Pre-Analysis Plan:
Risk taking on behalf of others - the importance of uncertainty revelation *

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July 1, 2019

1 Introduction

How do people behave when making risky decisions on behalf of others? Examples of risk-taking for others can be found in many contexts: politicians take risky decisions on behalf of their voters, managers on behalf of their employees and shareholders, parents on behalf of their children, and physicians on behalf of their patients. Due to its practical relevance and the extensive literature on individual risk preferences, risk-taking on behalf of others has received increasing attention in economic studies.[1] One commonality of the experimental studies is that the outcomes of decisions made on behalf of others are instantaneously revealed to decision makers (Andersson et al., 2016; Bolton et al., 2015; Füllbrunn and Luhan, 2015; Reynolds et al., 2009). However, instantaneous revelation does not apply to real-life decisions like those mentioned above, and it excludes a class of decision situations characterized by a delay before the decision outcomes are revealed. Moreover, decision makers, such as those dealing with climate policies, lack of ex-post revelation of the outcomes of their decisions on behalf of future generations. The decision making without revelation has not been studied yet in existing literature. Thus, in the present study, we focus on the decision making on behalf of others without ever knowing the outcome (no revelation), and compare the decision making with unknown outcome to that with immediate resolution and finite delays of resolution.

In a between-subjects setting, we implement four treatments. In our two main treatments, we vary whether the decision-maker, who has no monetary stakes in the decision, learns about the

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[1] See, for example, Eriksen et al. (2017) and Füllbrunn and Luhan (2015) for an overview.

consequences of her decision for a passive recipient, who has worked on a real-effort task to gain money, or not. Additionally, we implement two treatments, where we investigate how the timing of uncertainty revelation influences risk-taking for others. Studying the effect of delayed resolution of uncertainty informs us whether situations without ex-post revelation of the outcome constitute a distinct class of decision situations, or whether decisions in these situations are similar to decisions made in situations involving a delay.

A pilot study for this project has already been conducted in 2011. In a small scale laboratory experiments conducted at NHH, we compared risk taking on one's own behalf to risk taking on behalf of others with or without ex-post revelation of the outcome. 168 students from Norwegian School of Economics participated the pilot study.

2 Sample and research strategy

In this project, we will recruit two types of participants: the decision-makers and the recipients. We recruit both types of participants using the infrastructure of leading data-collection agencies. The decision makers are recruited from the Norwegian general population via the survey agency Norstat. The recipients are recruited from the Amazon Mechanical Turk. One out of five decision makers will be chosen to determine the payoff of a recipient. We plan to recruit 2400 participants: 2000 decision makers and 400 recipients.

3 Experimental design and implementation

3.1 Overview of treatments

In this section, we provide details about the treatments and the implementation of the experiment. The two main treatments, Treatment T1 and Treatment T2, test how the lack of ex-post revelation of the outcome influences risk-taking for others. Treatments T3 and T4 study the length of revelation delay influences risk taking for others.

Our concern is not so much time discounting, so all payments to recipients will be made 4 months after the main experiment, after the long delay in uncertainty revelation to decision makers. This keeps the issue of the time-value of money invariant between treatments.

- T1 (**No delay**): Risk taking on behalf of others with immediate revelation of outcomes to decision makers.
- T2 (**No revelation**): Risk taking on behalf of others without revelation of outcomes to decision makers.
- T3 (**Short delay**): Risk taking on behalf of others with outcomes revealed to decision makers 7 days after decision making.

- T4 (**Long delay**): Risk taking on behalf of others with outcomes revealed to decision makers 3 months after decision making.

3.2 Implementation

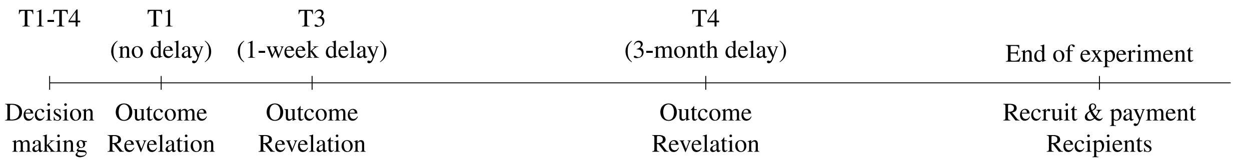

Figure 1: Timeline of the experiment

3.2.1 Decision making phase

In the first part of the experiment, *decision makers* are recruited by survey agency Norstat from a panel of Norwegian participants representing the general population. Each decision maker in T1 (No delay), T2 (No revelation), T3 (Short delay) and T4 (Long delay), is asked to evaluate four lotteries. The four lotteries are randomly chosen from the ten lotteries in Table 1. Each lottery is presented as a fair die, and the probabilities are represented by how many sides a given amount is represented on. For each lottery, a decision maker will make binary choices between the lottery and different safe amounts. The list includes seven binary choices between the lottery and different safe payoffs as seen in Table 1. Each decision maker makes a total of twenty-eight binary choices.

Before making choices, decision makers are told that for every five decision makers, one will be randomly chosen, and one of his/her decisions will be implemented to determine the payoff of a *recipient*. Decision makers in T1, T3 and T4 will also be told that they will know whether they are chosen to determine payoffs of others, which decision is chosen to be implemented, and the outcome of that decision at respective times. Decision makers in T1 will know above information about their decisions immediately after making decisions. Decision makers in T3 and T4 will know information about their decisions seven days and three months after making decisions, respectively. Decision makers in T2 will be told that they will never receive any information about the outcome of their decisions. Decision makers will be told that the choice outcomes will not influence their own payoffs and that recipients will be informed that decisions of others determine their payoffs. Decision makers will also that recipients will be recruited and paid four months after the first part of the experiment, long after decision making.

After making choices, decision makers will answer questions about their risk preferences, beliefs about others' risk preferences, social concerns, and feelings during the experiment, see Section 3.2.2. In the end of the survey, decision makers will answer background questions such as gender, age, education, and whether they are parents.

Decision makers in T1 will see the realization information online at the end of the survey. Decision makers in T3 and T4 will be contacted via text message about the outcomes in seven days and three months, respectively. Contacting decision makers will be done by the survey agency and research team will not record contact information of decision makers.

Table 1: Pool of lotteries to be shown to participants

	Die outcome (Y)							
Lottery	1	2	3	4	5	6	$E[Y]$	Safe outcome alternatives
1	0	0	0	0	0	240	40	$(10, 20, 30, 40, 50, 60, 70)$
2	0	0	0	0	240	240	80	$(20, 40, 60, 80, 100, 120, 140)$
3	0	0	0	0	120	120	40	$(10, 20, 30, 40, 50, 60, 70)$
4	120	120	120	120	240	240	160	$(130, 140, 150, 160, 170, 180, 190)$
5	60	60	60	60	120	120	80	$(70, 75, 80, 85, 90, 95, 100)$
6	80	80	80	80	200	200	120	$(90, 100, 110, 120, 130, 140, 150)$
7	180	180	180	180	240	240	200	$(190, 195, 200, 205, 210, 215, 220)$
8	0	0	0	240	240	240	120	$(30, 70, 100, 130, 170, 200, 230)$
9	0	0	240	240	240	240	160	$(30, 70, 100, 130, 170, 200, 230)$
10	0	240	240	240	240	240	200	$(30, 70, 100, 130, 170, 200, 230)$

Note: The 10 lotteries of Table 1 are borrowed from Abdellaoui et al. (2011). A pilot study was conducted to test whether the context matters for a single choice, whether the spread of the safe outcomes (small or large) influences choices between lotteries and safe outcomes. Results of the pilot study found no such contextual effects.

3.2.2 Follow-up questions

In all treatments, decision makers will respond to a non-incentivized survey question about their willingness to take risk in a hypothetical situation. We will use their answers to control for individual risk preferences, which might influence how individuals make decisions on behalf of others. In addition, we will elicit the decision makers' beliefs about the others' risk preferences with the same hypothetical question. We use hypothetical questions similar as in the study by Falk et al. (2018), as below. The other two questions for decision makers include social concern, also modelled after Falk et al. (2018), and feelings when making decisions (van Winden et al., 2011), as below.

1. In general, on a scale of 1 to 7, how much are you willing to take risk on your own behalf? 1 means you are "unwilling to take risk", 4 means you are "quite average" willing to take risk, and 7 means you are "very willing to take risk".

2. What do you think the average participant in this survey answers about their own willingness to take risk? 1 means "unwilling to take risk", 4 means "quite average", and 7 means "very willing to take risk".

3. How much are you willing to contribute to good causes if you cannot expect anything in return? 1 means "unwilling to contribute", 4 means "quite average", and 7 means "very willing to contribute".

4. What would best describes how you experienced when making decisions on behalf of others in this survey? Hopeful, excited, worried, anxious, or none of above.

In addition to these questions, we will ask about basic demographics: Gender, age, whether the participant is a parent, and their level of education.

3.2.3 Recipient phase

In the last part of the experiment, we will recruit recipients from online labor platform Amazon Mechanical Turk. Recipients will receive a fixed payment of one US dollar and informed that their additional earnings will be determined by the decision outcome of a decision maker randomly matched with them. Recipients will perform a minor task to justify payment, and the lottery choice, will be described to the recipients.

3.2.4 Sample size and budget

There will be 2000 decision makers and 400 recipients in this study. For every five decision makers, one will be randomly chosen to implement one of his/her decisions. The decision outcome will determine the payoff of a recipient. The average payoff to recipients will depend on choices of decision makers. If decision makers always choose the safe outcome, expected payment is 113 NOK, if they maximize expected outcomes, that will be 133 NOK, if they always choose the risky option, the expectation is 120 NOK.

4 Parametric model

We will do the formal consideration of hypotheses within a straigthforward model of choice under risk.

4.1 A choice model

A lottery can be represented by the list

$$L = (y_1, p_1; y_2, p_2; \cdots; y_n, p_n), \quad y_1 < y_2 < \cdots < y_n,$$

in which y_i is a monetary outcome and p_i is the corresponding probability.

We will assume a model of rank dependent utility, in which participants have power utility,

$$u(y) = y^{\rho}, \quad \rho > 0. \tag{1}$$

The probability weighting function is that of Prelec (1998),

$$w(p) = e^{-\beta(-\log p)^{\alpha}}, \quad w(0) = 1, \quad \alpha, \beta > 0. \tag{2}$$

For the case of a lottery with only two outcomes, the rank dependent utility can be written

$$\text{RDU}(L) = (1 - w(p_2))u(y_1) + w(p_2)u(y_2),$$

see Dhami (2016, Chapter 2.3). In the experiment, the participants face the choice between a lottery L and a safe alternative S. The choice depends on the difference in the certainty equivalent of the lottery,

$$\text{CE}(L) = \Big(\text{RDU}(L)\Big)^{1/\rho},$$

and the safe amount, $\text{CE}(L) - S$.

This model becomes a fully specified stochastic choice model by assuming random utility, and with a precision parameter $\lambda > 0$, the probability of choosing the lottery over the safe amount can be written

$$P[L] = \Lambda\big(\lambda(\text{CE}(L) - S)\big), \tag{3}$$

with Λ being the CDF of the logistic distribution. The vector of parameters that fully describe the problem, θ, is

$$\theta = (\alpha, \beta, \rho, \lambda).$$

4.2 A statistical model

This subsection describes a statistical version of the choice model in the previous subsection, allowing for inference on a heterogeneity rich specification with a hierarchical Bayesian model. The aim is to allow for estimation using a probabilistic programming language (Stan Development Team, 2017).

Let us model the indicator function for choosing a lottery, I^L:

$$I_{ij}^{L} \sim \text{Bernoulli}(p_{ij}), \tag{4}$$

$$\text{logit}(p_{ij}) = \lambda_i(\text{CE}_{ij} - s_{ij}), \tag{5}$$

$$\text{CE}_{ij} = \left((1-\pi_{ij})y_{1ij}^{\rho_i} + \pi_{ij}y_{2ij}^{\rho_i}\right)^{1/\rho_i}, \tag{6}$$

$$\pi_{ij} = \exp\left(-\beta_i(-\log p_{2ij})^{\alpha_i}\right), \tag{7}$$

$$\log \alpha_i \sim N(\mu_\alpha, \sigma_\alpha^2), \tag{8}$$

$$\log \beta_i \sim N(\mu_\beta, \sigma_\beta^2), \tag{9}$$

$$\log \rho_i \sim N(\mu_\rho, \sigma_\rho^2), \tag{10}$$

$$\log \lambda_i \sim N(\mu_\lambda, \sigma_\lambda^2), \tag{11}$$

$$\mu_\alpha \sim N(0.5, 2^2), \tag{12}$$

$$\mu_\beta \sim N(0.5, 2^2), \tag{13}$$

$$\mu_\rho \sim N(0.5, 2^2), \tag{14}$$

$$\mu_\lambda \sim N(0.5, 2^2), \tag{15}$$

$$\sigma_\alpha \sim \text{Cauchy}_+(0, 1), \tag{16}$$

$$\sigma_\beta \sim \text{Cauchy}_+(0, 1), \tag{17}$$

$$\sigma_\rho \sim \text{Cauchy}_+(0, 1), \tag{18}$$

$$\sigma_\lambda \sim \text{Cauchy}_+(0, 1). \tag{19}$$

Equations (4)–(7) code the choice model, while (8)–(11) code log-normal priors for each of the four model parameters. Equations (12) – (19) code hierachical meta-priors for the individual utility parameters, allowing for rich heterogeneity in parameters.

The specific values of the meta-priors (12) – (19) might need to be tuned in light of actual data for stability and convergence, but all inference with respect to the treatment differences will be made symetrically, without prior information that biases the treatment effects one way or another.

We have developed a Stan implementation of (4)–(19) that seems to converge across chains on simulated data.

5 Empirical strategy

The main aim of this experiment is to study how the lack of ex-post revelation of the outcome affects risk-taking behavior on behalf of others. Furthermore, we study the effect of delayed resolution of uncertainty and we shed light on the role of beliefs about the others' willingness to take risk.

5.1 Hypotheses

For the hypotheses put forward in this pre-analysis plan, we are not going to test them with null hypothesis significance testing, instead we are going to rely on the Bayesian estimation outlined in the previous section and evaluate the hypotheses using the posterior distributions.

5.1.1 No delay vs short delay

The comparison between immediate revelation (on the experimental web platform) and the short delay (an SMS text message one week later) is potentially a mix of (a) a change in the mode of communication, and (b) the effect of having to wait 7 days. We hypothesize that the effect of a short delay is small and difficult to detect, but we cannot entirely rule out that such an observed effect is due to the change of mode. Still, we put forward the hypothesis that there are small differences between no delay and a short delay.

Hypothesis 1. *Decision makers don't distinguish in quantitatively important ways between no delay and a short delay.*

5.1.2 Long delay vs short delay

Risk tolerance has been found to increase from no delay to short and to long delays for private decisions (Shelley, 1994; Keren and Roelofsma, 1995; Öncüler et al., 2000; Abdellaoui et al., 2011; Savadori and Mittone, 2015). Changes of risk taking with different delays may result from different cognitive attention on the probabilities, different subjective treatment of physical outcomes (hyperbolic discount factor), and the anticipatory feelings (van Winden et al., 2011; Golman and Loewenstein, 2016). Abdellaoui et al. (2011) showed that for private decisions, increase in risk tolerance with delay arose from probability weighting function at different time periods. Probability weighting function is more linear when there is a revelation delay. They suggested an affect-based explanation for this. The more a lottery is put to the future, the less strong anticipatory emotional reactions are, and the more linear probability function is. This implies for greater risk tolerance when there is long delay before outcome revelation:

Hypothesis 2. *Decision makers take more risk on behalf of others when the the revelation delay is long than when it is short.*

And also, to follow up,

Hypothesis 3. *The difference in risk taking behavior with short and long delay is due primarily to differences in probability weigthing, not to differences in risk aversion.*

5.1.3 No revelation

There are two different ways to think about the no revelation case. First, we can consider taking the limit of a very long time to revelation, in which case the "no revelation" is a strong version of "long delay". Second, one can note that no anticipation is no reason to expect any future revelation. In this case, one can argue that no revelation is more similar to immediate revelation, since neither involves any significant waiting for revelation of uncertainty. Based on this, we formulate two competing hypotheses:

Hypothesis 4. *The effect of no revelation is like the effect of a long delay, but stronger.*

Hypothesis 5. *The decisions with no revelation are close to those without any delay.*

5.2 Exploratory analysis

We collect data that allow us to look at some questions that are ancillary to the main treatment effects.

5.2.1 The role of demographics

We collect data on age, gender, being a parent and level of education. It is natural to map risk-taking on behalf of others by these characteristics.

5.2.2 The role of social preferences

To care about decisions for others, one needs at least some social motivation. We ask one simple question about this, and we would like to see if those with stronger social motivation care more (in the sense of having less noise in their decisions), and if those with strong social motivation might put more weight on their beliefs about the preferences of others.

5.2.3 The role of beliefs

In our pilot study, we found out that subjects relied decision making more on their beliefs about others' risk preferences when the outcome will not be revealed, than when the outcome will be revealed. With revelation of outcomes, the subjects applied their own risk preferences to the decision making for others. This indicates that the weight people put on their beliefs about others may be related to the revelation of outcomes. To see whether the role of beliefs in risk taking for others is related to revelation delay, we plan to examine whether beliefs about the difference between own and others's preferences matter at all, and whether the importance of this difference is influenced by the length of the revelation delay.

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