Eliciting Minimum Acceptable Probabilities

Pre-Analysis Plan

Martin Strobel Maria Polipciuc*

Very preliminary—please do not cite

May 11, 2021

*Maastricht University. Email: m.polipciuc@maastrichtuniversity.nl. We thank Elias Tsakas for valuable comments.

1 Main page description (public)

Interventions

Intervention(s)

We compare minimum acceptable probabilities (MAPs) for which a participant considers a binary lottery equally desirable to a sure payoff across treatments within individual. Individuals have to decide in randomized order in three scenarios (treatments). The treatments keep the sure payoff and the payoffs of the lottery fixed, but vary the distribution of the winning probability of the lottery.

Trial Start Date

Not applicable

Intervention Start Date

TBD

Intervention End Date

TBD

Primary Outcomes

Primary Outcomes (end points)

MAPs

Primary Outcomes (explanation)

The MAPs are elicited as indifference values.

Experimental Design

Experimental Design

We elicit MAPs in an online experiment in a lottery similar to the *Decision Problem* in Bohnet and Zeckhauser (2004). The aim is to test an assumption required for the MAP elicitation procedure to be incentive-compatible. Specifically, we test whether there is evidence that participants' declared MAPs are independent of the underlying distribution from which the probability of success of the gamble is drawn. We do this by exogenously manipulating this distribution, and comparing the resulting MAPs across treatments.

Experimental Design Details

Not available

Randomization Method

Computer

Randomization Unit

Individual

Was the treatment clustered?

No

Planned Number of Observations

420

Was IRB approval obtained (only for "In Development" and "On-going" trials)? If so, also

IRB Name

IRB Approval Date

IRB Approval Number

2 Introduction

The Minimum Acceptable Probability (MAP) is an elicitation procedure for an indifference value (expressed as the probability or as the number of favorable outcomes) between a sure payoff and trusting someone. In other words, it is the value which makes an individual indifferent between engaging and not engaging in a trusting interaction.

The concept was introduced by Bohnet and Zeckhauser (2004) and it has been used—with slight variations—to elicit a determinant of trust, betrayal aversion, in a difference-in-difference design. This procedure is incentive compatible if "a principal adheres to the Substitution Axiom of von Neumann-Morgenstern utility [...] A MAP is a cutoff value relating to preferences, and the estimated value of p^* [*NR: the winning probability*] should not affect it." (Bohnet et al., 2008, p. 298). While empirical violations of this axiom—which implies expected utility—have been documented (see footnote 5 on p. 275 in Li et al., 2020, for a list of studies finding empirical violations), to our knowledge it is not yet established whether this violation is empirically relevant in the context of the MAP elicitation procedure.

This paper investigates whether the MAP is influenced by a participant's belief about the distribution from which the chance of a favorable outcome is drawn. We remove the social and strategic aspects of a trust decision, and study the MAP for accepting a risky lottery. The treatments vary the distribution from which the chance of the favorable outcome is drawn, thus manipulating participants' expectations about the lottery's winning chances.

Below we present the sample selection procedure, the experimental design, and the empirical strategy.

3 Research Strategy

This project will collect experimental data on an online platform dedicated to academic research (Prolific) in May 2021. Participants will be exposed to three treatments sequentially, in randomized order. In each of the treatments, participants have to state the MAP (minimum acceptable probability) for which they prefer a lottery over a sure payment. This is a version of Bohnet and Zeckhauser's (2004) *Decision Problem* (p. 469). The treatments differ in the underlying distribution from which the lottery is drawn. Given the complexity of the task, we will recruit participants with completed higher education (also students?), to increase the chances that task comprehension is not an issue.

The pre-analysis plan will be registered at the AEA RCT registry before the start of the data collection.

3.1 Recruitment

Participants are registered users on the online platform Prolific. This platform is tailored for academic research, and gathers demographics about registered users. We will send an invitation to the experiment only to participants who have completed higher education (maybe also to students?), for the reasons mentioned above.

4 Design

The study consists of three parts. The first part describes the task and ask comprehension questions (unincentivized). This part pays a fixed payoff. Only those who answer the comprehension questions correctly are directed to the main part, which is incentivized. After this, those who complete the main part go through a survey. Uncertainty is resolved at the very end, when participants are informed about their payoff for the second (main) part.

As mentioned above, participants in the experiment are asked to state their MAP in a *Decision Problem*: what is their MAP for taking a gamble rather than accepting a sure payoff? The experiment uses a within-subject design. The complete instructions are available in Appendix XYZ.

Below we present the main task in more detail.

4.1 Explanation of the main task in Part 1

See the document 'Explanation.pdf'.

4.2 Main task in Part 2

After having answered the comprehension questions in Part 1 correctly, participants see a picture like the one below with the following text:

[Insert images]

Consider the wheels above. Which wheels do you prefer to SPIN for your bonus? Please enter an integer between 0 and 15.

I prefer to SPIN wheels which have at least ... blue sectors.

If the randomly selected wheel has fewer than ... blue sectors, I DON'T SPIN it. My bonus is €2.

If the randomly selected wheel has ... or more blue sectors, I SPIN it. My bonus is

- *€1 if the selected wheel lands on a pink sector, and*
- *€4 if it lands on a blue sector.*

4.3 Survey questions in Part 2

Participants answer the following type of questions:

- an adapted cognitive reflection test (Frederick, 2005; Thomson and Oppenheimer, 2016);
- a general risk taking question (Dohmen et al., 2011);
- a question about their aspiration level for earnings from participating in a survey;
- a couple of questions to check their anchoring susceptibility, from which an anchoring score can be computed (Cheek and Norem, 2017);
- a set of questions about their optimism/pessimism, the revised Life Orientation Test (Scheier et al., 1994);
- a brief sensation seeking scale, BSSS-4 (Stephenson et al., 2003).

Additional information will be requested from Prolific, who can provide data on participants' age, gender, and investment behavior. All participants have completed higher education or are currently enrolled in higher education. Our sample consists of residents of the United Kingdom.

5 Empirical Strategy

The experiment is meant to study how much of betrayal aversion can be explained by different underlying distributions from which the winning probability is drawn.

In each treatment, the subjects are faced with a different distribution of the possible states of the world. Each state of the world is represented by a wheel of fortune with 15 sectors. Sectors are either blue (worth the high payoff) or pink (worth the low payoff). Each of the three treatments consists of 32 different wheels, which can be ordered by the overall expected value over all wheels in the treatment. We call the three treatments: the Good (the treatment with the highest expected value over all 32 wheels, which is left-skewed), the Bad (the treatment with the lowest expected value over all 32 wheels, which is right-skewed), and the Uniform (the expected value is in-between the ones in the other treatments, and the distribution of risk is uniform).

Payoffs are determined by a two-stage lottery with objective probabilities. In Stage 1, one of the 32 wheels is randomly drawn. In Stage 2, the number of blue sectors in the randomly selected wheel is compared with the participant's MAP. Should this number be equal to or exceed her MAP, the participant spins the virtual wheel for her payoff. Should the number be lower than her MAP, the wheel is not spun, and the participant receives the intermediate safe payoff.

Should participants be expected utility maximizers, their MAPs should not differ between the three treatments. This would be in line with what Bohnet and Zeckhauser (2004); Bohnet et al. (2008) assume. However, if participants have preferences over the distribution of winning probabilities (Stage 1 risk), the MAPs will capture these preferences and may differ between treatments. A large literature in economics and finance shows that individuals have preferences over higher moments of the distribution of risks cite (Ebert and Wiesen, 2014; Ebert, 2015; Grossman and Eckel, 2015).

This literature generally finds a dislike for left-skewed (negatively skewed) risks, holding mean and variance constant. In this paper, the more left-skewed a distribution, the higher its expected value (while the standard deviation is fairly similar at 4.61–4.62 in all three treatments).[1] We test empirically whether the net effect of preferences over risks of all orders makes a difference for MAPs in this setting.

On the one hand, we could expect this threshold to be higher the more favorable the distribution of risks, for instance because of (i) a different perception of what is a fair chance or (ii) anchoring on higher values (for instance, a higher mean of p^*) or (iii) a different thrill from gambling or (iv) different aspiration levels or (v) different reference points—leading to different loss aversion effects.[2]

On the other hand, research on risk taking at different levels of skewness has shown that individuals are more risk taking for lotteries which are more left skewed (Bougherara et al., 2021). From this, we expect the highest MAP for the Bad distribution, followed by the MAP for the Uniform distribution, followed by the MAP for the Good distribution.

This leads to the following hypotheses.

[1] The Bad and the Uniform distribution were chosen to reflect potential distributions imagined by participants in Bohnet and Zeckhauser (2004) and Bohnet et al. (2008) in the Trust Game and in the Decision Problem, respectively. Specifically, the Bad distribution has an expected probability of a blue sector over all 32 wheels of 0.2895, close to p^* in the Trust Game. The Uniform distribution is plausibly what participants in the Decision Problem expected to face.

[2] The post-experimental survey could shed some light on whether (some of) the factors matter. We leave it to future research to study the mechanisms at play, should we find that results in line with our expectations.

5.1 Hypotheses

5.1.1 Main hypotheses

Hypothesis 1 *The MAP in the world with left skew (more mass on high values of p^*) is higher than the MAP in the world with right skew (more mass on low values of p^*).*

Hypothesis 2 *The MAP in the world with left skew (more mass on high values of p^*) is higher than the MAP in the world with a uniform distribution over p^*.*

Hypothesis 3 *The MAP in the world with right skew (more mass on low values of p^*) is lower than the MAP in the world with a uniform distribution over p^*.*

5.1.2 Heterogeneity

Since the MAP is a way to gauge risk aversion, we expect that in the same world, females state higher MAPs than males on average.

Hypothesis 4 *Within each world, females require higher MAPs on average than males.*

Our treatments vary the objective distribution of the winning probability. How subjects process these probabilities might depend on things like (i) their optimism/pessimism etc. These heterogeneity analyses will be based on subsamples resulting from answers to the post-experimental survey.[3]

Hypothesis 5 *Within each world, more optimistic individuals require lower MAPs on average than pessimistic individuals.*

[3] Gender is among the demographics which we can obtain from Prolific.

5.2 Specifications and Analysis

We present the OLS regressions which will be used to test the hypotheses. Additionally, we will also run non-parametric Mann-Whitney U tests and Friedman tests, to check whether the MAPs in all treatments are from the same distribution.

The main hypotheses (1–3) will be tested using the following regression:

$$MAP_i = \beta + \beta_L L + \beta_R R + \epsilon_i \tag{1}$$

where MAP_i is the MAP chosen by participant i, L is an indicator which takes the value of 1 if the decision was made in the left skew world, R is an indicator which is 1 if the decision was made in the right skew world and ϵ_i is a random error term. Standard errors in the estimation will be clustered at the individual level.

For heterogeneity analyses, we will interact all terms in equation (1) with an indicator variable corresponding to each specific hypothesis. For instance, for Hypothesis 5, all terms will be interacted with indicator variable F_i, which takes the value 1 if the participant is female:

$$MAP_i = \beta + \beta^F F_i + \beta_L L + \beta_L^F L F_i + \beta_R R + \beta_R^F R F_i + \epsilon_i \tag{2}$$

The formal statements of the hypotheses are in the Appendix.

References

Bohnet, I., Greig, F., Herrmann, B., and Zeckhauser, R. (2008). Betrayal aversion: Evidence from Brazil, China, Oman, Switzerland, Turkey, and the United States. *American Economic Review*, 98(1):294–310.

Bohnet, I. and Zeckhauser, R. (2004). Trust, risk and betrayal. *Journal of Economic Behavior & Organization*, 55(4):467–484.

Bougherara, D., Friesen, L., and Nauges, C. (2021). Risk taking with left- and right-skewed lotteries. *Journal of Risk and Uncertainty.*

Cheek, N. N. and Norem, J. K. (2017). Holistic thinkers anchor less: Exploring the roles of self-construal and thinking styles in anchoring susceptibility. *Personality and Individual Differences*, 115:174–176.

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.

Ebert, S. (2015). On skewed risks in economic models and experiments. *Journal of Economic Behavior & Organization*, 112:85–97.

Ebert, S. and Wiesen, D. (2014). Joint measurement of risk aversion, prudence, and temperance. *Journal of Risk and Uncertainty*, 48(3):231–252.

Frederick, S. (2005). Cognitive reflection and decision making. *Journal of Economic Perspectives*, 19(4):25–42.

Grossman, P. J. and Eckel, C. C. (2015). Loving the long shot: Risk taking with skewed lotteries. *Journal of Risk and Uncertainty*, 51(3):195–217.

Li, C., Turmunkh, U., and Wakker, P. P. (2020). Social and strategic ambiguity versus betrayal aversion. *Games and Economic Behavior*, 123:272–287.

Scheier, M. F., Carver, C. S., and Bridges, M. W. (1994). Distinguishing optimism from neuroticism (and trait anxiety, self-mastery, and self-esteem): A reevaluation of the Life Orientation Test. *Journal of Personality and Social Psychology*, 67(6):1063–1078.

Stephenson, M. T., Hoyle, R. H., Palmgreen, P., and Slater, M. D. (2003). Brief measures of sensation seeking for screening and large-scale surveys. *Drug and Alcohol Dependence*, 72(3):279–286.

Thomson, K. S. and Oppenheimer, D. M. (2016). Investigating an alternate form of the cognitive reflection test. *Judgment and Decision Making*, 11(1):99–113.

Appendix A Hypothesis Testing

A.1 Hypothesis 1

$H0 : \beta_L - \beta_R = 0$

$H1 : \beta_L - \beta_R > 0$

A.2 Hypothesis 2

$H0 : \beta_L = 0$

$H1 : \beta_L > 0$

A.3 Hypothesis 3

$H0 : \beta_R = 0$

$H1 : \beta_R > 0$

A.4 Hypothesis 4

Within each world:

$H0 : \beta^F = 0$

$H1 : \beta^F > 0$

or

$H0 : \beta^F + \beta^F_L = 0$

$H1 : \beta^F + \beta^F_L > 0$

or

$H0 : \beta^F + \beta^F_R = 0$

$H1 : \beta^F + \beta^F_R > 0$

A.5 Hypothesis 5

Analogous to Hypothesis 4.