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Ambiguity Attitudes in the Loss Domain: Decisions for Self versus Others

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Abstract

Important financial and medical decisions are often made on behalf of others. We study whether and how people's ambiguity attitudes differ when deciding for others as compared to deciding for oneself in the loss domain. Our results are consistent with the loss part of the fourfold pattern: ambiguity aversion for low likelihood losses and ambiguity neutrality for moderate likelihood losses. This pattern holds both when deciding for oneself and for others. We find no differences in ambiguity attitudes between self- and other-regarding decision-making.

JEL Classification

D81, C91

Keywords

ambiguity attitudes
decision-making for others
losses and uncertainty

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1 Introduction

Ellsberg's paradox (Ellsberg, 1961) has inspired decades of research on attitudes towards ambiguity (situations where objective probabilities of potential outcomes are unknown), because of their potential to explain important behavioral anomalies in economics and finance (e.g. Trautmann and van de Kuilen, 2015), and therefore inform regulation and policy choices (Farber, 2010; Weisbach, 2015). Although the vast majority of experimental/empirical studies in the literature concern decision-making for oneself under ambiguity, decisions in the field are often made on behalf of others. More often than not, these decisions fall into the loss domain: for instance doctors making treatment decisions for their patients or stock brokers choosing stocks on behalf of their clients. An extreme example of decision-making for others is when powers of attorney are drawn. In this case, agents typically make all financial and health decisions on behalf of their principals without their active involvement, possibly because they are already mentally incapable. Many decisions on family matters share similar features, e.g., parental decisions for young children.

To date, the only study probing self- and other-regarding ambiguity attitudes is König-Kersting and Trautmann (2016), who find no difference between decision-making for oneself and for others in the realm of gains. This result was rather surprising given that, in the domain of known risks, a substantial number of studies show that people make different choices when making risky decisions for others, though the results are mixed (Reynolds et al., 2009; Sutter et al., 2009; Eriksen and Kvaløy, 2010; Chakravarty et al., 2011; Pollmann et al., 2014; Füllbrunn and Luhan, 2015).

People's ambiguity attitudes for others' outcomes in the loss domain is still and open issue. When considering uncertainty in the loss domain, previous studies provide clear evidence that people are less loss-averse when making decisions for others (Polman, 2012; Andersson et al., 2014; Vieider et al., 2015; Füllbrunn and Luhan, 2017). Given these results, we conjecture that self-other differences might be more pronounced in decisions involving losses as opposed to gains.

Observing that the study by König-Kersting and Trautmann (2016) considers only prospects in the gain domain, we extend their study and compare people's ambiguity attitudes with pure loss prospects when making decision for oneself and for others. In addition, previous research has suggested a four-fold pattern of ambiguity attitudes: people are ambiguity averse for low likelihood losses and ambiguity seeking for moderate likelihood losses, with the opposite pattern for gains (Viscusi and Chesson, 1999; Mauro and Maffioletti, 2004; Baillon and Bleichrodt, 2015; Trautmann and van de Kuilen, 2015; Bouchouicha et al., 2017; Kocher et al., 2018). We test if the loss part of the fourfold pattern persists when making decisions for others.

We find that other-regarding ambiguity attitudes do not differ systematically from self-regarding ones. Attitudes toward ambiguity follow the loss part of the fourfold pattern in both self- and other-regarding decisions. The next section describes the experimental design and procedures. The results are presented in the third section. We conclude and discuss the potential implications of our results in the last section.

2 Experiment Design and Procedures

The experiment consists of two stages. In the first stage, subjects participate in a real effort task of adding up five two-digit numbers (Niederle and Vesterlund, 2007). When five questions are solved correctly (with unlimited attempts), every subject earns a fixed payment of 20 New Zealand Dollars (NZD), which serves as an endowment for the potential losses in the second stage of the experiment. Subjects are not informed about the details of the second stage before finishing the first one. In the second stage, we extend the Ellsberg-urn task implemented by Kocher et al. (2018) to measure subjects' ambiguity attitudes in the loss domain when making decisions for themselves (SELF) or for others (OTHER). We employ both 2-color urns to capture moderate likelihood losses and the 10-color urns for low likelihood losses (see details below and Kocher et al. (2018)),[1] constituting a 2×2 between-subject design: SELF/Moderate, SELF/Low, OTHER/Moderate, and OTHER/Low.

More specifically, in treatment OTHER, subjects first make decisions for others as agents, and later serve as principals. Our one-way matching ensures that each agent will only serve a principal who is not at the same time making decisions for herself. That is, we rule out the possibility for direct reciprocity and this point has been clearly made in the instructions. Moreover, they get to see their results as principal only after making decisions as agents for their own principals.[2]

The Ellsberg tasks were administered in the following way. In both 2-color and 10-color settings, subjects choose between opaque bags filled with 100 deflated balloons in either two and ten colors, respectively. In one bag, the distribution of the colors is known (risky prospect, see Table 1). In the other bag, the distribution of colors is unknown to the subjects (ambiguous prospect), but the potential colors in the bag are known to them. Subjects will lose 15 NZD if they choose the risky bag with known distribution and the color of the balloon drawn is blue, or if they choose the ambiguous bag and the color of the balloon drawn matches the color of their choice.[3] Otherwise, no money will be deducted from the initial earning of 20 NZD. In each setting, subjects make

[1] See Appendix B for a picture of the bags used in the experiment.

[2] When severing as principals, every subject sees all choices made by her agent in treatment OTHER. A summary screen of lottery outcomes and earnings is also shown on their screen at the end.

[3] For the ambiguous prospect, allowing subjects choose their personal colors (out of 2 or 10 colors) prevents the experimenters from strategically filling the bags to the disadvantage of the subjects. This point has been clearly communicated to our subjects. Since the distribution is known to the subjects for the risky prospect, they are free from this problem and therefore we have predetermined the "losing" color as blue for the risky prospect. Subjects were encouraged to check the composition of the bags after the experiment, which was communicated when reading out the summary of the instructions.

Table 1: Order of decisions and probabilities of loss in the risky prospects

Decision	**Moderate-likelihood setting**	**Low-likelihood setting**
1	0.50	0.10
2	0.35	0.01
3	0.65	0.19
4	0.40	0.04
5	0.60	0.16
6	0.45	0.07
7	0.55	0.13

Notes: In each decision set, subjects made seven decisions in a fixed order with various probabilities of losing 15 NZD. The probabilities are designed to reduce potential elicitation biases (Kocher et al., 2018). Entries read as follows. For Decision 1 of the Moderate-likelihood set, a subject will lose 15 NZD with the probability 50% if she chooses the risky prospect. If the ambiguous prospect is chosen, the chance of losing 15 NZD is unknown (2-color setting).

seven decisions between risky bags with varying number of blue balloons, and an ambiguous bag with unknown composition of colors. Following König-Kersting and Trautmann (2016), the seven decisions are shown sequentially in a fixed order, as demonstrated in Table 1. The motivation for this design feature was to reduce potential anchoring or range effects sometimes observed in single-screen choice lists.

The first decision is a direct binary choice between an ambiguous prospect and its corresponding ambiguity-neutral risky prospect under expected utility. In the 2-color task, this risky bag contains exactly 50 red and 50 blue balloons. In the 10-color task, it contains 10 blue and 90 balloons in other colors. The advantage of using this choice as the first of the sequence is that it allows us to classify ambiguity attitudes as typically done in single-choice designs in the literature, free from any potential choice list effects. We can classify subjects as ambiguity averse or ambiguity seeking based on their first decision (with ambiguity neutral subjects potentially included in both categories). For instance, an ambiguity seeking individual in the 10-color setting would prefer the ambiguous bag over the risky bag containing exactly 10 balloons in blue.

For the full set of seven decisions, we can calculate a *probability equivalent (PE henceforth)* for the ambiguous prospect, defined as the probability of a risky prospect such that an individual is indifferent between the risky and the ambiguous prospects. Operationally, we follow Kocher et al. (2018) and take the mid-point between the highest risky probability for which the decision maker chooses the risky prospect and the lowest risky probability for which she chooses the ambiguous one.[4] If someone is willing to accept a large known probability of loss, she is then considered

[4]For instance, for the 2-color moderate likelihood task, suppose a decision maker prefers the risky bag when the chance of drawing a blue balloon is 0.55 but opts for the ambiguous option when the chance of a blue balloon increases to 0.6, then her PE is calculated as $0.55 + \frac{1}{2} * (0.6 - 0.55) = 0.575$. Additionally, we implement the following rule

ambiguity averse. Indeed, for prospects in the loss domain, the larger the PE is, the more ambiguity averse a person is. Specifically, an individual is considered as ambiguity seeking (averse) if the elicited PE is smaller (larger) than 0.5 in the task with moderate likelihood losses, or 0.1 in case of low likelihood losses. The elicited PEs allow us to rank subjects by their degree of ambiguity aversion.

A total number of 236 subjects participated in our experiment with roughly 60 subjects in each of the four treatments. The experiment was conducted at the Waikato Experimental Economics Lab (WEEL) at University of Waikato in Hamilton, New Zealand. Participants were invited to participate via ORSEE (Greiner, 2015) and the experiment was computerized using z-Tree (Fischbacher, 2007). Each session lasted about 70 minutes with an average payment of 15 NZD.

In the first stage of the experiment, subjects completed a real-effort task and received a flat payment of 20 NZD. Once all participants completed the real-effort task, subjects privately read on-screen instructions for stage two at their own-pace [5], followed by a summary and demonstration of a single draw by the experimenter. The bags for the Ellsberg tasks were placed on the table in front of the lab and subjects were encouraged to check the distribution of the risky bags after the experiment. We communicated to the subjects that once all seven decisions were made, a volunteer would come to the front and draw a balloon from each bag to resolve the uncertainty. This way, we aimed to ensure a high level of credibility perceived by the subjects regarding our procedure. The outcomes were then entered into the computer, confirmed by subjects on a summary screen, and payoffs were calculated for each participant or each principal-agent pair by randomly selecting one choice task taken for real.

3 Results

3.1 Results from the whole sample

We first consider the results using the whole sample. The left panel of Table 2 shows the ambiguity attitudes of all subjects by treatment. We separately report the direction of ambiguity attitudes based on the following two measures: *(i)* the proportion of ambiguous prospect chosen in the first decision task, and *(ii)* the probability equivalents derived from all seven decisions. Although the seven decisions were made sequentially on separate screens in a fixed order, the consistency between the first choice and the elicited PEs is high for both tasks: 73.3% for the 2-color task and

if one never changes her decision. Suppose that a subjects chooses the ambiguous prospect [the risky prospect] all the time in the moderate likelihood task, then her PE is set to 0.325 [0.675]. Similarly, if she chooses the ambiguous prospect [the risky prospect] for all decisions in the low likelihood task, then her PE is set to 0.005 [0.205].

[5] see Appendix A for experiment instructions.

81.1% for the 10-color task.[6]

For the decisions made for oneself, a minority of 38% chooses the ambiguous prospect in the first choice when facing moderate chance of losses, which is marginally lower than 50%, assuming that ambiguity neutral subjects choose randomly between the risky and the ambiguous prospects (binomial test, p=0.07; N=61). The corresponding average PE equals 0.501, which is indistinguishable from ambiguity neutrality (two sided t-test, p=0.93; N=57). When the chance of losses is low, 42% subjects choose the ambiguous prospect in Decision 1, which is not significantly different from 50% (binomial test, p=0.30; N=59), but points in the direction of ambiguity aversion. The corresponding average PE is 0.115, indicating ambiguity aversion (two sided t-test, $p<0.01$; N=53).

As for the decisions made for others, in OTHER/Moderate, 41% of our subjects choose the ambiguous prospect in the first choice, indicating ambiguity aversion. Yet, the proportion is not significantly lower than 50% (binomial test, p=0.24; N=58). The corresponding average PE indicates that subjects are on average ambiguity seeking, though not significantly so (two sided t-test, p=0.77; N=55). In OTHER/Low, a minority of 29% of our subjects choose the ambiguous prospect in the first decision, which is significantly lower than 50% (binomial test, $p<0.01$; N=58), pointing in the direction of ambiguity aversion. This is confirmed by the corresponding PE that equals to 0.132, which is significantly larger than ambiguity-neutral probability of 0.1 (two sided t-test, $p<0.01$; N=58). The overall picture suggests that subjects are ambiguity neutral when facing moderate likelihood losses and ambiguity averse when facing low likelihood losses. Similar to Kocher et al. (2018), the pattern we found based on the whole sample is not fully consistent with the loss part of the fourfold pattern because it predicts ambiguity seeking/neutrality in case of a moderate likelihood of losses.

We next consider if ambiguity attitudes differ across treatments when comparing decision-making for oneself and for others. For moderate likelihood losses, we do not find any differences between making decisions for oneself and for others. For low likelihood losses, we find some suggestive evidence based on PEs that subjects are more ambiguity averse when making decisions for others than for oneself based on the whole sample. However, no significant difference is found when considering only the first decision.

[6]There are 14 subjects for whom the probability equivalent cannot be calculated (SELF/Moderate: 1; SELF/Low: 3; OTHER/Moderate: 4; OTHER/Low: 6, accounting for 6% of the whole sample). This happens if a subject prefers the ambiguous prospect when the probability of losses in the ambiguous prospect is small and switches to the risky one when the probability gets larger.

Table 2: Ambiguity attitudes in loss domain

Treatment	Whole Sample: # obs.[a] First choice	Whole Sample: First choice:[b] ambiguous choices (%)	Whole Sample: All choices:[c] probability equivalent		Subsample: Distinct from Neutrality[d]: # obs.[a] First choice	Subsample: Distinct from Neutrality[d]: First choice: ambiguous choices (%)	Subsample: Distinct from Neutrality[d]: All choices: probability equivalent
SELF/Moderate	61 (57)	37.71 AA^{*}	.501 (AS)		37 (33)	59.46 (AS)	.484 (AS)
SELF/Low	59 (53)	42.37 (AA)	.115 AA^{**}	⌉[e]	42 (36)	28.57 AA^{***}	.128 AA^{***}
OTHER/Moderate	58 (55)	41.38 (AA)	.497 (AS)	**	38 (35)	57.90 (AS)	.485 (AS)
OTHER/Low	58 (51)	29.31 AA^{***}	.132 AA^{***}	⌋	48 (41)	22.91 AA^{***}	.142 AA^{***}

Notes: a: The numbers in parentheses are the numbers of observations in each treatment where the probability equivalents can be defined. b: The entries of first choice report percentages of choosing the ambiguous prospect in the first decision in Table 1, two-sided binomial test against 0.5. c: Entries of all choices report means of probability equivalents, two-sided t-test against 0.5 (0.1) for moderate- (low-) likelihood task. d: The subsample consists of subjects who are not ambiguity neutral. e: Test if the PEs under OTHER/Low and SELF/Low are significantly different by Mann-Whitney U test. *, **, *** denote significance at the 10%, 5% and 1% level. No significant difference is found between decisions make for oneself and others with Moderate-likelihood of losses. AA = ambiguity aversion; AS=ambiguity seeking. Results that are insignificantly different from ambiguity neutrality indicated by parentheses.

3.2 Results from the subsample distinct from ambiguity neutrality

Our whole sample contains a substantial proportion of people who potentially exhibit neutral attitudes towards ambiguity and cannot be properly identified by the tasks (see discussions in Kocher et al. (2018), Appendix A3). The share of subjects that were classified as ambiguity neutral ranges from 17% to 39% in our treatments, summarized in Table 3. Compared with Kocher et al. (2018), we have substantially less ambiguity neutral subjects, but the number is still large. We, therefore, present results based on a subsample that excludes ambiguity neutral subjects in the right panel of Table 2, following Kocher et al. (2018).

Table 3: Ambiguity neutral subjects by treatments

SELF/Moderate	SELF/Low	OTHER/Moderate	OTHER/Low
39.3%	28.8%	34.5%	17.2%

Notes: This table summarizes the percentage of subjects whose probability equivalents lie in the interval [0.475, 0.525] in the moderate-likelihood task, and in the interval [0.085, 0.115] in the low-likelihood task.

In this subsample, whether making decisions for oneself or for others, subjects show ambiguity seeking for moderate likelihood losses, though insignificantly, and strong ambiguity aversion for low likelihood losses. Specifically, in SELF/Moderate, 59% of our subjects choose the ambiguous prospect in the first decision (binomial test, p=0.32; N=37). In SELF/Low, this measure is 29% (binomial test, p<0.01; N=42). The corresponding average PE of decisions for oneself is 0.484 for moderate likelihood losses (two sides t-test, p=0.37; N=33) and 0.128 for low likelihood losses (two sided t-test, p<0.01; N=36). When making decisions for others, 58% choose the ambiguous prospect in the first decision in OTHER/Moderate (binomial test, p=0.42; N=38). This number is 23% in OTHER/Low (binomial test, p<0.01; N=48). The average PE of decisions for others is

0.485 for moderate likelihood losses (two sides t-test, p=0.20; N=35) and 0.142 for low likelihood losses (two sided t-test, $p<0.01$; N=41). This means that the behavior of subjects who are not ambiguity neutral is strongly in line with the predicted loss part of the fourfold pattern of ambiguity attitudes both when making decisions for oneself, and for others. Lastly, there is no difference between self- and other-regarding ambiguity attitudes revealed from the analyses based on the subsample.

4 Discussion and Conclusion

This paper investigates whether and how people's ambiguity attitudes differ when making decisions involving losses for others. We follow the design of Kocher et al. (2018) and replicate the result that when making decision for oneself, people are ambiguity neutral for moderate likelihood losses and ambiguity averse for low likelihood losses. These findings are in line with the loss part of the four-fold pattern commonly observed in the literature (Trautmann and van de Kuilen, 2015). Second, our results suggest that ambiguity attitudes do not differ when comparing decisions for oneself and for others. Although we initially conjectured that people might be more sensitive to losses when making decision for others based on studies of loss aversion (Polman, 2012; Andersson et al., 2014; Füllbrunn and Luhan, 2017), we find no difference between self-other decision making concerning ambiguity in the loss domain. Together with the results of König-Kersting and Trautmann (2016) , it seems that ambiguity attitudes are not significantly affected by the agency situation in both gain and loss domains. This result is reassuring as agents typically behave as if they were making decisions for themselves when acting on behalf of their principals, at least for the case where there is no asymmetric information and incentives problems that distort decisions as the case of credence goods Dulleck and Kerschbamer (2006).

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Appendices

Appendix A

This appendix presents the on-screen instructions of our experiment. A summary is provided by the experimenter after subjects finish these instructions at their own pace. The instructions provided here is based on treatment OTHER. The instructions for treatment SELF is identical, except that we administered game N (2-color setting) and game P (10-color setting) separately in different sessions. In treatment OTHER, subjects are randomly assigned to two groups. One group play game N (2-color) on behalf of their principals who are at the same time playing game P (10-color) for them as agents, following König-Kersting and Trautmann (2016).

A1. General instructions

Welcome to this experiment. At the end of the experiment your entire earnings from the experiment will be immediately paid to you in cash. It is prohibited to communicate with the other participants during the experiment. Should you have any questions please ask us. If you violate this rule, we shall have to exclude you from the experiment and from all payments. Today, you will play two games, game N and game P. In each game, your possible payoff is denoted in dollars.

Part 1: The real-effort task

In the first part of the experiment, you are asked to add up some numbers. You will earn $20 if you manage to solve 5 math problems correctly.

Part 2: Ambiguity measurements

This part of the experiment consists of two games, N and P. In each game there are two types of players, a decision-maker and a recipient. Each recipient is assigned to one decision-maker. The assignments of the roles as well as the pairings occur randomly by the computer.

In one of the games, you take the role of the decision-maker and in the other game you take the role of recipient.

Please note that your recipient will NOT play the role as your paired decision-maker. Rather, you will be paired with another participant who will make decisions on your behalf.

In each of the two games, the decision-maker completes 7 choice tasks. Only one of the choice tasks will be chosen randomly at the end of the experiment to determine the final earnings. Since you do not know which choice task is paid, you should behave in each choice task as if this were the one that determines your **recipient's** final payoffs.

For each choice task, the decision-maker is presented two opaque bags containing different distributions of colored balloons. The decision-maker chooses a bag from which a balloon will be drawn.

The decision-maker's choice of bag, together with the color of the drawn balloon, determines the final payoff of the recipient.

After the decision-makers complete their seven choice tasks, the unanswered choice tasks are presented to their paired recipient. After the recipient has viewed all the tasks, the computer randomly selects the choice task to be used to determine the recipient's final payoff.

The experimenters will then randomly select one of the experiment participants to come forward and draw a balloon from each of the bags.

Lastly, the decision-maker's decision is made known to the recipient and final payoffs calculated.

At the end of the experiment, all bags used in the experiment can be checked by the participants if they wish.

The next screen explains the game in more details. In treatment OTHER, subjects are randomly assigned to two groups. In one group, they see game N and in the other group, they see game P.

You are playing game N

You are the decision-maker in this game

In this game, each bag contains exactly 100 balloons. There are 2 types of balloons that may be in each of the bags: red and blue. In this game you decide between a bag labeled N-A and a bag labeled N-B. The bags N-B are numbered from N-B1 to N-B7 as there are 7 decisions in total and the distributions of coloured balloons in these bags are displayed on the following screen. The distribution of coloured balloons in bag N-A is unknown to you.

You are playing game P

You are the decision-maker in this game

In this game, each of the two bags contain exactly 100 balloons. There are 10 types of balloons that may be in each of the bags: blue, red, yellow, lime, dark green, pink, purple, orange, black and white. Your choice tasks are to decide between a bag labeled P-A and a bag labeled P-B. The bags P-B are numbered from P-B1 to P-B7, as there are 7 decisions in total and the distributions of coloured balloons in these bags are displayed on the following screen. The distribution of coloured balloons in bag P-A is unknown to you.

Choose the personal color

Before you make your selection of bags in the choice tasks, you must first select a color of balloon that will determine the outcome of the game. That is, if this color is drawn from the N-A bag [P-A bag, in case of low likelihood treatment] that you select, then the recipient loses [you lose, in case of SELF treatment] $15. However, if any other color is drawn, then the recipient loses [you lose] $0. Any losses will be deducted from the recipient's [your] earnings in Part 1 of the experiment. Please now select a color from the options. For all the other bags with known distributions of balloons, if a blue balloon is drawn, then the recipient loses [you lose] $15 if you chose the known distribution bag instead of the N-A bag in the choice task that is randomly selected for payment. If any other color is drawn, then the recipient loses [you lose] $0. Any losses will be deducted from your recipient's [your] earnings in Part 1 of the experiment. Please now select a color from the options.

The choice screen appears and the real experiment starts. After all decisions were made In treatment OTHER, subjects would get to see the choice problems faced by their agents when they later serviced as principals themselves. Afterwards, the experimenter asked a volunteer to resolve the uncertainty of the lotteries.

Appendix B Picture of the bags in the experiment