Motivating Risky Choices Increases Risk Taking

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Abstract

We study the impact of the mode of cognition on risk taking. In an online experiment we ask participants to make a simple decision involving risk. In the control group no manipulation is made, while in the treatment group we exogenously manipulate the mode of cognition by asking subjects to write down a text that motivates their risky choice before any decision is actually made. Such motivation treatment is meant to induce more reflection upon the decision to be made. Our results show an effect of the motivation treatment on risk taking, suggesting that higher reflection makes subjects more prone to risk taking. The effect is stronger if we consider only subjects who imperfectly understand the probability distribution implied by the simple choice task. Based on our experimental findings, we suggest that reflection and comprehension might be substitutes when individuals make decisions involving risk.

JEL classification code: D01; D81.

Keywords: dual process; risk taking; motivation; deliberation; intuition; bomb risk elicitation task.

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1 Introduction

In many real-life situations people make decisions intuitively with barely no effort, while in other situations they exert a substantial effort to make more conscious and reflected decisions. Given the pervasiveness of decisions involving risk, it seems important to understand how these different modes of cognition affect decision-making under risk. Such understanding would be especially relevant for policy interventions related to excessive or insufficient risk taking.

In this paper we experimentally investigate the impact of greater reflection on risk taking. Risk preferences are typically assumed to be a stable trait of the individual, being constant across different choice situations. However, experimental evidence shows that this is not always the case, especially for what concerns risk aversion in relation with different modes of cognition (Deck and Jahedi, 2015; Kirchler et al., 2017). While such evidence points to an effect of cognition on risk taking behavior, there is no general consensus on how this effect actually shapes risk taking; indeed, the effect seems to depend on the method which is employed to manipulate the mode of cognition. By inducing greater reflection through motivation, we intend to provide an alternative method to address this issue.

In an online experiment we ask participants to make a simple decision involving risk: the "Bomb Risk Elicitation Task" (BRET) introduced by Crosetto and Filippin (2013), which has been recently used in a number of studies to measure risk taking behavior (Crosetto and Filippin, 2016; Gioia, 2017; Hillenbrand and Winter, 2018; Spadoni and Potters, 2018). We attempt to manipulate the extent of reflection by means of a motivation treatment: participants are required to motivate their choice with a written text before any decision is actually made. Online experiments are characterized by shorter procedures and lower stakes with respect to laboratory experiments, which reasonably increase the likelihood that participants make quick and intuitive decisions. This allows a starker comparison between the control group (where no manipulation is done) and the treatment group.

The experimental data collected provide evidence for a positive effect of the motivation treatment: participants in the treatment group take significantly more risk than participants in the control group. This is in line with Kahneman and Egan (2011), who suggest that decisions processed intuitively are more likely to be consistent with risk aversion. Moreover, the treatment effect is stronger and more statistically significant if we consider only participants who imperfectly understand the probability distribution implied by BRET. Finally, we ob-

serve that better understanding is associated with more risk only for participants who are in the control group. Based on this findings we suggest that reflection and comprehension are substitute factors that can increase risk taking. This, to the best of our knowledge, is a novel finding.

The paper is structured as follows. Section 2 provides an overview of the literature on the main aspects concerning this study. In Section 3 the design and the procedures of the experiment are described. In Section 4 the collected data are presented and analyzed. In Section 5 we discuss in detail the experimental evidence and we indicate possible directions for future researches.

2 Related Literature

Many models have been developed adopting Dual Process Theory to explain individual decision-making (Stanovich and West, 2000; Evans, 2008; Evans and Stanovich, 2013; Kahneman, 2003; Kahneman and Egan, 2011). According to this theory individuals can make choices through intuitive or deliberative modes of cognition. Intuition is often described as fast, effortless, automatic and unconscious, while deliberation is often described as slow, demanding, controlled and conscious.

In the experimental literature on decision-making different methodologies have been adopted to promote a specific mode of cognition. One method aims at loading cognitive abilities (Deck and Jahedi, 2015; De Neys et al., 2011; Greene et al., 2008; Schulz et al., 2014), or at depleting them (Hagger et al., 2010; Xu et al., 2012; Achtziger et al., 2015, 2016) in order to induce little reflection. Alternatively, decision times can be manipulated exogenously through constraints or incentives (Kirchler et al., 2017; Kocher et al., 2013, 2019; Rand et al., 2012; Tinghog et al., 2013), e.g., as done in manipulations based on time pressure (to induce little reflection) or time delay (to induce greater reflection). Issues with time pressure methods occur in case subjects fail to respond within the constrained time window, as experimental results depend on whether these observations are included or not. Alós-Ferrer and Garagnani (2020) address this point by considering a manipulation in which a certain amount of money is detracted from subjects' endowment as time passes. Another method to promote a specific mode of cognition is priming, which consists in asking experimental subjects to recall situations where they relied on the cognitive mode to be promoted

(Butler et al., 2013; Lotz, 2015; Peysakhovich and Rand, 2015; Rand et al., 2012). A further method relies on arousing the emotional system (Jahedi et al., 2017) in order to induce less reflection. In the current paper we rely on the method developed in Bilancini et al. (2020) where greater reflection is promoted by requiring subjects to motivate their decision with a short written text before any decision is actually made.

Several studies have investigated how the two modes of cognition affect behavior in a wide array of tasks (see Capraro, 2019, for a recent review), including risk taking. Overall, the evidence is mixed. According to Kahneman and Egan (2011), the intuitive mode drives choices toward risk to be more in line with risk aversion. In particular, in the domain of gains, people tend to be more risk averse if their choices are processed intuitively. Although this prediction is consistent with the evidence provided by Frederick (2005), who finds that subjects' Cognitive Reflection Test scores are inversely related with risk aversion, results from other researches focusing on the causal effect of the mode of cognition on risk taking are mixed and seem to depend on the manipulation method. In line with Kahneman and Egan (2011), time pressure leads to more risk aversion (Guo et al., 2017; Kirchler et al., 2017), and cognitive load is associated with more risk-averse behaviors (Deck and Jahedi, 2015); however, reliance on intuition increases risk tolerance (Butler et al., 2013), and arousal increases risk taking (Jahedi et al., 2017), which would suggest that intuition is not associated with more risk aversion. Finally, in a study by Gerhardt et al. (2017) no significant evidence arises from depleting self-control.

Fischer and Smith (2004) provide evidence that lower reflection is correlated with higher probabilities to participate in risky activities. In Fischer and Smith (2004) students are asked how many times in the past year they were involved in risky activities and, in order to assess the extent of reflection, they rely on the conscientiousness domain of the NEO Personality Inventory Revisited (Costa and McCrae, 2008). This study suggests that a relation between reflection and risk taking exists but the causal effect cannot be established.

Finally, Chandler et al. (2014) show how subjects on Amazon Mechanical Turk may devote limited attention while performing online tasks. Our experiment was designed to be quick, succinct, and clear, in order to minimize the amount of resources needed to understand and carry out the experimental task.

3 Experimental design and procedures

This study was pre-registred on AsPredicted.org and run on Prolific, a crowdsourcing platform which recruits participants for research purposes.[1] Our experimental design does not require simultaneous interactions among players, which is often troublesome in online experiments (Arechar et al., 2018).

The experiment was conducted using oTree (Chen et al., 2016). Data were collected in a single session in March 2019. On Prolific, the experiment was labeled "An experiment on decision making", and was described as follows: "This is an experiment on decision making. We will ask you to complete a quick task, which may allow you to earn additional payments, and a short questionnaire". The sample was restricted to subjects from the UK and the US, in an age between 18 and 35. A minimum of two submissions in previous studies, with at least a 50% approval rate, was also imposed. We gave an estimate of three minutes for the time needed to complete the experiment, while we set to 10 minutes the maximum time for completion. Subjects received a show up fee of 0.30 GBP. All participants gave their informed consent at the beginning of the experiment, and they were given instructions about the task to be performed. Payoffs were automatically converted in USD for participants from the US.

To measure risk taking behavior we employed the BRET (Crosetto and Filippin, 2013) which is increasingly applied in the experimental literature (Crosetto and Filippin, 2016; Gioia, 2017; Hillenbrand and Winter, 2018; Spadoni and Potters, 2018). In our implementation of the BRET,[2] subjects had to choose how many boxes to collect from a 10x10-grid containing 100 boxes. They were told that one of the boxes contained a bomb that, if picked, would have destroyed all boxes, but they ignore where it was located. If they collected the bomb, they earned zero; otherwise, they received 0.01 GBP for each box.[3]

The manipulation of the cognitive mode was attempted with a motivation treatment: subjects in the treatment group were required to write down a motivation for their decision (of at least 30 characters) before they could enter the number of boxes they wanted to open. At the end of the experiment, subjects were asked to fill a questionnaire including demographic information, their self-assessed measure of risk attitude (Dohmen et al., 2011), a test to elicit

[1] Palan and Schitter (2018) offer a comparison of Prolific with the other main crowdsourcing platforms, explaining advantages and disadvantages.

[2] This method was conducted by using the pre-programmed tool for oTree by Holzmeister and Pfurtscheller (2016).

[3] Note that expected performance (and earnings) is maximized at 50 boxes.

subjects' personality traits (Rammstedt and John, 2007), a test of comprehension of the task (subjects were asked: "If you have collected 35 boxes, what is the probability of getting the bomb?" and they have to enter manually a number, see Slide 5A in the Appendix A), and a control question to verify data validity (subjects were asked: "If you're reading this check 'Agree little':" and they have to choose correctly, see Slide 5B in Appendix A).

4 Results

Out of 398 participants, 9 are excluded from the dataset before the analysis, as 2 subjects failed the control question (1 in the control group and 1 in the treatment group), and 7 subjects decided to open 100 boxes (4 in the control group and 3 in the treatment group), which is a dominated strategy and therefore likely associated with a mistake.[4] 200 participants were randomly assigned to the control group, and 189 to the treatment group. Subjects in the treatment with motivation took about 60 seconds more than the control group to complete the BRET. A subject took on average 3 minutes to complete the experiment. Average earnings were 0.49 GBP.

The treatment and the control group appear to be balanced. Gender, age, and self-assessment of risk preferences, which are all potentially associated with risk taking behavior, are similarly distributed in the two samples. Mann-Whitney tests confirm that the two groups are not statistically different in the means of the control variables (gender $z = 0.034$, $p = 0.97$; age $z = 0.789$, $p = 0.43$; self-assessment of risk preferences, $z = 0.564$, $p = 0.57$).

To assess risk taking we look at the number of boxes opened by subjects (referred to as "boxes"). The greater the number of boxes, the greater the level of risk taken.

Figure 1 shows how the mean of boxes opened varies across treatments and correctness of the answer to the comprehension question. The top-left chart of the figure suggests that the motivation treatment induces subjects to be more prone to take risk. By looking at the top-right chart, we can see that this effect is stronger among those who have given a wrong answer to the comprehension question, while it almost disappears for those who have given the correct answer to the comprehension question. From the bottom-left chart of Figure 1, we also see that comprehension seems to affect the number boxes opened only in the

[4] Appendix B provides an analysis of the data with no restrictions on the sample. This analysis lead to results that are not qualitatively different from those reported in this section.

control group, while it does not seem to have a considerable effect on the whole group of experimental subjects (bottom-right chart).

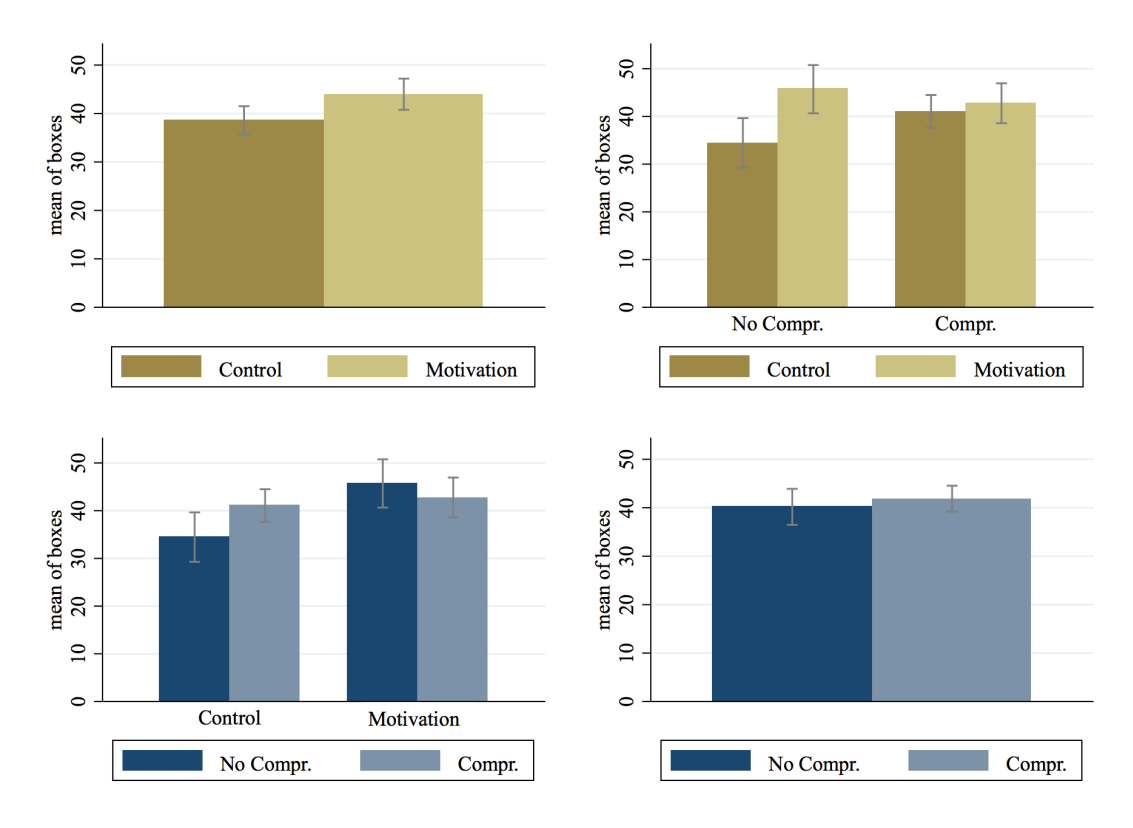

Figure 1: Mean of boxes opened by groups. *Top-left chart:* by treatment; *top-right chart:* by treatment and then by comprehension; *bottom-left chart:* by comprehension and then by treatment; *bottom-right chart:* by comprehension. Confidence intervals on means are at 95%.

In order to assess the statistical significance of what can be inferred from Figure 1, we provide a series of non-parametric tests which are summarized in Table 1. From the column totals (i.e., pooling over groups "Comprehension= No" and "Comprehension= Yes") we can see a significant treatment effect (p=0.024) on the mean of boxes opened which leads to an increase from 38.59 in the control group to 43.98 in the treatment group. From the row totals (i.e., pooling over treatments "Control" and "Motivation") we see that comprehension does not go with a statistically significant difference (p=0.338) in the mean of boxes opened. However, comparing the two rows "Comprehension = No" and "Comprehension = Yes", we see that there is a significant treatment effect (p=0.001) on mean boxes opened for subjects giving a wrong answer to the comprehension question, leading to an increase from 34.45 in the

		Treatment		M-W test	Row Total
		Control	**Motivation**		
Comprehension	**No**	34.45	45.71	**p = 0.001**	40.19
		(22.84) [75]	(22.73) [78]	z=3.21	(23.40) [153]
	Yes	41.07	42.77	**p = 0.782**	41.87
		(19.49) [125]	(22.40) [111]	z=0.28	(20.88) [236]
M-W test		**p = 0.011**	**p = 0.274**		**p = 0.338**
		z=2.54	z=1.10		z=0.94
Column Total		38.59	43.98	**p = 0.024**	41.21
		(21.00) [200]	(22.52) [189]	z=2.28	(21.89) [389]

Table 1: Mann-Whitney tests for comparing means of boxes opened by groups and subgroups generated by treatments (control and motivation) and comprehension (yes or no). Standard deviations are in round parentheses. Numbers of observations are in squared brackets. The tested hypothesis is that the mean of boxes opened by one group does not differ from the mean of boxes opened in the other group.

control sub-group to 45.71 in the treatment sub-group. Instead, the treatment effect is not statistically significant (p = 0.782) for subjects giving a correct answer to the comprehension question.

Furthermore, we see from the left column of Table 1 that the mean of boxes opened by subjects in the control group is significantly higher (p = 0.011) for subjects giving a wrong answer to the comprehension question, with an increase from 34.45 to 41.07. Instead, the mean of boxes opened by subjects in the treatment group is not significantly different (p = 0.274) for subjects giving a wrong answer to the comprehension question with respect to those giving a correct answer (actually, with a reduction from 45.71 to 42.77). This evidence suggests a potential interaction between the treatment effect and the comprehension of the task.

We also tested the hypothesis that the mean boxes opened in the sub-group of subjects in the motivation treatment who gave a correct answer to the comprehension question is equal to the mean of boxes opened in the control treatment who gave a wrong answer to the comprehension question (for the sake of exposition results are not reported in Table 1): the Mann-Whitney test does not reject the null hypothesis (p = 0.180, z=1.34). Finally, as comprehension turns out to relate significantly with subjects' decisions, it is necessary to control its distribution in the two treatments: the Mann-Whitney test does not reject the null hypothesis of equal means in the two treatments (p = 0.4474, z=0.76).

Given the potential for interactions we also run a multivariate analysis which is reported in Table 2. We use linear regressions (OLS) where the number of boxes opened is the dependent variable and treatment, comprehension, and their interaction are included as regressors, besides control variables (sex, age and self-reported risk). A first finding is that the effect of the motivation treatment is sizeable, positive and statistically significant in all specifications. Further, by comparing Model (2), where there is the interaction between the motivation treatment and comprehension, and Model (1), where there is no interaction, we can see that the coefficient of comprehension is statistically significant only if we include the interaction. Focusing on Model (2), we see a positive and statistically significant coefficient of both motivation and comprehension, and a negative and statistically significant coefficient of the interaction between the two variables. In Model (3) we include further controls: we see that the variables considered in Model (2) are still statistically significant and that the estimated coefficients do not vary substantially in their magnitude.

Dependent variable:	Model	Model	Model
Mean of boxes opened	(1)	(2)	(3)
Motivation (treatment)	5.460**	11.25***	10.69***
	(2.219)	(3.679)	(3.502)
Comprehension (correct answer)	1.895	6.619**	7.045**
	(2.308)	(3.159)	(2.944)
Motivation × Comprehension		-9.558**	-9.116**
		(4.594)	(4.401)
Female			0.137
			(2.188)
Age			0.378*
			(0.223)
Self-assesment of risk aversion			3.071***
			(0.534)
Constant	37.41***	34.45***	7.045
	(2.173)	(2.633)	(7.774)
Observations	389	389	389
Adjusted R^2	0.012	0.021	0.108

Table 2: Regression of boxes Notes: Linear regressions with boxes as dependent variable. Robust standard errors are reported in parenthesis. Significance of coefficients: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

5 Discussion

In this paper we explored how manipulating the mode of cognition to induce more reflection can affect risk taking. Although this issue has been investigated in other studies, the evidence collected so far is mixed and suggests that much depends on the method applied to manipulate cognition. We add to the ongoing discussion by providing evidence from an online experiment where we attempt to manipulate the mode of cognition by means of a motivation treatment, i.e., we require subjects to write down a text that motivates their risky choice before any decision is actually made.

Our main finding is that the motivation treatment induces more risk taking. This suggests that greater reflection makes subjects more prone to take risks. This is in line with Kahneman and Egan (2011). However, we also find that the treatment effect is sizeable for the subjects who did not answer correctly to the comprehension question regarding the probability distribution implied by the choice task, while the effect almost disappears for subjects who gave the correct answer. Moreover, while the motivation treatment does not appear to affect comprehension of the probability distribution, the latter seems to go with more risk taking only for the control group. From these findings we argue that greater reflection and comprehension may be substitutes in promoting risk taking. Indeed, in our experiment they both go with more risk taking when considered individually, but no further increase in risk taking is observed when they are considered together.

Summing up, we found that requiring subjects to motivate their decision tends to increase risk taking only for individuals with imperfect probabilistic understanding of the decision problem. This finding could perhaps be explained with reference to the reduction of ambiguity brought about by greater reflection. Subjects with imperfect probability understanding who also reflect little on their decision might be affected by incompetence, which is a well-known source of ambiguity aversion (Heath and Tversky, 1991). Thus, as people tend to prefer clear over vague prospects (for a review of the experimental literature see, e.g., Camerer and Weber, 1992), it is reasonable to expect a positive relation between risk taking and reflection as far as there is no probability understanding.

To better understand the role played by the comprehension of the probability distribution implied by the choice task, and to check whether this is the outcome of a some other unobserved variable, future research may be dedicated to explicitly manipulate comprehension by means of a treatment where, e.g., the probabilistic assessment of the choice task

is favored. Such experiments would clarify whether comprehension may be a policy target to affect choices under risk, or simply a measure of exogenous cognitive abilities (Brañas-Garza et al., 2008; see also Brañas-Garza and Smith, 2016 and the articles in the special issue). Furthermore, by exogenously manipulating ambiguity aversion, it would be possible to explore more deeply our interpretation of the relation between reflection and risk taking. For example, according to the *comparative ignorance hypothesis* (Fox and Tversky, 1995), ambiguity aversion arises only from a comparison with more knowledgeable individuals or with less ambiguous prospects, which are settings not allowed in our design.

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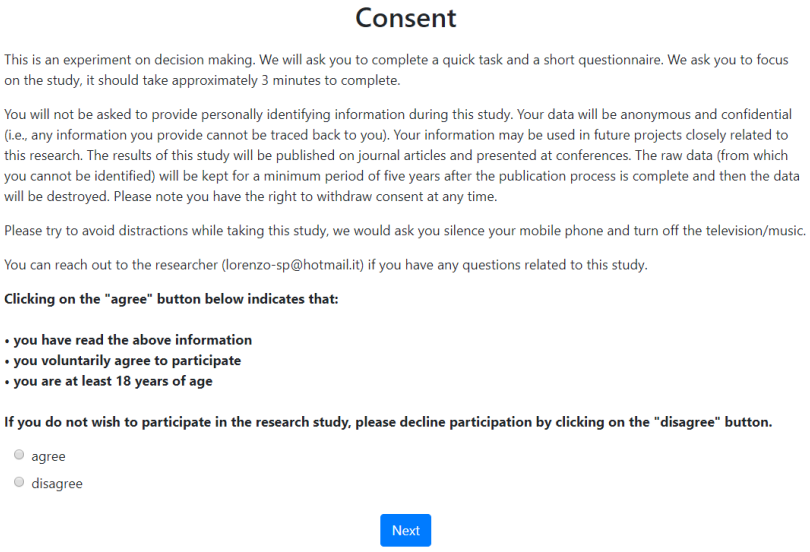
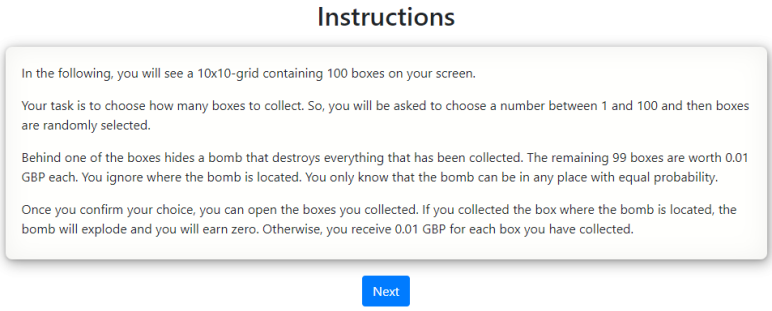
Appendix A. Screens

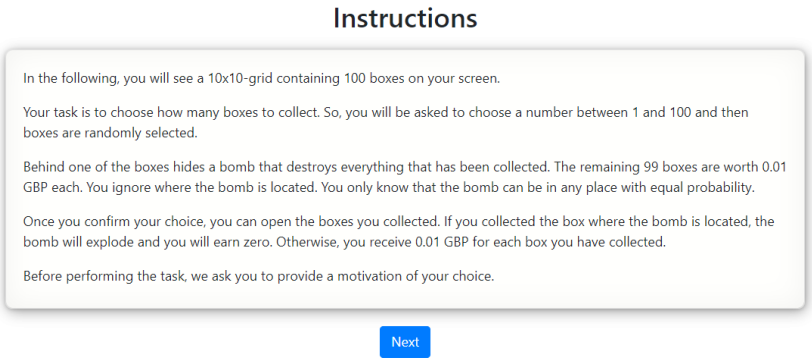
Screen 1



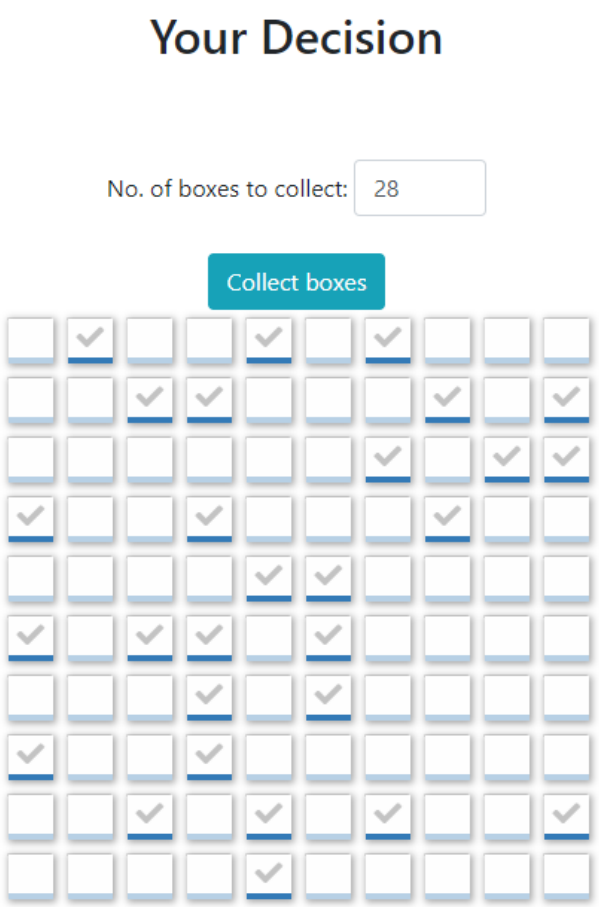
Screen 2 (Control group)



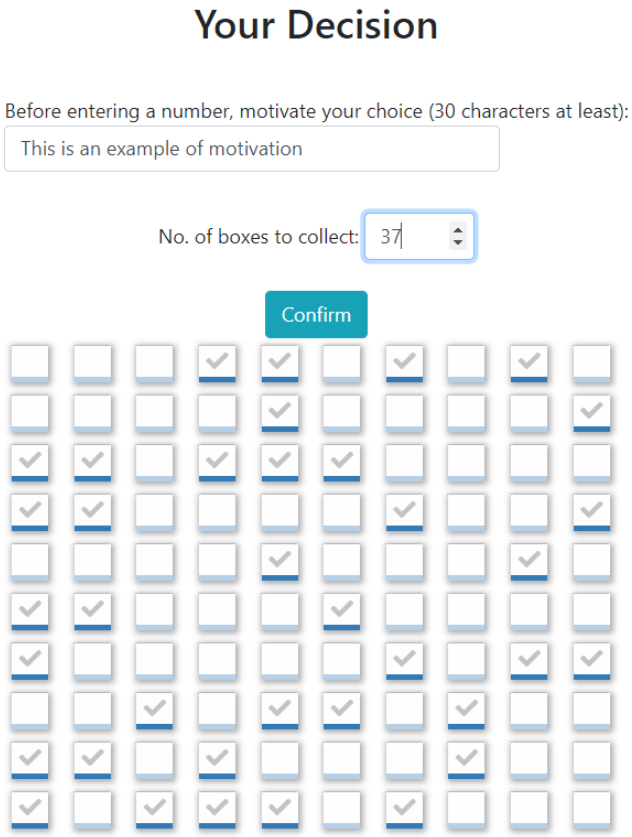
Screen 2 (Motivation treatment)



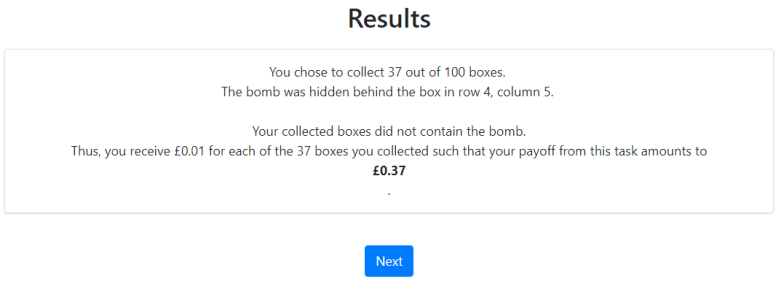
Screen 3 (Control group)



Screen 3 (Motivation treatment)



Screen 4



Screen 5A

Questionnaire

Please answer the following questions.

What is your age?

What is your gender?

○ Male ○ Female

How do you see yourself: Are you generally a person who is fully prepared to take risks or do you try to avoid taking risks? Please take a button on the scale, where the value zero means "not at all willing to take risks" and the value ten means "very willing to take risks".

○ 0 ○ 1 ○ 2 ○ 3 ○ 4 ○ 5 ○ 6 ○ 7 ○ 8 ○ 9 ○ 10

If you had collected 35 boxes, what would be the probability of getting the bomb?

%

Screen 5B

How well do the following statements describe your personality?

I see myself as someone who...

... is reserved:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... is generally trusting:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... tends to be lazy:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

... is relaxed, handles stress well:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... has few artistic interests:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... is outgoing, sociable:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... tends to find fault with others:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

... does a thorough job:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... gets nervous easily:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

... has an active imagination:

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

---

If you're reading this check "Agree a little":

○ Disagree strongly ○ Disagree a little ○ Neither agree nor disagree ○ Agree a little ○ Agree strongly

Next

Appendix B. Data analysis with no sample restrictions

Dependent variable:	Model	Model	Model
Mean of boxes opened	(1)	(2)	(3)
Motivation (treatment)	4.726**	11.04***	10.45***
	(2.322)	(3.940)	(3.711)
Comprehension (correct answer)	0.887	6.102*	6.729**
	(2.434)	(3.375)	(3.127)
Motivation × Comprehension		-10.53**	-10.06**
		(4.842)	(4.612)
Female			0.469
			(2.300)
Age			0.351
			(0.234)
Self-assessment of risk aversion			3.240***
			(0.556)
Constant	39.41***	36.16***	8.191
	(2.316)	(2.829)	(8.060)
Observations	398	398	398
Adjusted R^2	0.006	0.016	0.103

Table 3: Linear regressions with boxes as dependent variable. Robust standard errors are reported in parenthesis. Significance of coefficients: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

		Treatment		M-W test	Row Total
		Control	**Motivation**		
Comprehension	**No**	36.16	47.20	**p = 0.002**	41.85
		(24.86) [77]	(24.87) [82]	z=-3.04	(25.39) [159]
	Yes	42.26	42.77	**p = 0.984**	42.49
		(20.81) [128]	(22.40) [111]	z=0.02	(21.52) [239]
M-W test		**p = 0.017**	**p = 0.176**		**p = 0.504**
		z=2.40	z=1.35		z=0.67
Column Total		39.97	44.65	**p = 0.047**	42.24
		(22.55) [205]	(23.52) [193]	z=1.99	(23.12) [398]

Table 4: Mann-Whitney tests for comparing means of boxes opened by groups and subgroups generated by treatments (control and motivation) and comprehension (yes or no). Standard deviations are in round parentheses. Numbers of observations are in squared brackets. The tested hypothesis is that the mean of boxes opened by one group does not differ from the mean of boxes opened in the other group.