also positive, indicating considerable agreement on choices in this instance. Choosing however the safe amount for small probability prospects is considered to be very dissatisfying, as shown by the large negative coefficient of the interaction effect. Recipients are in general less satisfied as the expected value difference increases under large probabilities, which is indicated by the simple effect of the relative dummy. They are however more satisfied with a choice of the safe alternative for large differences in expected value under large probabilities. Females tend to be much more satisfied when the safe amount is chosen over the large probability prospects, while past profits have no influence on satisfaction ratings.

**Table 5**: Random Effects Probit Regression: *** represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10.

| **Dep. Var.**: satisfied with choice | **I** | **II** |
|---|---|---|
| Choice of sure amount | 1.690***<br>(0.395) | 1.467***<br>(0.411) |
| Small probability (10%) | 0.813*<br>(0.413) | 0.862*<br>(0.415) |
| Safe choice * small probability | –1.972***<br>(0.463) | –2.056***<br>(0.467) |
| EV difference | –0.813***<br>(0.226) | –0.837***<br>(0.227) |
| EV difference * safe choice | 1.213***<br>(0.253) | 1.240***<br>(0.254) |
| female | 0.434**<br>(0.150) | 0.083<br>(0.213) |
| Female * safe choice | | 0.556*<br>(0.262) |
| Past profit | | –0.006<br>(0.009) |
| constant | –0.479<br>(0.377) | –0.265<br>(0.405) |
| Nr. Observation<br>(subjects) | 600<br>(60) | 600<br>(60) |
| Wald Chi2 | 61.70 | 64.59 |

### 4.4 Discussion

The social norm hypothesis and the probability weighting hypothesis make very different predictions on behavior for small probabilities in the gain domain. While for large probabilities both theories predict an increase in risk aversion under responsibility, for small probabilities the social norm argument predicts a cautious shift towards increased risk aversion (or at least reduced risk seeking), whereas the probability weighting argument predicts *increased* risk seeking. Having directly tested these contradictory predictions in experiment 2, we conclude that the social norm dictating a cautious shift under conditions of responsibility has been discredited as an explanation of the results: only an increased fourfold pattern of risk attitudes can explain our results.

This conclusion in turn lends support to our suspicion that subjects do not recognize probability weighting as a bias and may even perceive it to be normative. Indeed, when sufficiently motivated to so by bearing the responsibility of determining somebody else's outcomes as well as one's own, the naïve theory of a bias that subjects seem to form is that of being too moderate in their choices. When responsible for other subjects in the gain domain, they thus shift away from such positions, become more risk averse for large to medium sized probabilities, and more risk seeking

for small probabilities.

Further support for the aura of normativity surrounding probability weighting also derives from our accountability manipulation in experiment 1. Vieider (2008) found that accountability did not influence either probability weighting or utility curvature in an individual decision making task. The fact that requiring subjects to potentially justify their decisions in front of somebody else who is directly affected by those decisions does not change the increased probability weighting observed under responsibility indicates that subjects perceive such behavior as legitimate and justifiable. Finally, the increased satisfaction ratings under such conditions indicate that the decisions makers' intuition is indeed correct: there is complete consensus on the acceptability of accentuated probability weighting.

A completely different picture emerges for loss aversion. While subjects tend to be on average more satisfied with safe choices in mixed prospects, there seems to be little consensus on the 'correct' or most acceptable choice, as indicated by the generally lower satisfactions levels for decisions concerning mixed prospects. This evidence is further reinforced in the accountability treatment, where decisions makers considerably reduce their choice of the safe outcome. It thus seems like loss aversion is generally recognized as a bias, and when the possibility of having to justify one's choice exists, choosing a mixed prospect implying the possibility of a loss is perceived as perfectly justifiable.

The differential nature of probability weighting and loss aversion may have important consequences for the debiasing of decision making processes. Indeed, decision puzzles that are caused by loss aversion—such as the endowment effect, the equity premium puzzle, or the willingness-to-accept willingness-to-pay discrepancy—may be relatively easy to debias; some evidence in this direction does indeed exist (Fellner & Sutter, 2009; List, 2004; Plott & Zeiler, 2005). Issues deriving from probability weighting on the other hand may be more resilient. This in turn means that explicit rules may need to be introduced to reign in biases deriving such risk attitudes, or special training may be desirable for managers not to fall prey to decision patterns that may be suboptimal for the firms they manage (Fiegenbaum, 1990; Lefebvre & Vieider, 2010)

## 5. Conclusion

We systematically explored decision situations in which a decision maker bears responsibility for somebody else's outcomes as well as for her own. In the gain domain we confirmed the intuition that being responsible for somebody else's payoffs increases risk aversion. Looking at risk attitudes in the loss domain however, we find an increase in risk seeking under responsibility. An additional accountability mechanism does not change risk behavior, except for mixed prospects, in which it reduces loss aversion.

This raises issues about the nature of various decision biases under risk, and to what extent changed behavior under responsibility may depend on a social norm of caution in situations of responsibility versus naive corrections from perceived biases. To further explore this issue, we designed a second experiment to explore risk-taking behavior for gain prospects offering very small or very large probabilities of winning. For large probabilities, we find increased risk aversion, thus confirming our earlier finding. For small probabilities however, we find an increase of risk seeking under conditions of responsibility. The latter finding thus discredits hypotheses of a social rule dictating caution under responsibility, and can be explained through flexible self-correction models predicting a shift in behavior that will depend on decision makers' naive theories of bias.

## Appendix

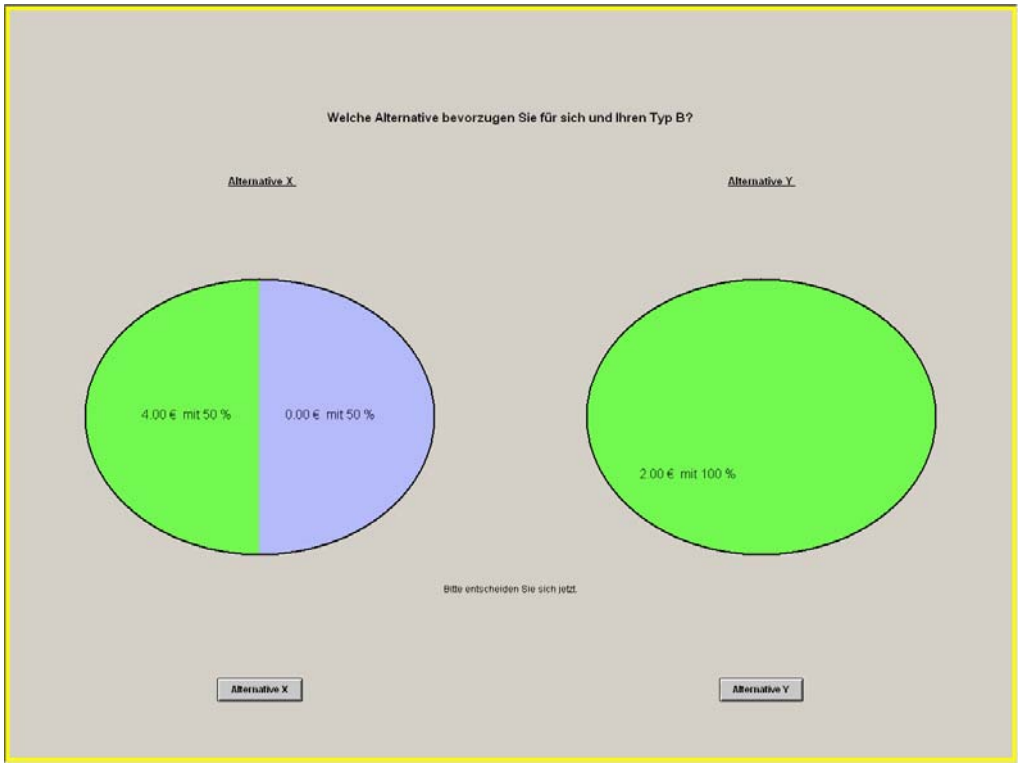
### A1. Tables

**Table 1: Overview of Lotteries**

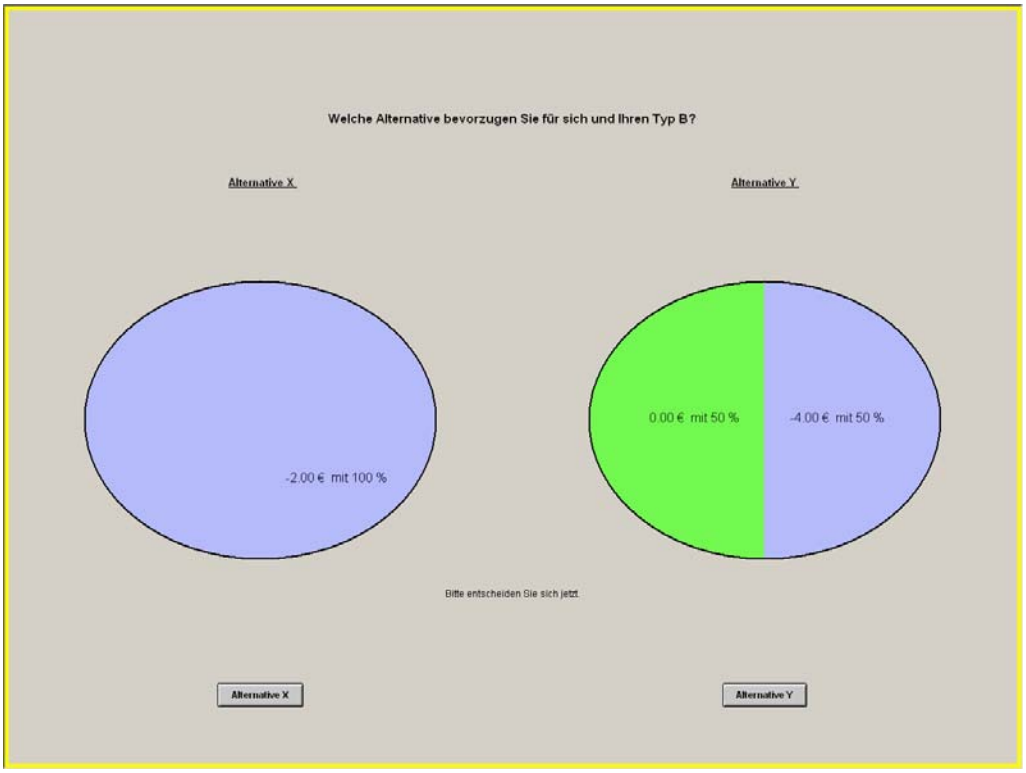
| | Option A ("Safe") | | | | Option B ("Risky") | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Lottery Number | Prob Left | Amount Left | Prob Right | Amount Right | Prob Left | Amount Left | Prob Right | Amount Right | Category |
| 1 | 1 | 2 | 0 | 0 | 0.5 | 4 | 0.5 | 0 | Base |
| 2 | 0 | 0 | 1 | -2 | 0.5 | 0 | 0.5 | -4 | Loss shift |
| 3 | 1 | 0 | 0 | 0 | 0.5 | 2 | 0.5 | -2 | Mixed |
| 4 | 0.5 | 3 | 0.5 | 1 | 0.5 | 4 | 0.5 | 0 | Lottery |
| 5 | 1 | 2 | 0 | 0 | 0.5 | 5 | 0.5 | -1 | CE |
| 6 | 1 | 1.5 | 0 | 0 | 0.5 | 4 | 0.5 | 0 | Sensitivity Down |
| 7 | 1 | 2.5 | 0 | 0 | 0.5 | 4 | 0.5 | 0 | Sensitivity Up |
| 8 | 1 | 3 | 0 | 0 | 0.5 | 5 | 0.5 | 1 | Positive Shift |
| 9 | 1 | 4 | 0 | 0 | 0.5 | 8 | 0.5 | 0 | Base |
| 10 | 0 | 0 | 1 | -4 | 0.5 | 0 | 0.5 | -8 | Loss shift |
| 11 | 1 | 0 | 0 | 0 | 0.5 | 4 | 0.5 | -4 | Mixed |
| 12 | 0.5 | 6 | 0.5 | 2 | 0.5 | 8 | 0.5 | 0 | Lottery |
| 13 | 1 | 4 | 0 | 0 | 0.5 | 10 | 0.5 | -2 | CE |
| 14 | 1 | 3 | 0 | 0 | 0.5 | 8 | 0.5 | 0 | Sensitivity Down |
| 15 | 1 | 5 | 0 | 0 | 0.5 | 8 | 0.5 | 0 | Sensitivity Up |
| 16 | 1 | 6 | 0 | 0 | 0.5 | 10 | 0.5 | 2 | Positive Shift |
| 17 | 1 | 6 | 0 | 0 | 0.5 | 12 | 0.5 | 0 | Base |
| 18 | 0 | 0 | 1 | -6 | 0.5 | 0 | 0.5 | -12 | Loss shift |
| 19 | 1 | 0 | 0 | 0 | 0.5 | 6 | 0.5 | -6 | Mixed |
| 20 | 0.5 | 9 | 0.5 | 3 | 0.5 | 12 | 0.5 | 0 | Lottery |
| 21 | 1 | 6 | 0 | 0 | 0.5 | 15 | 0.5 | -3 | CE |
| 22 | 1 | 4.5 | 0 | 0 | 0.5 | 12 | 0.5 | 0 | Sensitivity Down |
| 23 | 1 | 7.5 | 0 | 0 | 0.5 | 12 | 0.5 | 0 | Sensitivity Up |
| 24 | 1 | 9 | 0 | 0 | 0.5 | 15 | 0.5 | 3 | Positive Shift |
| 25 | 1 | 8 | 0 | 0 | 0.5 | 16 | 0.5 | 0 | Base |
| 26 | 0 | 0 | 1 | -8 | 0.5 | 0 | 0.5 | -16 | Loss shift |
| 27 | 1 | 0 | 0 | 0 | 0.5 | 8 | 0.5 | -8 | Mixed |
| 28 | 0.5 | 12 | 0.5 | 4 | 0.5 | 16 | 0.5 | 0 | Lottery |
| 29 | 1 | 8 | 0 | 0 | 0.5 | 20 | 0.5 | -4 | CE |
| 30 | 1 | 6 | 0 | 0 | 0.5 | 16 | 0.5 | 0 | Sensitivity Down |
| 31 | 1 | 10 | 0 | 0 | 0.5 | 16 | 0.5 | 0 | Sensitivity Up |
| 32 | 1 | 12 | 0 | 0 | 0.5 | 20 | 0.5 | 4 | Positive Shift |
| 33 | 1 | 10 | 0 | 0 | 0.5 | 20 | 0.5 | 0 | Base |
| 34 | 0 | 0 | 1 | -10 | 0.5 | 0 | 0.5 | -20 | Loss shift |
| 35 | 1 | 0 | 0 | 0 | 0.5 | 10 | 0.5 | -10 | Mixed |
| 36 | 0.5 | 15 | 0.5 | 5 | 0.5 | 20 | 0.5 | 0 | Lottery |
| 37 | 1 | 10 | 0 | 0 | 0.5 | 25 | 0.5 | -5 | CE |
| 38 | 1 | 7.5 | 0 | 0 | 0.5 | 20 | 0.5 | 0 | Sensitivity Down |
| 39 | 1 | 12.5 | 0 | 0 | 0.5 | 20 | 0.5 | 0 | Sensitivity Up |
| 40 | 1 | 15 | 0 | 0 | 0.5 | 25 | 0.5 | 5 | Positive Shift |

## A2. Figures

### Figure 1: Screenshots




Gain Lottery




Loss Lottery

## A3. Prospect type regression

Random Effects Probit Regression: coefficients show effects relative to choices in the basic prospect pair; *** represents significance at p=0.001, ** at p=0.01, * at p=0.05, and † at p=0.10.

| **Dep. Var**: choice of safe prospect | **I** | **II** | **III** |
|---|---|---|---|
| Sensitivity up | 0.702*** | 0.702*** | 0.722*** |
| | (0.108) | (0.108) | (0.110) |
| Sensitivity down | –1.260*** | –1.260*** | –1.307*** |
| | (0.092) | (0.092) | (0.094) |
| Positive shift | –0.454*** | –0.454*** | –0.722*** |
| | (0.090) | (0.090) | (0.096) |
| Lottery choice | 0.341*** | 0.341*** | 0.339*** |
| | (0.099) | (0.099) | (0.100) |
| Mixed Lottery | 0.191* | 0.191* | 0.661*** |
| | (0.096) | (0.096) | (0.107) |
| Mean-preserving | –0.191* | –0.191* | –0.204* |
| | (0.092) | (0.092) | (0.093) |
| Loss | –0.482*** | –0.483*** | –0.510*** |
| | (0.090) | (0.090) | (0.091) |
| Female | | 0.249* | 0.254* |
| | | (0.112) | (0.115) |
| Age | | 0.032* | 0.033* |
| | | (0.015) | (0.015) |
| Stake size | | | 0.083*** |
| | | | (0.008) |
| Nr. Observation (subjects) | 3840 (96) | 3840 (96) | 3840 (96) |
| Wald Chi2 | 510.18 | 515.91 | 587.36 |

Table 1 shows a random effects Probit model, with coefficients indicating the deviation of choices with respect to the basic prospect pair. In addition to the effects already discussed above, it shows that females are on average significantly more risk averse than males. Also, risk aversion increases with age. Both findings are commonly found in decision making under risk (Donkers, Melenberg, & Soest, 2001; Eckel & Grossman, 2008). More interestingly, we find an effect of stake size, represented by the expected value of the prospect (taken in absolute terms for the pure loss prospect). The higher the stakes of the decision, the more risk averse subjects become on average. This is in agreement with general findings in the literature (Binswanger, 1980; Kachelmeier & Shehata, 1992; Lefebvre, Vieider, & Villeval, 2010). Controlling for stake effects also makes the effect of the mixed prospects much more significant. This increased effect derives from the fact that the mixed prospects are obtained by adjusting the expected value of the prospect downward from the basic prospect pair. Since subjects tend to be less risk averse for lower stakes, the increased risk aversion found for mixed prospects appears more relevant once one controls for the decreased stakes in those choice pairs.

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