Are Algorithms as Risk-Averse as We Are? – Risk-Taking Under Accountability for Oneself and Others*

Jason Dana,[†] Christina Strobel[‡]

August 31, 2019

We examine whether decisions made under accountability differ for self and others using lottery choice tasks that contain only positive amounts (gaining lottery), positive and negative amounts (mixed lottery) and mainly negative amounts (losing lottery). Accountability is ensured by letting participants hold up a sign with their decision after the experiment. We find that when accountable to the public, participants are more risk-averse for others than for themselves in gaining, mixed and losing lotteries. However, the difference is only statistically significant in the gaining lottery. We also find participants who decide another person's outcome to be significantly less risk-averse when accountable than when not accountable to the person they decided for in the gaining lottery but find no significant difference in the mixed and losing lotteries.

Keywords: Experiment; Lottery Choice; Risk Aversion; Responsibility; Accountability
JEL classification: D81, C91

*This document was created on August 31, 2019, with R version 3.4.1 (2017-06-30), on x86_64-w64-mingw32. We thank the Yale School of Management for financial support. We also thank the people working at the Yale School of Management Behavioral Lab.

†Yale University, School of Management, 165 Whitney Avenue, New Haven CT 06511, jason.dana@yale.edu.

‡FSU Jena, School of Economics, Bachstraße 18k, 07737 Jena, Christina.Strobel@uni-jena.de.

1. Introduction

Developing an algorithm means taking risks.[1] The programmer has to decide what risks (s)he is willing to take, for example when determining confidence intervals and safety distance premiums that are going to be used in a medical diagnostic algorithm or a self-driving car algorithm.[2] The programmer also takes risks when (s)he decides which data source to use when developing a self-learning algorithm.[3] Algorithms, however, are often programmed by someone who will not use the system in the end. As it is not possible to determine the end users' risk preferences for every choice in the development process, algorithm settings are mainly determined by the programmer. Thus, the programmer decides to what extent (s)he is willing to take a risk, not for himself/herself but for others – the end users of the algorithm. Former experimental research on risk-taking for others has shown that people are not necessarily as risk-averse or risk-seeking for others as they are for themselves.[4] Hence, while some programmers might make such decisions exactly as they would for themselves, other programmers' choices might diverge from the choices they would make for themselves when deciding for others.

A reason why programmers decide differently for others than they would for themselves might be that they aim to cause or avoid specific feedback from the public or the end user. In other words, decisions are influenced by whether or not the decision maker expects to be held accountable or, as proposed by Tetlock (1992), expects to have to justify his/her decision to the affected individual or the public. Thereby, as Prospect Theory by Kahneman and Tversky (1979) suggests, it might also matter whether the decision determines a positive outcome or a negative outcome.

As the design process of an algorithm can hardly be explained to the end user of the algorithm, the risk settings are usually not transparent. However, as pointed out by Shariff et al. (2017), people hesitate to use an automated system if they are not sure that it has been programmed in their best interest. Thus, algorithm risk settings play an important role in the acceptance of autonomous systems. A first step to counteract uncertainty about algorithm risk settings is to find out whether choices for others generally diverge from choices for oneself in the event of a gain or a loss, and whether it matters who the decision maker is accountable to for the decision.

In this paper, we use three different lotteries that are similar to the Multiple Price Lists (MPLs) used by Holt and Laury (2002) to investigate risk preferences in choices for oneself and for others under different accountability settings. The first lottery contained only positive amounts (gaining lottery), the second lottery contained mainly negative amounts

[1]For the purpose of this paper we define algorithms as a set of rules to reach a defined outcome, following the definition by Markov (1954, p. 54).

[2]For example, the automotive and energy company Tesla plays with the safety distance programmed into the car and provides software with more or less aggressive safety distance settings (O'Kane, 2019).

[3]For example, in 2015 the technology company Amazon found out that their recruiting algorithm discriminates against women due to a biased training dataset (?).

[4]An overview of the experimental research on risk-taking on behalf of others can be found in Eriksen et al. (2017). The overview shows that, apart from some studies that found no difference between decisions made for others and decisions made for oneself, most studies found that decisions for others are either more or less risk-seeking than decisions for oneself.

(losing lottery), and the last one contained positive and negative amounts (mixed lottery). To remove any concerns about how a reciprocal relationship might affect choices for others, participants are randomly assigned to decide either on behalf of themselves or on behalf of another person.

Our results show that participants in all treatments are slightly risk-averse when accountable to the public. Participants deciding for others are significantly more risk-averse than participants who decide for themselves in the gaining lottery, but the risk preferences in the mixed lottery and losing lottery do not differ significantly. We also find participants who decide another person's outcome to be more risk-seeking when accountable than when not accountable to the person they decide for in the gaining lottery, but again do not find a significant difference in the mixed lottery or in the losing lottery.

The remainder of the paper is organized as follows. Section 2 provides a literature review focusing on experimental evidence from economics and social psychology. In particular, we discuss the literature on individual risk-taking as well as findings from research on risk-taking for others under accountability. In Section 3, we describe the basic experimental design. Then, in Section 4, we relate the experiment to the theoretical background and derive behavioral predictions. We present the results in Section 5. Section 6 concludes the paper by summarizing the main findings and discussing their implications and further research ideas.

2. Related literature

In Section 2.1 below, we present studies on risk preferences in decisions on behalf of oneself and others. In Section 2.2, we then turn to studies on risk preferences in choices for oneself and others under accountability.

2.1. Decision-making for oneself and others

According to the Expected Utility Theory by Von Neumann and Morgenstern (1947), risky decisions are no more than choices in lottery situations with different probability distributions. Thus, the economic literature mainly focuses on monetary risks to assess levels of risk aversion (e.g., Weber and Milliman, 1997; Pennings and Smidts, 2000; Dohmen et al., 2011).

One way to elicit individuals' risk attitudes is to use MPLs, which give participants an ordered array of binary lottery choices.[5] Studies that use an MPL task, however, come to very different results. While Chakravarty et al. (2011) and Haavik and Zeiler (2010) find a *risky shift* in the gain domain, Bolton et al. (2015) find a *cautious shift* and Humphrey and Renner (2011) find no difference between choices for oneself and choices for others.[6] In the mixed domain, Andersson et al. (2014) find a *risky shift* while Atanasov (2012) finds a *cautious shift*.

[5] An overview of experimental studies on risk-taking for oneself and others can be found in Table 3 in Appendix A.1.

[6] The terms *risky shift* and *cautious shift* were first used by Stoner (1961) and refer to situations where people become less or more risk-averse for others than for themselves.

Another way to measure risk aversion is to use a series of Random Lottery Pairs (RLPs).[7] Pahlke et al. (2015), Polman (2012) and Vieider et al. (2016) use a certainty equivalent RLP task where participants are asked to choose between a safe amount of money and a lottery with potential for higher gain and loss.[8] While Pahlke et al. (2015) find a *cautious shift* for decisions for others in gaining lotteries, Vieider et al. (2016) find a *risky shift*. In losing lotteries, Pahlke et al. (2015) and Vieider et al. (2016) find a *risky shift*. In mixed lotteries, Polman (2012) and Vieider et al. (2016) find a *risky shift* but Pahlke et al. (2015) find a *cautious shift*.

Further possibilities to measure risk attitudes include an Ordered Lottery Selection (OLS) task, an investment setting or a game. Eriksen et al. (2017) use an OLS task where participants have to pick one lottery from an ordered set and they find a *cautious shift* in gaining lotteries. Eriksen and Kvaløy (2010) and Füllbrunn and Luhan (2015) use an investment task design where an agent has to invest in a risky or safe asset on behalf of a principal and find a *cautious shift* when deciding for others. Charness and Jackson (2009) use a Stag Hunt Game where participants have to decide between a risky but payoff maximizing option and a safe option. They also find a *cautious shift*.

The different approaches are alike, in that no clear rule of thumb can be derived for whether decisions for others are riskier or more cautious than decisions for oneself. What becomes clear, however, is that risk attitudes depend on the area in which the decision is made, as the risk propensity differs between profit and loss situations in most of the studies. With regard to our experiment, it is therefore essential to consider the risk propensity in decisions for oneself and others between situations in which either gains or losses prevail and situations which include gains as well as losses.

2.2. Accountability in decisions for others

The experimental literature uses different approaches to induce accountability.[9] What most of the approaches have in common is that they increase accountability by revoking the anonymity of the decision maker. Vieider (2009), for example, interviewed the participants about their choices after the experiment to induce accountability and finds participants to be significantly less risk-averse (*risky shift*) in a lottery task when deciding about their own outcome compared to when there was no interview.

There are also experiments studying the effect of accountability on choices for others. Some studies revoke the anonymity of the decision maker. Sutter (2009), for example, revokes the anonymity of all participants by seating them in groups and letting them decide together. Sutter finds that participants who are accountable to a group show a lower level of risk aversion (*risky shift*) than participants who decide on their own without being accountable

[7] Harrison and Rutström (2009) suggest being cautious when comparing risk measurements generated by different elicitation formats. However, based on experimental evidence, RLP tasks – where the subject picks one lottery per pair – and MPL tasks – where all lotteries are presented at once – seem to create comparable results.

[8] In the study by Polman (2012), the experiment incentives for the decision maker are not salient and deception is used in other parts of the experiment.

[9] An overview of experimental studies on risk-taking for others under accountability can be found in Table 4 in the Appendix A.1.

to the group for their decision. Reynolds (2009) revokes the decision maker's identity in a Stage Hunt Game by letting recipients into the room after the decision maker has made his/her choice. He finds a significantly higher number of safe choices (*cautious shift*) when others' payoffs are at stake than when subjects decide only for their own payoff.

Other studies ensure that the decision maker is accountable to the affected individual, either by relying on already existing relationships or by revoking the anonymity of the decision maker during the experiment. Humphrey and Renner (2011), for example, require participants to bring a friend (a classmate, housemate or partner) to the experiment, for whose payoff they are then responsible. They find that risk aversion in the gain domain is not influenced by whether participants decide for a friend or a stranger. In contrast, Montinari and Rancan (2013) also require participants to bring a friend but find less risk-taking for friends (*cautious shift*) than for oneself or a stranger.

A different approach was taken by Pahlke et al. (2012), who expose decision makers to the threat of their anonymity being lifted. At the end of each session, one decision maker was randomly chosen and then had to justify her/his choices in front of her/his recipient. Pahlke et al. find significantly more risk-taking (*risky shift*) for others in the mixed lottery but no difference in the pure gain and pure loss lotteries under the threat of having one's anonymity suspended. In addition, Lefebvre and Vieider (2013) use the same method as Pahlke et al. (2012) and find significantly less risk-taking (*cautious shift*) under the threat of having one's identity revoked compared to a baseline treatment without the threat.

A further approach to increase accountability is to allow the recipient to reward the decision maker for his/her decision. Pollmann et al. (2014), for example, allow recipients to monetarily reward the decision maker before the outcome becomes known (ex-ante) and, in another treatment after the outcome has turned out favorably or unfavorably (ex-post). Pollmann et al. find that making subjects ex-post accountable for the outcome reduces risk tolerance to the same level that subjects have for decisions affecting themselves. However, making subjects ex-ante accountable for the decision leads to significantly less risk-taking (*cautious shift*) for others than for oneself.

Based on the literature, it is clear that there are two different concepts of accountability. While one part of the literature looks at accountability to the public, the other part focuses on accountability to the person affected by the decision. However, to the best of our knowledge, there is up to now no study that compares decisions for others under both kinds of accountability. Our experiment closes this gap by looking at risk attitudes in decisions for oneself and others under both concepts of accountability.

3. Experimental design

We implemented an experiment with the following elements: (i) an instruction quiz to ensure that the participants understood the experiment instructions correctly, (ii) three different lotteries with 10 choices, (iii) an accountability task where all participants had to hold up a sign with their choice in the payoff-relevant decision, and (iv) a short demographic questionnaire.

3.1. Lotteries

In accordance with previous research, we used choices in lotteries to measure risk preferences. In particular, we used an MPL lottery task as this design provides a very clean and structured approach to studying risk-taking in different domains. Similar to the design used by Holt and Laury (2002), participants had to decide between a (safer) lottery with a small spread between the possible outcomes – lottery A – and a (riskier) lottery with a large spread – lottery B. We had three different lotteries in total: the gaining lottery consisted of only positive payoffs, the mixed lottery contained three positive payoffs and one negative payoff, and the losing lottery contained only one positive payoff alongside three negative payoffs.[10] The lottery payoffs were varied so that all lotteries had approximately similar constant relative risk aversion (CRRA) values.[11] Following Holt and Laury (2002), participants were classified as risk-averse (risk-seeking) when preferring lottery A (B), even when the expected value of lottery A (B) was lower than the expected value of lottery B (A). Participants were classified as risk-neutral when choosing the option with the highest expected value in each decision.

3.2. Treatments

We conducted three treatments in total. In treatment OWN, each participant – called the decision maker – decided his/her own payoff. In treatment OTHER and $\text{OTHER}_{\text{Rec}}$, the participants were put into pairs. Each pair consisted of a decision maker and a recipient. While the decision makers' choices affected the recipients' outcome, the recipients made hypothetical choices to prevent participants from being influenced by different activities. To avoid any reciprocal behavior, all participants knew in advance whether they were going to decide another person's payoff or make hypothetical decisions. The decision maker's and recipient's outcomes were independent of each other to ensure that the decision maker's choices were not influenced by the alignment of his/her outcome to the recipient's outcome. The general show-up fee was \$5. Decision makers in treatments OTHER and $\text{OTHER}_{\text{Rec}}$ received a fixed payment of \$10. The recipients' payment depended on the choices made by the decision makers.

The economic literature mainly induces accountability by disclosing the identity of the participants. The effect of accountability on risk-taking behavior for others was researched by making people accountable either to the public or directly to the affected individual. In our experiment, we induce both types of accountability. Therefore, we have developed a new approach that allows us to compare risk-taking for others under accountability when accountable to the public and to the affected individual. To achieve accountability to the public, all participants in all treatments had to hold up a sign showing their choice in the randomly selected payoff-relevant decision.[12] As a result, the decision makers and their choices in the payoff-relevant decision were visible to the audience in the lab. Decision

[10] The lotteries are provided in Tables 5, 6, and 7 in Appendix A.2.

[11] The CRRA intervals for each lottery are provided in Table 8. The mean and the standard deviation for each lottery are shown in Table 9 in Appendix A.3.

[12] Recipients also had to hold up a sign to ensure that recipients were aware of any divergence between their hypothetical choice and the choice made by the decision maker in the payoff-relevant decision.

makers in treatment $\text{OTHER}_{\text{Rec}}$ were also accountable to the affected individual, as recipients got to know the seat number of their decision maker. Hence, decision makers were not only accountable to the public but also directly identifiable for the affected individual.

3.3. Procedure

The entire experiment was computerized using z-Tree (Fischbacher, 2007). All experimental instructions were presented via computer interfaces, provided in paper form and read aloud before the experiment started. We framed the game as neutrally as possible, avoiding any loaded terms. The observations for all statistical tests are independent for the three treatments as we applied a between-subjects design.

We used the following procedure in each experimental session. Upon arrival at the laboratory, participants were randomly seated. Participants in treatment OWN were informed that they would decide their own payoff. Participants in treatments OTHER and $\text{OTHER}_{\text{Rec}}$ were informed that, depending on their role in the experiment, their decisions would determine another person's payoff or would only be hypothetical.

At the beginning of each session, participants were quizzed to ensure that they all understood the instructions. When a participant gave a wrong answer during the quiz, they had to call an experimenter. The experimenter then explained the experiment to the participant again and unlocked the question by entering a code so that the participant could try to answer the question again.

After all the participants had passed the quiz, they started to make their choices in each lottery. To control for potential order effects, the order of the lotteries was randomly alternated individually for each participant in all treatments. Each participant made 30 choices in total – 10 choices in each lottery. The lottery choices were presented one at a time. After every 10 choices, a summary screen was shown with all the participant's choices in that lottery and participants were able to revise their choices.[13] In treatments OTHER and $\text{OTHER}_{\text{Rec}}$, the roles were determined right after the quiz but before participants started to make their lottery choices.

After all the participants had made their decisions in all lotteries, one participant was randomly chosen by the computer to roll a 30-sided die and a 10-sided die. The roll of the 30-sided die determined the payoff-relevant decision, while the roll of the 10-sided die determined the outcome of the gamble in that decision. Based on the results of the dice rolls, the final payoffs for all participants were calculated and displayed on each participant's screen. Recipients in treatment $\text{OTHER}_{\text{Rec}}$ were informed of the seat number of their decision maker. Afterwards, all participants were asked to hold up a sign one after another showing their decision in the payoff-relevant lottery. At the end of each session, participants answered a short questionnaire that collected some descriptive data before being paid privately upon leaving the lab.

[13] For the individual and summary decision screens, see Figures 2 and 3 in Appendix A.4.

4. Behavioral hypotheses

Former experiments find that participants are risk-averse in small-stakes laboratory gambles (e.g., Holt and Laury, 2002, 2005; Harrison et al., 2005; Chakravarty et al., 2011; Haavik and Zeiler, 2010). Thus, we expect participants to switch from Option A – the safer option – to Option B – the riskier option – later than a risk-neutral expected-value maximizer, who would switch from Option A to Option B as soon as the expected value of Option A is lower than the expected value of Option B (Hypothesis 1). In other words, we expect participants to be risk-averse.

Hypothesis 1 *Participants in all treatments are risk-averse according to the risk preference classification by Holt and Laury (2002) in the*

(i) gaining,

(ii) mixed, and

(iii) losing lotteries.

There are different approaches that explain a *risky shift* as well as a *cautious shift* when deciding for others compared to when deciding for one's own outcome. According to the Social Responsibility Hypothesis by Bolton et al. (2015), people aim to avoid blame in the event that a decision turns out to be wrong and thus are less risk-tolerant (*cautious shift*) when their decision influences someone else's welfare. By contrast, as Eriksen and Kvaløy (2010) stated in the Self-Other Distance Hypothesis and Montinari and Rancan (2013) and Andersson et al. (2014) confirmed by their experimental research, distance between a decision maker and a recipient makes it easier to make risky decisions. Decisions for others should therefore be more risk-seeking (*risky shift*) than decisions for one's own outcome.

As pointed out in Section 2.1, results from former experimental research on whether decisions for others are more or less risk-seeking than decisions for oneself is ambiguous. Thus, based on the ambiguous results from former experiments and theoretical concepts, we expect participants who decide for another person to have on average different risk preferences from participants who decide for themselves in the gaining (Hypothesis 2.(i)), mixed (Hypothesis 2.(ii)), and losing lotteries (Hypothesis 2.(iii)) when accountable to the public.

Hypothesis 2 *The mean risk participants take for another person's outcome (treatment OTHER) differs from the mean risk participants take for their own outcome (treatment OWN) when accountable to the public in the*

(i) gaining,

(ii) mixed, and

(iii) losing lotteries.

We know from former research, for example by Tetlock (1983), that people take the possibility of being accused by others into account when making a decision for another person. Thereby, we assume that it matters who one expects to be accused by when making a decision. In other words, we expect that people decide differently if they expect to be accused by the public or by the affected individual.

Former experimental studies on decision-making for others investigate how being accountable either to the public or to the affected individual affects risk-taking for others. Sutter (2009), for example, finds that being accountable to the public increases risk-taking for others in the mixed domain compared to a situation where the decision makers cannot be held accountable. In contrast, Reynolds (2009) finds less risk-taking in the gain domain when accountable to the public than when not accountable at all. With regards to being accountable to the affected individual, Lefebvre and Vieider (2013) find less risk-taking but Pahlke et al. (2012) find more risk-taking in the mixed domain. To investigate the effect accountability has on risk preferences in decisions for others, it is essential to compare risk-taking behavior across both kinds of accountability.

Furthermore, the effect accountability has on risk preferences in decisions for others might also depend on whether a decision has been made in a gain or loss situation. Prospect Theory by Kahneman and Tversky (1979) has shown that the pain of losing is psychologically much more powerful than the good feeling that arises from gaining. If transferring this finding to decision-making for others under accountability, decision makers could expect to be blamed more harshly for a decision resulting in a loss than they would be praised for a decision resulting in a gain. Hence, decision makers' willingness to take risks when losses are possible might decrease when recipients can hold the decision makers directly accountable, compared to a situation where decision makers are solely accountable to the public. On the other hand, decision makers who are accountable to the affected individual might anticipate a higher chance of being praised for a decision that leads to a gain than decision makers who are accountable to the public. Thus, decision makers who can be identified by recipients might be willing to take more risks when only gains are possible compared to decision makers who are solely accountable to the public.

In our experiment, decision makers in treatment $\text{OTHER}_{\text{Rec}}$ are accountable to the affected recipients, and decision makers in treatment OTHER are accountable to the public. As the public is not directly affected by the decision made, decision makers in treatment OTHER might expect the chance [risk] of being praised [blamed] for their decision to be lower than decision makers in treatment $\text{OTHER}_{\text{Rec}}$. Therefore, we expect participants who decide for another person and are exposed to the chance [risk] of being praised [blamed] by the recipient to take more risks on average in the gaining lottery (Hypothesis 3.(i)) but fewer risks in the mixed (Hypothesis 3.(ii)) and losing lotteries (Hypothesis 3.(iii)) than participants who are solely accountable to the public for their decision.

Hypothesis 3 *The mean risk participants take for another person's outcome if they can be held accountable by the person for whom they decide (treatment OTHER_{Rec}) is*

(i) higher in the gaining lottery,

(ii) lower in the mixed lottery, and

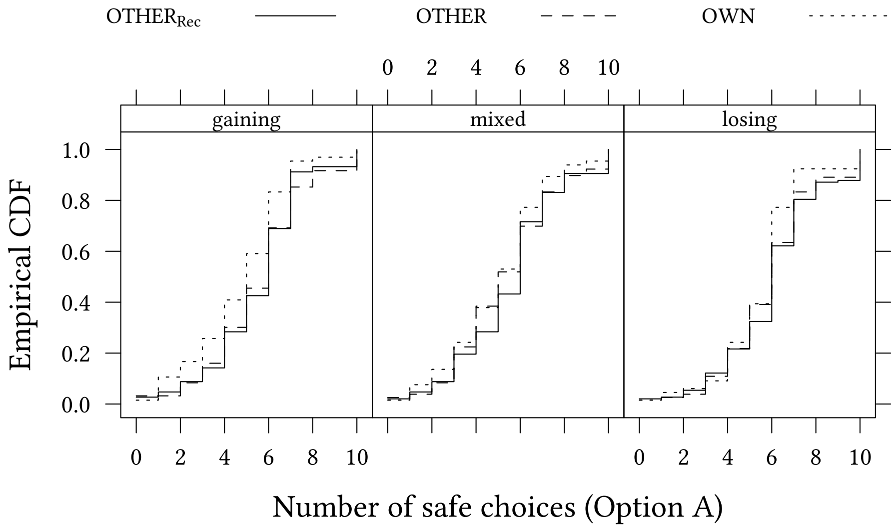

Figure 1: Risk aversion between treatments by decision makers.

(iii) lower in the losing lottery

than the mean risk participants take for another person's outcome if they can be held accountable by the public (treatment OTHER).

5. Results

All sessions were run in November 2017, December 2017 and September 2018 at the Yale School of Management Behavioral Lab. Overall, 370 participants (60.8% female) participated in three treatments.[14] The experiment took about 45 minutes and participants earned on average $16.73. Most of the participants (68.4%) were students and 73.8% of the participants did not know anybody else in the lab.

Following Holt and Laury (2002), we use the number of safer choices – Option A – as a proxy for the decision maker's individual risk aversion. This allows us to also include inconsistent choice patterns, i.e. choices by decision makers whose lottery choices show more than one switching point, in our analysis.[15]

5.1. Hypothesis 1: risk aversion

Figure 1 shows the cumulative proportion of safe choices by decision makers in the gaining, mixed and losing lotteries. According to Hypothesis 1, decision makers in all treatments

[14] In total, 66 participants (63.6% female) took part in treatment OWN, 148 participants (60.8% female) in treatment $\text{OTHER}_{\text{Rec}}$, and 156 participants (59.6% female) in treatment OTHER. In treatments $\text{OTHER}_{\text{Rec}}$ and OTHER, half of the participants decided for another participant.

[15] An analysis of the inconsistent choices per lottery and treatment can be found in Table 10 in Appendix A.5.

lottery	OWN		OTHER		OTHER$_{\mathrm{Rec}}$	
gaining	$\varnothing = 4.73$ (2.12)	($p = 0.0071$)	$\varnothing = 5.9$ (2.1)	($p = 0.0000$)	$\varnothing = 5.23$ (2.01)	($p = 0.0000$)
mixed	$\varnothing = 5.06$ (2.25)	($p = 0.0003$)	$\varnothing = 5.28$ (2.28)	($p = 0.0000$)	$\varnothing = 5.38$ (2.17)	($p = 0.0000$)
losing	$\varnothing = 5.61$ (1.96)	($p = 0.0000$)	$\varnothing = 5.69$ (2.08)	($p = 0.0000$)	$\varnothing = 5.84$ (2.31)	($p = 0.0000$)

The table shows the mean number of safe choices for each lottery ($\varnothing = \ldots$), the corresponding standard deviation (in brackets) and p-values ($p = \ldots$) for a two-sided independent-samples t-test on whether the mean number of safe choices differs from the mean number of safe choices by perfectly risk-neutral individuals.

Table 1: Risk-aversion tests for decision makers.

should be slightly risk-averse in the gaining (Hypothesis 1.(i)), mixed (Hypothesis 1.(ii)) and losing lotteries (Hypothesis 1.(iii)). Indeed, as Figure 1 shows, the majority of decision makers pick the safe option (Option A) more often than a risk-neutral individual, who would choose Option A exactly four times in each lottery before switching to the riskier option (Option B).[16]

Table 1 provides the mean number of safe choices for each lottery and p-values from a t-Test on whether the mean differs significantly from the mean under perfect risk neutrality. Indeed, the table confirms that the mean number of safe choices differs significantly from the risk-neutral mean in all treatments and lottery types. Therefore, Hypotheses 1.(i), 1.(ii) and 1.(iii) can be confirmed.

5.2. Hypothesis 2: OWN vs.OTHER

According to Figure 1, the distribution of safe choices within the gaining lottery differs between treatments OWN and OTHER but the distributions in the mixed and losing lotteries seem to be quite similar in both treatments. Table 2 shows the differences in the mean number of safe choices and provides the corresponding p-values from a t-Test for whether the means are significantly different. The middle column of Table 2 shows that decision makers in treatment OTHER make more safe choices on average than decision makers in treatment OWN. The difference, however, is only statistically significant in the gaining lottery. Hence, we can confirm Hypothesis 2.(i), i.e. that the mean risk participants take for another person's outcome differs from the mean risk participants take for their own outcome when accountable to the public in the gaining lottery, but we cannot confirm the hypotheses for the mixed lottery (Hypothesis 2.(ii)) or the losing lottery (Hypothesis 2.(iii)).

[16]We provide an analysis of the recipients' hypothetical lottery choices in treatments OTHER and OTHER$_{\mathrm{Rec}}$ in Appendices A.7, A.8, and A.9.

Lottery	OWN - OTHER	$\text{OTHER}_{\text{Rec}}$ - OTHER
gaining	Δ = -1.17	Δ = -0.67
	(p =0.0012)	(p =0.0470)
mixed	Δ = -0.22	Δ = 0.1
	(p =0.5595)	(p =0.7901)
losing	Δ = -0.08	Δ = 0.15
	(p =0.7984)	(p =0.6843)

The table shows differences between treatments ($\Delta = \ldots$) and p-values for a two-sided independent-samples t-test of whether this difference could be zero.

Table 2: Differences in risk aversion between treatments by decision makers.

5.3. Hypothesis 3: $\text{OTHER}_{\text{Rec}}$ vs. OTHER

According to Hypothesis 3.(i), decision makers in treatment $\text{OTHER}_{\text{Rec}}$ should take more risks, i.e. make fewer safe choices, than decision makers in treatment OTHER in the gaining lottery. In fact, this is what we see on the right-hand side of Table 2. The difference is also significant. According to Hypotheses 3.(ii) and 3.(iii), decision makers in treatment $\text{OTHER}_{\text{Rec}}$ should take fewer risks than decision makers in treatment OTHER in the mixed and in the losing lotteries. Indeed, as Table 2 shows, decision makers make more safe choices in the mixed and losing lotteries when accountable to the recipient compared to when solely accountable to the public. However, the difference is not significant for either the losing lottery or the mixed lottery. Therefore, we can confirm Hypothesis 3.(i) but not Hypotheses 3.(ii) and 3.(iii).

6. Conclusion

In this paper, we investigate risk-taking preferences for decisions affecting oneself or others under accountability. It is our understanding that this is the first paper looking at the influence of the audience that the person is accountable to: either to the public or directly to the affected individual as well. We do so in the gaining, mixed and losing domains. The results show that, while slightly risk-averse in all lotteries and treatments, participants take fewer risks for another person's outcome than for their own outcome when accountable to the public in all lotteries. The difference, however, is only statistically significant in the gaining lottery. Moreover, when participants can be held accountable by the person for whom they made the decision, they take significantly more risks for others in the gaining lottery compared to when they can be held accountable by the public. In contrast, participants take slightly fewer risks for others in the mixed and losing lotteries when they are directly accountable to the person they decide for compared to when they are accountable only to the public. The differences in the mixed and losing lotteries, however, do not reach statistical significance.

The participant's expectations about the other person's reaction in response to a gain or a loss could be an explanation for the finding that participants are more risk-seeking for others in the gaining but not in the mixed and losing lotteries when accountable to the affected individual. Participants who decide for another person and who can be held accountable by that person might start to gamble when facing gains, as there might be some praise for a positive outcome. However, they try to avoid being blamed for a negative outcome and, thus, are more risk-averse if losses are possible. We deliberately did not ask the participants in our experiment about their expectations when deciding for others, as we did not want to trigger any specific behavior. However, this could be an area for further research. We also did not differentiate between being accountable for the outcome and being accountable for the decision, in order to keep the design as clear as possible. This could also be an area that we have to leave to future research.

Our study, like most of the economic literature on accountability, mainly focuses on disclosing participants' identity to induce accountability. Therefore, the manipulation is very subtle as the experimenter has no control over how decision makers are held accountable by the public or by the recipients. For this reason, a next step could be to get more control over how accountability is expressed. One way of doing so could be by measuring the reaction of the public and the recipients toward the decision maker after the anonymity is revoked. Other possibilities would be to allow the public and the recipients to send predefined messages to the decision maker after the latter's identity has been revealed, or to allow the audience and the recipients to reward or punish the decision maker.

To conclude, we found evidence that choices for others diverge significantly from choices for self in the gain domain when decision makers are accountable to the public for their decision. We also found evidence that choices for others are significantly more risk-seeking for gains when the decision maker can be held accountable by the person for whom the choice was made compared to when the decision maker can be held accountable solely by the public. This means that for automated systems there might a potential that the system as a whole might be more risk-seeking than the users of such systems due to the difference in the gaining domain. Developers should bare this in mind and activly act against this bias when programming algortihms.

References

Andersson, O., Holm, H. J., Tyran, J.-R., and Wengström, E. (2014). Deciding for others reduces loss aversion. *Management Science*, 62(1):29–36.

Atanasov, P. (2012). *Comparing risk preferences in choices for self and others.* PhD thesis, University of Pennsylvania.

Bolton, G. E., Ockenfels, A., and Stauf, J. (2015). Social responsibility promotes conservative risk behavior. *European Economic Review*, 74:109–127.

Chakravarty, S., Harrison, G. W., Haruvy, E. E., and Rutström, E. E. (2011). Are you risk averse over other people's money? *Southern Economic Journal*, 77(4):901–913.

Charness, G. and Jackson, M. O. (2009). The role of responsibility in strategic risk-taking. *Journal of Economic Behavior & Organization*, 69(3):241–247.

Dohmen, T., Falk, A., Huffman, D., Sunde, U., Schupp, J., and Wagner, G. G. (2011). Individual risk attitudes: Measurement, determinants, and behavioral consequences. *Journal of the European Economic Association*, 9(3):522–550.

Eckel, C. C. and Grossman, P. J. (2002). Sex differences and statistical stereotyping in attitudes toward financial risk. *Evolution and Human Behavior*, 23(4):281–295.

Eriksen, K. W. and Kvaløy, O. (2010). Myopic investment management. *Review of Finance*, 14(3):521–542.

Eriksen, K. W., Kvaløy, O., and Luzuriaga, M. (2017). Risk-taking on behalf of others.

Fischbacher, U. (2007). z-tree: Zurich toolbox for ready-made economic experiments. *Experimental Economics*, 10(2):171–178.

Füllbrunn, S. and Luhan, W. J. (2015). Am i my peer's keeper? social responsibility in financial decision making.

Gneezy, U. and Potters, J. (1997). An experiment on risk taking and evaluation periods. *The Quarterly Journal of Economics*, 112(2):631–645.

Haavik, M. and Zeiler, S. (2010). Risk-taking on behalf of others: A laboratory experiment. Master's thesis, University of Stavanger.

Harrison, G. W., Johnson, E., McInnes, M. M., and Rutström, E. (2005). Risk aversion and incentive effects: Comment. *American Economic Review*, 95(3):897–901.

Harrison, G. W. and Rutström, E. (2009). Risk aversion in the laboratory. In Cox, J. C. and Harrison, G. W., editors, *Risk Aversion in Experiments*, volume 12, pages 41–196. Emerald Group Publishing, Bingley, UK.

Holt, C. A. and Laury, S. K. (2002). Risk aversion and incentive effects. *American Economic Review*, 92(2):1644–1655.

Holt, C. A. and Laury, S. K. (2005). Risk aversion and incentive effects: New data without order effects. *American Economic Review*, 95(3):902–904.

Humphrey, S. J. and Renner, E. (2011). The social costs of responsibility.

Kahneman, D. and Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, 47(2):263–291.

Lefebvre, M. and Vieider, F. M. (2013). Reining in excessive risk-taking by executives: The effect of accountability. *Theory and Decision*, 75(4):497–517.

Markov, A. A. (1954). The theory of algorithms. *Academy of Science of the USSR: Works of the Mathematical Institute*, 42:3–375.

Montinari, N. and Rancan, M. (2013). Social preferences under risk: The role of social distance.

O'Kane, S. (2019). Elon musk says tesla will allow aggressive autopilot mode with 'slight chance of a fender bender'. Retreived June 16, 2019, from `https://www.theverge.com/2019/4/22/18511527/elon-musk-tesla-aggressive-autopilot-mode-fender-bender`.

Pahlke, J., Strasser, S., and Vieider, F. M. (2012). Risk-taking for others under accountability. *Economics Letters*, 114(1):102–105.

Pahlke, J., Strasser, S., and Vieider, F. M. (2015). Responsibility effects in decision making under risk. *Journal of Risk and Uncertainty*, 51(2):125–146.

Pennings, J. M. and Smidts, A. (2000). Assessing the construct validity of risk attitude. *Management Science*, 46(10):1337–1348.

Pollmann, M. M., Potters, J., and Trautmann, S. T. (2014). Risk taking by agents: The role of ex-ante and ex-post accountability. *Economics Letters*, 123(3):387–390.

Polman, E. (2012). Self–other decision making and loss aversion. *Organizational Behavior and Human Decision Processes*, 119(2):141–150.

Reynolds, D. (2009). Risky shift versus cautious shift: Determining differences in risk taking between private and public management decision-making. *Journal of Business and Economics Research*, 7(1):63–77.

Shariff, A., Bonnefon, J.-F., and Rahwan, I. (2017). Psychological roadblocks to the adoption of self-driving vehicles. *Nature Human Behaviour*, 1(10):694–696.

Stoner, J. A. F. (1961). *A comparison of individual and group decisions involving risk.* PhD thesis, Massachusetts Institute of Technology.

Sutter, M. (2009). Individual behavior and group membership: Comment. *American Economic Review*, 99(5):2247–2257.

Tetlock, P. E. (1983). Accountability and complexity of thought. *Journal of Personality and Social Psychology*, 45(1):74–83.

Tetlock, P. E. (1992). The impact of accountability on judgment and choice: Toward a social contingency model. *Advances in Experimental Social Psychology*, 25:331–376.

Tversky, A. and Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, 5(4):297–323.

Vieider, F. M. (2009). The effect of accountability on loss aversion. *Acta Psychologica*, 132(1):96–101.

Vieider, F. M., Villegas-Palacio, C., Martinsson, P., and Mejía, M. (2016). Risk taking for oneself and others: A structural model approach. *Economic Inquiry*, 54(2):879–894.

Von Neumann, J. and Morgenstern, O. (1947). *Theory of games and economic behavior, 2nd rev.* Princeton University Press, Princeton, NJ.

Weber, E. U. and Milliman, R. A. (1997). Perceived risk attitudes: Relating risk perception to risky choice. *Management Science*, 43(2):123–144.

A. Appendix

This section contains additional information on the interfaces and questions used in the treatments. We also present further analyses of data we collected in addition to the data used to test our hypotheses. Data and methods are available online.

A.1. Literature overview

Table 3 shows an overview of the literature on decision-making for oneself and others. Table 4 shows an overview of the literature on decision-making for others under accountability.

A.2. Gaining, mixed and losing lotteries

Table 5 shows the gaining lottery, Table 6 shows the mixed lottery, and Table 7 shows the losing lottery.

Decision	Option A Payoffs	Option		Option B Payoffs
1	\$15.00 if 1, \$4.75 if 2-10	A	B	\$19.75 if 1, \$1.00 if 2-10
2	\$15.00 if 1-2, \$4.75 if 3-10	A	B	\$19.75 if 1-2, \$1.00 if 3-10
3	\$15.00 if 1-3, \$4.75 if 4-10	A	B	\$19.75 if 1-3, \$1.00 if 4-10
4	\$15.00 if 1-4, \$4.75 if 5-10	A	B	\$19.75 if 1-4, \$1.00 if 5-10
5	\$15.00 if 1-5, \$4.75 if 6-10	A	B	\$19.75 if 1-5, \$1.00 if 6-10
6	\$15.00 if 1-6, \$4.75 if 7-10	A	B	\$19.75 if 1-6, \$1.00 if 7-10
7	\$15.00 if 1-7, \$4.75 if 8-10	A	B	\$19.75 if 1-7, \$1.00 if 8-10
8	\$15.00 if 1-8, \$4.75 if 9-10	A	B	\$19.75 if 1-8, \$1.00 if 9-10
9	\$15.00 if 1-9, \$4.75 if 10	A	B	\$19.75 if 1-9, \$1.00 if 10
10	\$15.00 if 1-10	A	B	\$19.75 if 1-10

Table 5: Gaining lottery screen.

Decision	Option A Payoffs	Option		Option B Payoffs
1	\$2.50 if 1, \$0.50 if 2-10	A	B	\$16.00 if 1, -\$9.25 if 2-10
2	\$2.50 if 1-2, \$0.50 if 3-10	A	B	\$16.00 if 1-2, -\$9.25 if 3-10
3	\$2.50 if 1-3, \$0.50 if 4-10	A	B	\$16.00 if 1-3, -\$9.25 if 4-10
4	\$2.50 if 1-4, \$0.50 if 5-10	A	B	\$16.00 if 1-4, -\$9.25 if 5-10
5	\$2.50 if 1-5, \$0.50 if 6-10	A	B	\$16.00 if 1-5, -\$9.25 if 6-10
6	\$2.50 if 1-6, \$0.50 if 7-10	A	B	\$16.00 if 1-6, -\$9.25 if 7-10
7	\$2.50 if 1-7, \$0.50 if 8-10	A	B	\$16.00 if 1-7, -\$9.25 if 8-10
8	\$2.50 if 1-8, \$0.50 if 9-10	A	B	\$16.00 if 1-8, -\$9.25 if 9-10
9	\$2.50 if 1-9, \$0.50 if 10	A	B	\$16.00 if 1-9, -\$9.25 if 10
10	\$2.50 if 1-10	A	B	\$16.00 if 1-10

Table 6: Mixed lottery screen.

Author(s)	Shift	Outcome aligned	Task	Design	Gaining	Mixed	Losing	Reciprocity
Chakravarty et al. (2011)	RS	No	MPL (H&L)	WS	RS (sig.)	-	-	-
Haavik and Zeiler (2010)	RS	No	MPL (H&L)	BS	RS (sig.)	-	-	-
Bolton et al. (2015)	CS	Yes	MPL (H&L)	WS	CS (sig.)	-	-	Strategy Method
Humphrey and Renner (2011)	same	Yes	MPL (H&L)	BS	same	-	-	-
Atanasov (2012)	CS	No	MPL (H&L)	BS	CS (not sig.)	CS (not sig.)	-	Yes
Andersson et al. (2014)	RS	No/Yes	MPL	BS	same	RS (sig.)	-	-
Pahlke et al. (2015)	CS/RS	No	RLP	BS	CS (sig.)	CS (sig.)	RS (sig.)	-
Polman (2012)	RS	No	RLP	BS	-	RS (sig.)	-	-
Vieider et al. (2016)	RS	Yes	RLP	BS	RS (sig.)	RS (weakly sig.)	RS (sig.)	Strategy Method
Eriksen et al. (2017)	CS	No	OLS (E&G)	BS	CS (sig.)	-	-	-
Eriksen and Kvaløy (2010)	CS	No	IT (G&P)	BS	-	CS (sig.)	-	-
Füllbrunn and Luhan (2015)	CS	No/Yes	IT (G&P)	WS	-	CS (sig.)	-	Strategy Method
Charness and Jackson (2009)	CS	No	SHG (C&J)	BS	CS (sig.)	-	-	-

Abbreviations: CS = *cautious shift*, i.e. more risk-averse for others than for self; RS = *risky shift*, i.e. less risk-averse for others than for self; MPL (H&L) = Multiple Price List in line with Holt and Laury (2002); RLP = Random Lottery Pairs with certainty equivalent; IT (G&P) = Investment Task in line with Gneezy and Potters (1997); OLS (E&G) = Ordered Lottery Choices in line with Eckel and Grossman (2002); SHG (C&J) = Stage Hunt Game in line with Charness and Jackson (2009); WS/BS = within-subjects/between-subjects design; sig. = significant (we consider significance levels of 5%); Reciprocity = participants were matched into reciprocal pairs and made choices on behalf of each other.

Table 3: Experimental studies on decision-making for oneself and others.

Author	Shift	Outcome aligned	Task	Design	Gaining	Mixed	Losing	Reciprocity	Accountable towards…
Vieider (2009)	same	-	RLP (T&K)	BS	-	RS (sig.)	-	-	experimenter
Humphrey and Renner (2011)	same	Yes	MPL (H&L)	BS	same	-	-	-	friend
Pahlke et al. (2012)	RS	Yes	RLP	BS	same	RS (sig.)	same	-	affected person
Montinari and Rancan (2013)	CS	Yes	IT (G&P)	BS	CS (sig.)	-	-	-	friend
Lefebvre and Vieider (2013)	CS	No	IT	BS	-	CS (sig.)	-	Strategy Method	affected person
Sutter (2009)	RS	Yes	IT (G&P)	BS	-	RS (sig.)	-	Yes	group
Pollmann et al. (2014)	CS	No	IT (G&P)	BS	-	CS (sig.)	-	-	monetary reward system
Reynolds (2009)	CS	No	SHG (C&J)	WS	CS (sig.)	-	-	-	group

Abbreviations: CS = *cautious shift*, i.e. more risk-averse for others when accountable; RS = *risky shift*, i.e. less risk-averse for others when accountable; RLP (T&K) = Random Lottery Pairs in line with Tversky and Kahneman (1992); MPL (H&L) = Multiple Price List in line with Holt and Laury (2002); RLP = Random Lottery Pairs with certainty equivalent; IT (G&P) = Investment Task in line with Gneezy and Potters (1997); IT = Investment Task; SHG (C&J) = Stage Hunt Game in line with Charness and Jackson (2009); WS/BS = within-subjects/between-subjects design; sig. = significant (we consider significance levels of 5%); Reciprocity = participants were matched into reciprocal pairs and made choices on behalf of each other.

Table 4: Experimental studies on decision-making for others under accountability.

Decision	Option A Payoffs	Option		Option B Payoffs
1	-\$0.75 if 1, -\$2.75 if 2-10	A	B	\$8.00 if 1 -\$8.75 if 2-10
2	-\$0.75 if 1-2, -\$2.75 if 3-10	A	B	\$8.00 if 1-2, -\$8.75 if 3-10
3	-\$0.75 if 1-3, -\$2.75 if 4-10	A	B	\$8.00 if 1-3, -\$8.75 if 4-10
4	-\$0.75 if 1-4, -\$2.75 if 5-10	A	B	\$8.00 if 1-4, -\$8.75 if 5-10
5	-\$0.75 if 1-5, -\$2.75 if 6-10	A	B	\$8.00 if 1-5, -\$8.75 if 6-10
6	-\$0.75 if 1-6, -\$2.75 if 7-10	A	B	\$8.00 if 1-6, -\$8.75 if 7-10
7	-\$0.75 if 1-7, -\$2.75 if 8-10	A	B	\$8.00 if 1-7, -\$8.75 if 8-10
8	-\$0.75 if 1-8, -\$2.75 if 9-10	A	B	\$8.00 if 1-8, -\$8.75 if 9-10
9	-\$0.75 if 1-9, -\$2.75 if 10-10	A	B	\$8.00 if 1-9, -\$8.75 if 10-10
10	-\$0.75 if 1-10	A	B	\$8.00 if 1-10

Table 7: Losing lottery screen.

A.3. Range of coefficients of relative risk aversion by lottery

Table 8 shows the CRRA of each lottery.

Number of safe choices	Range of relative risk aversion for $U(x) = x^{1-r}/(1-r)$		
(Choice A)	gaining	mixed	losing
1	r <-1.52	r <-0.85	r <-0.86
2	-1.52 <r <-0.81	-0.85 <r <-0.40	-0.86 <r <-0.39
3	-0.81 <r <0.22	-0.40 <r <-0.06	-0.39 <r <-0.02
4	-0.22 <r <0.31	-0.06 <r <0.23	-0.02 <r <0.3
5	0.31 <r <0.85	0.23 <r <0.49	0.3 <r <0.6
6	0.85 <r <1.43	0.49 <r <0.76	0.6 <r <0.91
7	1.43 <r <2.13	0.76 <r <1.06	0.91 <r <1.28
8	2.13 <r <3.19	1.06 <r <1.46	1.28 <r <1.80
9-10	3.19 <r	1.46 <r	1.80 <r

Table 8: CRRA coefficients for each lottery.

Table 9 shows the mean and the standard deviation for the CRRA coefficients.

gaining	mixed	losing
$\varnothing = 0.84$	$\varnothing = 0.31$	$\varnothing = 0.47$
(1.36)	(0.67)	(0.77)

The table shows the mean for each lottery ($\varnothing = \ldots$) and the corresponding standard deviation (in brackets).

Table 9: CRRA descriptives.

A.4. Interfaces

The individual decision screen for each decision is shown in Figure 2.

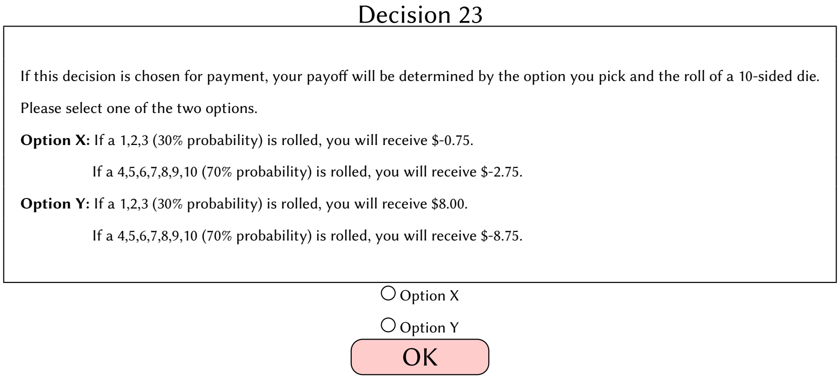

Figure 2: Single decision screen.

The summary screen, which was shown after each lottery with 10 single decisions, is shown in Figure 3.

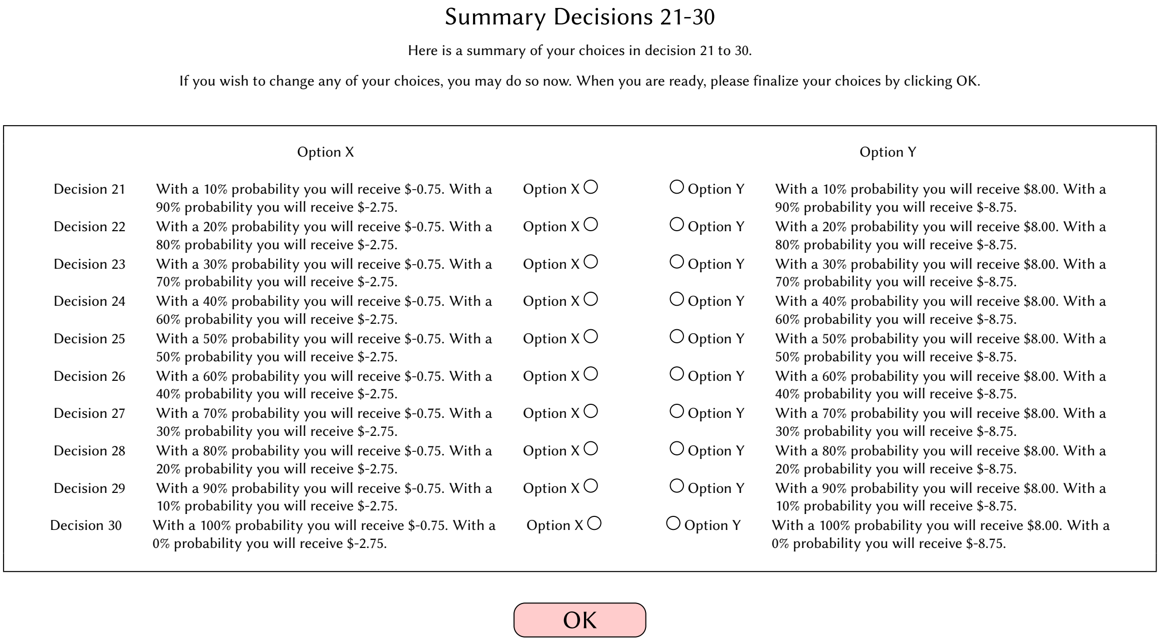

Figure 3: Summary decision screen.

A.5. Inconsistent choices

As Table 10 shows, only a small proportion of the participants have more than one switching point per lottery, i.e. show an inconsistent choice pattern.

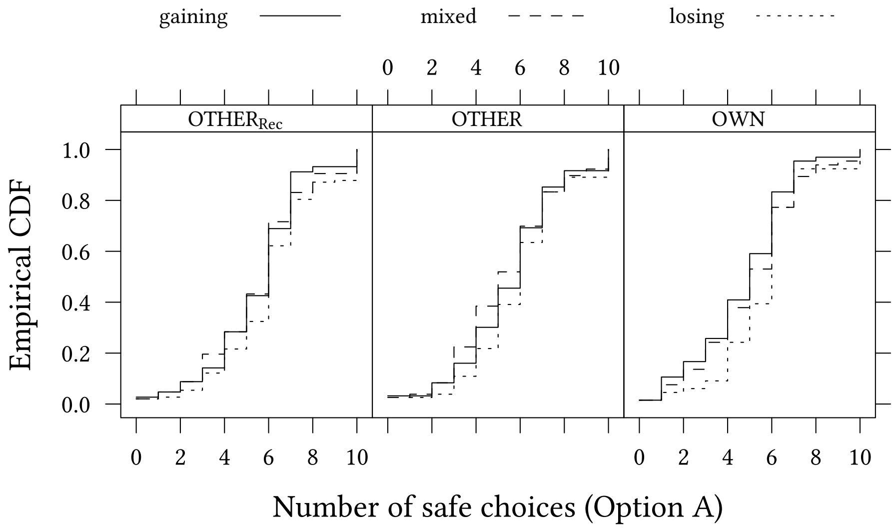

Figure 4: Risk aversion within treatments by decision makers.

lottery	OWN	OTHER	OTHER$_{Rec}$
gaining	15.15	14.1	14.19
mixed	13.64	9.62	11.49
losing	9.09	13.46	9.46

Table 10: Inconsistent choices per treatment and lottery [%].

A.6. Risk aversion within treatments by decision makers

Figure 4 shows the cumulative proportion of safe choices by decision makers in treatments OWN, OTHER, and OTHER$_{Rec}$. According to Figure 4, decision makers in all treatments seem to be slightly more risk-averse in the losing lottery than in the gaining lottery. Table 11 provides the difference between lotteries within the treatments and the corresponding p-values from a t-Test of whether the difference is significant. Indeed, as Table 11 confirms, decision makers in treatment OWN are significantly more risk-averse and decision makers in treatment OTHER$_{Rec}$ are weakly more risk-averse in the losing lottery than in the gaining lottery. Decision makers in treatment OTHER, however, are not significantly more risk-averse in the losing lottery than in the gaining lottery but are significantly more risk-averse in the mixed lottery than in the gaining lottery. Thus, the decision makers' risk-aversion pattern in treatment OTHER differs from the pattern found in treatments OWN and OTHER$_{Rec}$.

A.7. Risk aversion by recipients

Figure 5 shows the cumulative proportion of safe choices by recipients in the hypothetical decisions in treatments OTHER and OTHER$_{Rec}$. As Figure 5 shows, recipients in all treatments

lottery	OWN	OTHER	$\text{OTHER}_{\text{Rec}}$
gaining - losing	Δ = -0.88	Δ = 0.21	Δ = -0.61
	(p =0.0080)	(p =0.4532)	(p =0.0502)
mixed - losing	Δ = -0.55	Δ = -0.41	Δ = -0.46
	(p =0.0730)	(p =0.0753)	(p =0.1238)
gaining - mixed	Δ = -0.33	Δ = 0.62	Δ = -0.15
	(p =0.2922)	(p =0.0170)	(p =0.5093)

The table shows differences between lotteries ($\Delta = \ldots$) and p-values for a two-sided test of whether this difference could be zero.

Table 11: Differences in risk aversion within treatments by decision makers.

picked the safe option (A) more often than a risk-neutral individual, who would choose Option A exactly four times in each lottery before switching to the riskier option (B).

Table 12 provides the mean number of safe choices for each lottery and p-values from a t-Test on whether the mean differs significantly from the mean under perfect risk neutrality. Indeed, the table confirms that the mean number of safe choices differs significantly from the risk-neutral mean in all treatments and lottery types.

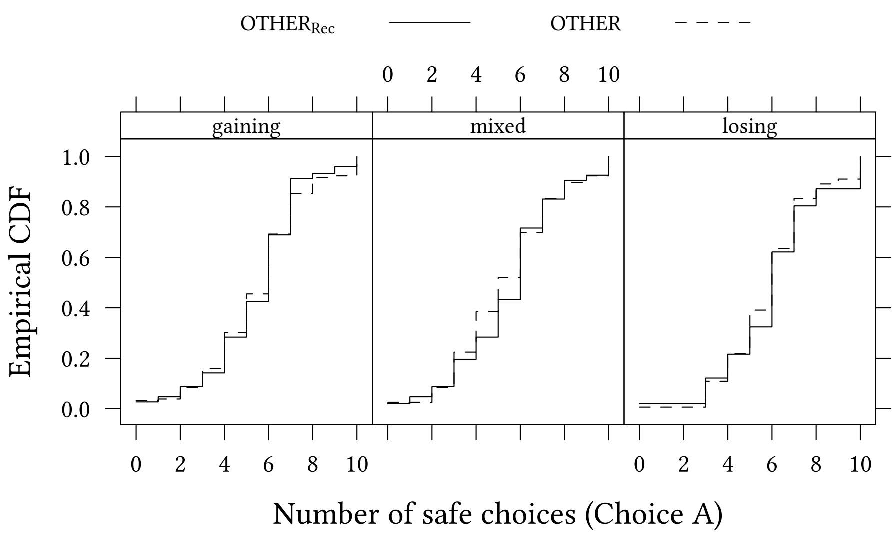

Figure 5: Risk aversion between treatments by recipients.

lottery	$\text{OTHER}_{\text{Rec}}$		OTHER	
gaining	$\varnothing = 5.76$ (2.11)	(p = 0.0000)	$\varnothing = 5.19$ (2.31)	(p = 0.0000)
mixed	$\varnothing = 5.73$ (2.37)	(p = 0.0000)	$\varnothing = 5.46$ (2.42)	(p = 0.0000)
losing	$\varnothing = 5.84$ (2.11)	(p = 0.0000)	$\varnothing = 5.69$ (2.01)	(p = 0.0000)

The table shows the mean for each lottery ($\varnothing = \ldots$), the corresponding standard deviation (in brackets) and p-values ($p = \ldots$) for a two-sided test.

Table 12: Risk-aversion tests for recipients.

A.8. Risk aversion between treatments by recipients

As Figure 5 shows, there is only a slight difference in the recipients' hypothetical decisions between treatments OTHER and $\text{OTHER}_{\text{Rec}}$. Table 13 shows the difference in the mean number of safe choices and provides p-values from a t-Test of whether the means are significantly different from each other. The table confirms that the number of safe choices does not differ significantly between the treatments, neither in the gaining nor the mixed or losing lotteries.

	$\text{OTHER}_{\text{Rec}}$ - OTHER
gaining	$\Delta = 0.57$
	(p = 0.1180)
mixed	$\Delta = 0.27$
	(p = 0.4904)
losing	$\Delta = 0.09$
	(p = 0.7851)

The table shows differences between treatments ($\Delta = \ldots$) and p-values ($p = \ldots$) for a two-sided test of whether this difference could be zero.

Table 13: Differences in risk aversion between treatments by recipients.

A.9. Risk aversion within treatments by recipients

Figure 6 shows the cumulative proportion of safe choices by recipients in the hypothetical decisions in treatments OTHER and $\text{OTHER}_{\text{Rec}}$. According to Figure 6, recipients in both treatments seem to be more risk-averse in the losing lottery than in the gaining lottery. Table 14 provides the difference between lotteries within the treatments and the corresponding p-values from a t-Test of whether the difference is significant. The table confirms that recipients in treatment OTHER make significantly more safe choices in the losing lottery than in the gaining lottery or the mixed lottery. Table 14 also shows that recipients in treatment $\text{OTHER}_{\text{Rec}}$ make only slightly more safe choices in the losing lottery than in the gaining lottery but also make significantly more safe choices in the losing lottery than in the mixed lottery. Choices in the gaining lottery, however, do not differ significantly from choices in the mixed lottery, neither in treatment OTHER nor in treatment $\text{OTHER}_{\text{Rec}}$.

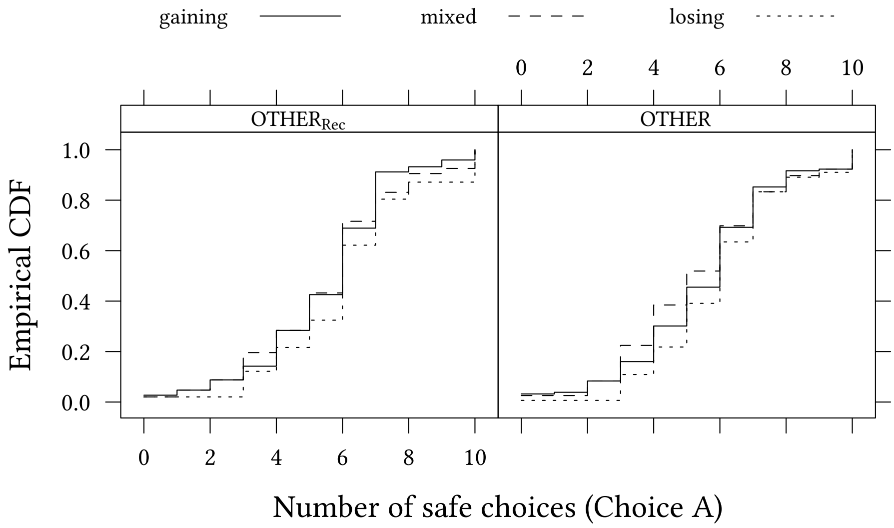

Figure 6: Risk aversion within treatments by recipients.

lottery	$\text{OTHER}_{\text{Rec}}$	OTHER
gaining vs. losing	Δ = -0.52	Δ = -1
	(p =0.0870)	(p =0.0007)
mixed vs. losing	Δ = -0.55	Δ = -0.73
	(p =0.0413)	(p =0.0161)
gaining vs. mixed	Δ = 0.03	Δ = -0.27
	(p =0.9232)	(p =0.4299)

The table shows differences between lotteries ($\Delta = \ldots$) and p-values ($p = \ldots$) for a two-sided test of whether this difference could be zero.

Table 14: Differences in risk aversion within treatments by recipients.