Risk preferences and the role of emotions

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Abstract

There is a large volume of research showing that emotions do have relevant effects on decision-making. We contribute to this literature by experimentally investigating the impact of four specific emotional states – joviality, sadness, fear, and anger – on risk attitudes. In order to do so, we fit two models of behavior under risk: the Expected Utility model (EU) and the Rank Dependent Expected Utility model (RDEU), assuming several functional forms of the weighting function. Our results indicate that all emotional states instigate risk-seeking behavior. Furthermore, we show that there are some differences across gender and participants' experience in laboratory experiments.

Keywords: Decision under risk, Emotions, Structural models
JEL Classification: D81, C91, D00

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1 Introduction

Traditionally, economists tend to emphasize the role of rationality and to overlook that of emotions in the decision making process.[1] Only in the last two decades there has been a large volume of research showing that emotions do have relevant effects on decision-making. Loewenstein (2000) argues that emotions (or *visceral factors*, in his terminology) play a role in three different manifestations of an individual's life. In particular, emotions affect people's bargaining behavior, their intertemporal choices (such as saving attitudes), and enter into their decision-making under risk and uncertainty. The latter is the object of investigation in the present work.

Loewenstein and Lerner (2003, p. 620) distinguish between *expected emotions*, which consist of "predictions about the emotional consequences of decision outcomes", and *immediate emotions*, which are "experienced at the time of decision making". Even though we cannot rule out the possibility that expected emotions play a role, in this work we focus on immediate emotions and investigate whether temporary emotional states, experimentally induced by film clips, affect risk preferences.

Empirical research in psychology and, more recently, in economics have demonstrated that affect can somewhat influence individual risk preferences. Two conflicting theories can be distinguished in this research area. On the one hand, Isen and Patrick (1983) introduced the Mood Maintenance Hypothesis (MMH), which holds that positive affect induces risk-averse behavior, while negative affect leads to risk-seeking behavior. On the other hand, there is the Affect Infusion Model (AIM), proposed by Forgas (1995), which suggests the exact opposite effects. Some authors (e.g., Kliger and Levy 2003; Zhao 2006) find empirical support for the MMH, while other scholars (e.g., Arkes et al. 1988; Yuen and Lee 2003; Chou et al. 2007; Grable and Roszkowski 2008) find evidence in favor of the AIM. There are also studies which end up with mixed results. Williams et al. (2003), for instance, show that while unhappy managers are significantly less risk-seeking, happy managers are not more likely to seek risk. Drichoutis and Nayga Jr. (2013) report that both positive and negative moods increase risk aversion. Finally, in an experiment inducing joy, fear, and sadness under nonexistent, low, and very high financial stakes, Treffers et al. (2012) find that, compared to a control group that did not receive any emotion manipulation, sadness

[1] Economists commonly use the terms "affect", "mood", and "emotion" as synonyms. Psychologists, instead, make clear distinctions among them. Robbins and Judge (2012, ch. 4, p. 98) define these terms as follows. "Affect is a generic term that covers a broad range of feelings people experience, including both emotions and moods. Emotions are intense feelings directed at someone or something. Moods are less intense feelings than emotions and often (though not always) arise without a specific event acting as a stimulus". Additionally, moods tend to last longer than emotions. In this work, the terms "emotion", "affective state", and "emotional state" are used interchangeably.

leads to more risk aversion only if the financial stakes are nonexistent or low; none of the induced affects influences risk preferences in the high-stake treatments.

The experimental study presented in this paper builds on this strand of literature. Yet, our experimental design is novel in a number of important respects. First, we consider discrete emotions, namely joviality, sadness, fear, and anger. With some exceptions (such as Lerner and Keltner 2001, Kugler et al. 2012, Treffers et al. 2012, Guiso et al. 2013), most previous studies follow a valence-based approach to affects and contrast affective states of different valence, that is "positive" versus "negative". Grouping affects can generate perverse effects in that affective states of the same valence (e.g., sadness, fear, and anger) may have conflicting influences on risk preferences, which can even cancel out one another (see, e.g., Raghunathan and Pham 1999).

Second, we use salient monetary incentives, whereas most of the existing studies in this area provide small financial incentives (if any) to experimental subjects.[2] In their review articles on the impact of financial incentives on choices, Camerer and Hogarth (1999) and Hertwig and Ortmann (2001) observe that incentives have the largest effect in individual decision making studies. We can verify whether the documented impact of affect on risk attitudes will survive the introduction of salient monetary incentives.

Third, in contrast to all former experiments, we implement a within-subject design in the sense that we measure, and compare, individual risk preferences both before and after affective states are manipulated. This gives our study an important advantage because it prevents the confounding effect of heterogeneity in preferences to disturb the effect of emotions on willingness to take risk.[3]

A further important novelty of this paper lies in the way attitude to risk is measured. Specifically, we follow Hey (2001) and elicit risk preferences by presenting participants with 100 pairwise-choice problems between two different lotteries. Previous economic studies measure risk preferences mainly looking at people's choices when faced with multiple price lists (MPLs).[4] The main advantage of a MPL is that it is easy to explain to subjects, and to implement. Additionally, it is incentive-compatible provided that only one decision is randomly selected for payment (Azrieli et al. 2012). However, a MPL has several disadvantages. For instance, Andersen et al. (2006) remark that it (i) only elicits interval responses rather than point ones, (ii) allows for multiple switching points, thus leading to potentially inconsistent decisions, and (iii) may be susceptible to framing effects. Recently, Bosch-Domènech and Silvestre (2013) find that MPLs suffer from "em-

[2] Notable exceptions are Lee and Andrade (2011), van Winden et al. (2011), and Treffers et al. (2012).

[3] As Friedman and Sunder (1994) point out, preferences toward risk are the most important characteristic that economic theory recognizes to vary across individuals.

[4] See, for instance, Treffers et al. (2012) or Drichoutis and Nayga Jr. (2013).

bedding bias", i.e., the removal of some pairs at the beginning and/or at the end of the list yields a decrease in risk aversion.[5] These problems are overcome by presenting subjects with a single binary choice task at a time, as we do here. This approach enables us to collect several observations from each experimental subject and, consequently, to estimate *precisely* the participants' risk attitudes and how they vary, if at all, with the emotional state.

To our knowledge, this would be the first attempt to use a thorough experimental design—departing from past works in the ways outlined above—to study the impact of four specific emotional states on risk preferences. We use the same 100 choice problems as Hey (2001). These problems are performed twice – before and after the affect induction, so that the total number of problems faced by each subject is 200. The four affective states (joviality, sadness, fear, and anger) are induced using short film clips.[6] Subjects participate either in one of the treatment groups (where the induction of *only* one of the four emotional states takes place) or in a control group (where a neutral affect film clip is shown). We check the efficacy of the affect induction procedures using the Positive and Negative Affect Schedule (PANAS-X; Watson and Clark 1999).

Previous literature shows that women are more risk-averse than men (see the surveys by Eckel and Grossman 2008, and Croson and Gneezy 2009). Moreover, conventional wisdom and previous research from psychology indicate that women are more "emotional" than men (e.g., Croson and Gneezy 2009, pp.451–452, and references therein). Croson and Gneezy (2009) suggest that gender differences in risk attitudes may relate to differences in emotional reactions to risk. To date, however, little is known about the (potentially) different effects of emotions on male and female risk preferences (some noteworthy exceptions are Lerner et al. 2003, Fessler et al. 2004, and Fehr-Duda et al. 2011).[7] Herein, we use our experimental data to determine whether there are gender differences in the impact of joviality, sadness, fear, and anger on risk preferences.

To further deepen the knowledge of the matter, we also explore whether there are differences in the effect of the four considered emotions on risk taking depending on previous participation in laboratory experiments, which we call *experience*. While there is some evidence regarding how experience in one experiment may impact willingness to take risk in later experiments (e.g., Jamison

[5]For advantages and pitfalls of MPLs, see also Charness et al. (2013).

[6]The literature has proposed several alternative procedures to elicit emotions (e.g., images, sounds, self statements, distribution of cookies or candies, relived or imagined scenes, music, and odors). Film clips have turned out to be one of the most powerful methods (Westermann et al. 1996; Lerner and Keltner 2001).

[7]Lerner et al. (2003) study the emotional reaction to the September 11 terrorist attack surveying members of a nationally representative sample of Americans. They find that, compared to females, males express more anger, less fear, and less pessimistic risk estimates, and that differences in reported emotions explain a large part of the gender difference. Fessler et al. (2004) show that anger leads men (but not women) to make riskier choices, whereas disgust leads women (but not men) to make less risky choices. Finally, Fehr-Duda et al. (2011) find that women in a better than usual mood tend to weight probabilities more optimistically (while men do not).

et al. 2008; Chuang and Schechter 2013), to the best of our knowledge, nobody has investigated the impact of emotions on risk preferences distinguishing between experienced and inexperienced subjects. Levin et al. (1988) posit that previous experience in laboratory experiments may help people to focus more on the main part of the experiment (in our case, the lottery choice tasks), and to pay less attention to aspects that are peripherical to the decision task (in our case, emotions). Following this line of reasoning, one should expect the experienced subjects' risk attitudes to be less affected by emotions than the inexperienced subjects'. Our data, and the information stored in our database, enable us to assess whether or not this prediction is correct.

To estimate the role of joviality, sadness, fear, and anger on risk taking, and to determine whether there are differences according to gender and subjects' laboratory experience, we fit two preference functionals: the Expected Utility (EU) and the Rank Dependent Expected Utility (RDEU), assuming several functional forms of the weighting function. We control for (i) heterogeneity *between* individuals by allowing the parameters of the model to vary between subjects, and (ii) heterogeneity *within* individuals (inconsistency of choices over repetitions) by means of a Fechnerian stochastic error term. Fitting different choice models of behavior under risk under different functional forms serves us to identify (statistically) which of the fitted models is able to represent the data best. We adopt this approach because we want to avoid that misspecifications of the functional form bias the results.

When considering the entire sample, our results indicate that all the manipulated emotions instigate risk-seeking behavior. We detect stark differences across gender: male risk preferences are influenced by sadness, while female risk propensity is affected by joviality. Both male and female risk attitudes are increased by fear. We find that past participation in experiments also matters in that joviality impacts on both the inexperienced and experienced participants' risk attitudes, whereas fear affects the inexperienced (but not the experienced) participants' risk attitudes. The influence of sadness and fear on risk attitudes, on the other hand, is found not to depend on the participants' experience.

The paper is organized as follows. Section 2 presents the experimental design and procedures. Section 3 describes the econometric model. Section 4 verifies if the emotion induction has been effective and reports the results about the changes in risk attitudes. Section 5 summarizes the main findings of the study and offers concluding remarks.

2 Experimental design

The experiment was programmed in z-Tree (Fischbacher 2007) and conducted in the experimental laboratory of the Max Planck Institute of Economics in Jena (Germany). The participants, undergraduate students from the Friedrich-Schiller University of Jena, were recruited using the ORSEE software (Greiner 2004).

The experiment was divided into two identical parts, separated by the emotion manipulation. Each part included a questionnaire about feelings, and the main experimental task aimed at measuring the participants' risk attitudes. In what follows, we will first describe the methods we used to elicit risk preferences, to induce emotions, and to measure emotions. We will then report the full sequence of events that characterized the experiment.

2.1 Methods

2.1.1 Elicitation of risk preferences

Risk attitudes were elicited using lotteries (as in Hey 2001). The subjects were presented with 100 pairwise choice problems between two different lotteries. They had to indicate whether they preferred the left-hand side lottery or the right-hand side lottery by pressing the corresponding button.[8] Lotteries were presented as segmented circles on the computer screen.[9]

All the 100 problems involved probabilities that were multiples of one-eighth, and subjects were informed about this (the probabilities we used are listed in Table 7 in Hey 2001). There were four possible outcomes: €0, €8, €16, and €24. Each lottery included at least one and at most three of these four outcomes.

2.1.2 Emotion induction

We induced emotions by following procedures similar to those used in prior studies (e.g. Lerner et al. 2004; Gino and Schweitzer 2008). Participants were randomly assigned to one of five treatments—a joviality treatment, a sadness treatment, a fear treatment, an anger treatment, or a neutral treatment, and were shown one of five different film clips (all tested on Germans by Hewig et al. 2005). Table 1 reports, for each treatment, the film from which the clip was taken

[8]We did not allow the participants to indicate indifference. The reasons for doing so are outlined in Hey (2001, p. 53).

[9]Previous research has shown that colors can affect emotions, mood, and feelings (e.g., Cimbalo et al. 1978; Bellizzi and Hite 1992). Hence, in order not to confound our emotion manipulation, segmented circles were displayed on the grey scale.

Treatment	Film title	Description of the clip
Joviality	When Harry met Sally	Harry and Sally discuss about whether Harry would notice that a woman fakes an orgasm.
Sadness	The Champ	A boxer is lying severely injured on a table when his son enters and sees him dying.
Fear	The Silence of the Lambs	A woman follows a dangerous killer into a basement.
Anger	My Bodyguard	A young man is attacked and beaten up by a group of older pupils.
Control/Neutral	All the President's Men	Two men are talking to each other in a courtroom.

Table 1: Film clips shown to the participants in each treatment.

and also gives a short description of the clip watched by the participants. Each clip lasted less than 4 min.

2.1.3 Emotion measure

To measure participants' emotions, we used the Positive and Negative Affect Schedule (PANAS-X; Watson and Clark 1999).[10] This psychometric scale contains 60 items, which describe different feelings and emotions. The 60 items can be compressed into two general (positive and negative affect), or eleven basic emotion scales.[11] All the 60 different emotion items appeared on the same screen, but their order was randomized across subjects. The participants were asked to rate the extent to which they presently felt each emotion item on a 5-point scale. The response scale ranged from 1 (very slightly or not at all) to 5 (extremely).

As a further check on the strength of the induction, we included a question at the end of the experiment explicitly asking participants whether the film clip made them feel happier, sadder, angrier, more fearful, or whether they did not feel any of these emotions. Our data analysis will focus on those participants for whom the emotion induction did work satisfactorily, that is, who reported having experienced the emotion the film was supposed to arouse.

2.2 Experimental procedures

The full sequence of events, in all sessions and all treatments, unfolded as follows.

Upon entering the laboratory, participants were randomly assigned to visually isolated computer terminals. Then all participants received written instructions informing them that the experiment included two parts. They were immediately given the instructions for Part 1, while

[10] We use the German translation of the PANAS-X questionnaire provided by Röcke and Grühn (2003).

[11] These emotions are fear, hostility, guilt, sadness, joviality, self-assurance, attentiveness, shyness, fatigue, serenity, and surprise.

the instructions for Part 2 were distributed after all participants completed Part 1.[12]

At the beginning of Part 1, we measured participants' baseline affect. Participants were instructed to read the list of 60 adjective descriptors of emotions from the PANAS-X, and to indicate the extent to which the adjectives described their current affective state on a 5-point scale. After completing the PANAS-X questionnaire, participants were asked to express their preferences for each of 100 pairwise lotteries (Hey 2001) as explained above.

Next, the instructions for Part 2 were distributed. The participants were informed that, before starting the second part, they had to watch a film clip. Each participant was asked to put on a headset and to press a "start" button on the computer. By doing so, they would launch one of five film clips, depending on the experimental treatment. Prior to watching the film clips, the participants were urged to (i) clear their mind of all thoughts, feelings, and memories, (ii) become involved in the feelings suggested by the situations in the film clip, and (iii) keep these feelings in mind for the remainder of the experiment. These instructions were provided to make the emotion induction effects more intense (Westermann et al. 1996).

Immediately after viewing the clips, participants were presented the same 100 lottery pairs as in Part 1, and asked to indicate their preferred lottery in each pair. The presentation of the lotteries as well as their left-right positioning was randomized across parts. After completing this task, participants completed once again the PANAS-X questionnaire, which included the same list of 60 emotions as in Part 1 but in a randomized order to avoid monotonous responses. The emotion manipulation check was included in Part 2 after the main experimental task because we wanted to measure risk attitudes immediately after the target emotion had been manipulated.

Finally, participants were administered a post-experimental questionnaire asking them about (i) demographic characteristics (age, gender, and field of study), (ii) participation in previous experiments, (iii) whether or not they had already watched the clip, and (iv) the way the watched clip made they feel.

In order to prompt participants to truthfully report their preferred lottery, we used the random lottery incentive mechanism. The subjects were informed that, at the end of the session, a randomly selected participant would draw a ball from an urn containing two balls, labeled 1 and 2, and that the number on the drawn ball would determine the payoff-relevant part. Then, to pick a problem from the selected part, the same participant had to draw a ticket from an opaque bag containing 100 tickets, numbered 1–100. Each participant was reminded of the choice she made

[12] An English translation of the instructions can be found in the appendix.

in the selected problem, played out the preferred lottery for real (using an eight-sided die), and was paid accordingly.

Overall, we ran twelve sessions. Each session lasted less than 2 hours and the average payment was about €20.00 (inclusive of a show up fee of €7.50), ranging from a minimum of €7.50 to a maximum of €31.50. The average payment was considerably more than a local student assistant's hourly compensation and thus we can assume that it was able to generate salient incentives.

3 The Econometric Model

In round t, let us consider a choice problem involving two lotteries, X_t and Y_t. Each lottery comprises, at most, three out of four outcomes. Let us denote the four outcomes of lottery X_t, $\forall t$, in ascending order, as x_1, x_2, x_3 and x_4, occurring with probability p_{1t}, p_{2t}, p_{3t} and p_{4t}, respectively, with $p_{1t} + p_{2t} + p_{3t} + p_{4t} = 1$. Similarly, let us denote the four outcomes of lottery Y_t, $\forall t$, as y_1, y_2, y_3 and y_4, occurring with probability q_{1t}, q_{2t}, q_{3t} and q_{4t}, respectively, with $q_{1t} + q_{2t} + q_{3t} + q_{4t} = 1$.[13]

In the absence of error, subject i evaluates the two lotteries, X_t and Y_t, as follows:

$$(1) \qquad V_i(x_1, p_{1t}; x_2, p_{2t}; x_3, p_{3t}; x_4, p_{4t}) = P_{i2t}u_i(x_2) + P_{i3t}u_i(x_3) + P_{i4t},$$

$$(2) \qquad V_i(y_1, q_{1t}; y_2, q_{2t}; y_3, q_{3t}; y_4, q_{4t}) = Q_{i2t}u_i(y_2) + Q_{i3t}u_i(y_3) + Q_{i4t}.$$

Here, the function $u_i(z)$ is a utility function, where z is the lottery outcome, and the P_i's and Q_i's are transformations of the true probabilities.

As a utility function, we adopt the Constant Relative Risk Aversion (CRRA) functional form, $u_i(z) = (z/max(Z))^{\alpha_i}$, where $max(Z)$ is the largest outcome faced by subject i, that is €24. The utility function is normalized so that $u(0) = 0$ and $u(max(Z)) = 1$. The parameter $\alpha_i > 0$ is less than 1 for risk-averter agents, equal to 1 for risk-neutral agents, and greater than 1 for risk-loving agents.

[13] Recall that, in our experiment, $x_1 = y_1 =$ €0, $x_2 = y_2 =$ €8, $x_3 = y_3 =$ €16, and $x_4 = y_4 =$ €24.

The P_i's and Q_i's correspond to the true probabilities in the following way:

$$
\begin{aligned}
R_{i2t} &= w_i(r_{2t} + r_{3t} + r_{4t}) - w_i(r_{3t} + r_{4t}) \\
R_{i3t} &= w_i(r_{3t} + r_{4t}) - w_i(r_{4t}) \\
R_{i4t} &= w_i(r_{4t})
\end{aligned}
\tag{3}
$$

where $w_i(r)$ is a probability weighting function of the true probability r.

We test different alternative functional forms for $w_i(r)$, which can be either linear or non-linear. If the weighting function is linear, that is $w_i(r) = r$, then subjects follow the Expected Utility theory (EU). If it is non-linear, then subjects follow the Rank Dependent Expected Utility theory (RDEU).

As alternative specifications of the weighting function $w_i(r)$, we use:

- Kahneman and Tversky: $w_i(r) = \frac{r^{\gamma_i}}{(r^{\gamma_i}+(1-r)^{\gamma_i})^{\frac{1}{\gamma_i}}}$;
- Power: $w_i(r) = r^{\gamma_i}$;
- Prelec: $w_i(r) = exp\left[-(-ln(r))^{\gamma_i}\right]$;

In each specification, the parameter $\gamma_i > 0$ determines the shape of the weighting function. In all cases, when $\gamma_i = 1$, there is no probability distortion, and the model reduces to the Expected Utility model.

The first weighting function goes back to Kahneman and Tversky (1979). When $0 < \gamma_i < 1$, the probability weighting function assumes an inverse-S shape. When $\gamma_i > 1$, it takes on a S-shape.

The second specification consists of a concave function when $0 < \gamma_i < 1$, while it assumes a convex form when $\gamma_i > 1$.

The third functional form was introduced by Prelec (1998). As $\gamma_i \to 0$, $w_i(r)$ becomes a step function, that is flat everywhere except at the edges of the probability interval. Similarly to the Kahneman and Tversky specification, the probability weighting function is inverse-S shaped when $0 < \gamma_i < 1$, and S-shaped when $\gamma_i > 1$.

In detail, the distributional assumptions of the parameters characterizing the EU model are:

$$
\begin{aligned}
\ln(\alpha_i) &\sim N\left(\mu_\alpha, \sigma^2_\alpha\right) \\
\gamma_i &= 1.
\end{aligned}
\tag{4}
$$

The lognormal density function evaluated at α will be denoted as $f(\alpha; \mu_\alpha, \sigma_\alpha)$.

In the RDEU case, the distributional assumptions about the parameters of the model are:

$$\begin{pmatrix} \ln(\alpha_i) \\ \ln(\gamma_i) \end{pmatrix} \sim N \left[\begin{pmatrix} \mu_\alpha \\ \mu_\gamma \end{pmatrix}, \begin{pmatrix} \sigma_\alpha^2 & \rho\sigma_\alpha\sigma_\gamma \\ \rho\sigma_\alpha\sigma_\gamma & \sigma_\gamma^2 \end{pmatrix} \right]. \tag{5}$$

The joint lognormal density function evaluated at (α, γ) will be denoted as $g(\alpha, \gamma; \mu_\alpha, \sigma_\alpha, \mu_\gamma, \sigma_\gamma, \rho)$. The parameter α_i in the EU model and the parameters α_i and γ_i in the RDEU model represent the unobserved heterogeneity, that is the individual specific effects.

Subjects are generally noisy when they choose. To capture this, we assume that they evaluate the difference in the lotteries in each pairwise-choice problem with error ϵ_t, known as "Fechner error", that we assume to be distributed $N(0, \sigma_\epsilon)$, so that the subject chooses X_t (Y_t) if and only if:[14]

$$V_{xt} - V_{yt} + \epsilon_t > (<) 0 \tag{6}$$

where V_{xt} and V_{yt} represent Eqs. (1) and (2), respectively.

Let us use the binary variable $d_t = 1(-1)$ to indicate that the subject chooses X_t (Y_t) in choice problem t. Then, the likelihood contribution of a single subject's choice in problem t, according to the EU theory, is:

$$\begin{aligned} P(d_t|\alpha, \gamma = 1, \sigma_\epsilon) &= \Phi\left[d_t \left(V_{xt} - V_{yt}\right)/\sigma_\epsilon\right] \\ & \quad d_t \in \{1, -1\} \end{aligned} \tag{7}$$

where $\Phi[\cdot]$ is the Standard Normal Cumulative Distribution function. Similarly, the likelihood contribution of a single subject's choice in problem t, according to the RDEU theory, is:

$$\begin{aligned} P(d_t|\alpha, \gamma, \sigma_\epsilon) &= \Phi\left[d_t \left(V_{xt} - V_{yt}\right)/\sigma_\epsilon\right] \\ & \quad d_t \in \{1, -1\}. \end{aligned} \tag{8}$$

Considering the 100 choice problems each subject faces in both parts of the experiment altogether and integrating the unobserved heterogeneity out, we get the individual likelihood contri-

[14] From now on, having made already clear which components of the model will be treated as individual-specific, we suppress the subscript i.

bution under the EU theory:

$$L(\mu_\alpha, \sigma_\alpha, \sigma_\epsilon) = \int_0^\infty \left[\prod_{t=1}^{100} P(d_t | \alpha, \gamma = 1, \sigma_\epsilon) \right] f(\alpha; \mu_\alpha, \sigma_\alpha) d\alpha. \tag{9}$$

The individual likelihood contribution under the RDEU theory is, instead:

$$L(\mu_\alpha, \sigma_\alpha, \mu_\gamma, \sigma_\gamma, \rho, \sigma_\epsilon) = \int_0^\infty \int_0^\infty \left[\prod_{t=1}^{100} P(d_t | \alpha, \gamma, \sigma_\epsilon) \right] g(\alpha, \gamma; \mu_\alpha, \sigma_\alpha, \mu_\gamma, \sigma_\gamma, \rho) d\alpha d\gamma. \tag{10}$$

In order to capture the effect of emotions on the mean of the population, in Part 2, we allow μ_α in the EU case and both μ_α and μ_γ in the RDEU case to depend linearly on treatment dummies.

The sample log-likelihood for all subjects is the sum of the logarithm of L given by (9) and (10) over all subjects. The models are estimated by maximum simulated likelihood. In order to integrate out the parameters α in Eq. (9) and α and γ in Eq. (10), we use sequences of 100 (shuffled) Halton draws.[15]

4 Results

Our sample comprises 171 participants, all of whom declared to have felt the appropriate target emotion.[16] Before presenting the main results of the study (Section 4.3), we check whether the random assignment assumption is valid (Section 4.1), and whether the PANAS-X data confirm that our experimental manipulation successfully induced the desired emotional states (Section 4.2).

4.1 Demographic characteristics

We begin our analysis by verifying that the random assignment of students to treatments was effective. This check is important because it has been shown that risk attitudes depend on some personal characteristics such as gender and age (see, e.g., Dohmen et al. 2011 and references therein).

Table 2 presents the demographics of our sample and the number of participation in previous

[15] For details on both Maximum Simulated Likelihood techniques and Halton sequences, see Train (2003).

[16] We elected to follow a conservative approach (see, e.g., Ugazio et al. 2012) and exclude from the sample participants who did not show the expected affective response to the manipulation. For instance, about 30% of the participants in the anger treatment—who watched the film clip from "My Bodyguard"—declared that the clip made them feel sadder rather than angrier. Such participants are not included in the data analysis.

experiments for each treatment. About three-fifth of the participants are female, ranging from 60% in the joviality treatment to 77% in the sadness treatment. The average age is around 22, which is not surprising given that subjects are recruited from the undergraduate student population. Approximately one-third of our subjects are enrolled in social science courses and only few of them attend either business administration or economics. Finally, the rate of participation in previous experiments is rather homogeneous across treatments. According to a series of Kruskal-Wallis rank-sum tests, there are no significant differences in any of the individual characteristics across treatments (p-values equal to 0.581, 0.579, 0.774, and 0.461 for gender, age, major of study, and number of previous experiments, respectively). The random assignment assumption cannot therefore be rejected.

	Treatment				
	Joviality	Sadness	Fear	Anger	Neutral
Observations	48	31	25	18	49
Female	0.60	0.77	0.64	0.67	0.61
Age	22.00	21.84	22.20	22.22	23.18
Major of study:					
Business Administration	0.10	0.10	0.12	0.05	0.11
Economics	0.00	0.00	0.08	0.05	0.00
Engineering	0.08	0.00	0.00	0.06	0.06
Law	0.02	0.07	0.04	0.05	0.10
Medicine	0.04	0.03	0.04	0.06	0.06
Sciences	0.10	0.16	0.28	0.11	0.19
Social sciences	0.44	0.42	0.20	0.39	0.27
Arts and Humanities	0.13	0.16	0.24	0.06	0.12
Other fields	0.08	0.06	0.00	0.17	0.10
Number of Experiments:					
None	0.06	0.00	0.00	0.05	0.02
Less than 4	0.21	0.19	0.40	0.11	0.16
Between 4 and 8	0.48	0.55	0.44	0.56	0.59
More than 8	0.25	0.26	0.16	0.28	0.23

Table 2: Demographic variables and experimental participation by treatment (relative frequencies for gender, major of study, and number of experiments; means for age).

4.2 Emotions manipulation check

To avoid revealing our interest in specific emotions, we included all 60 affective items listed in the PANAS-X questionnaire, although only 25 are of interest. The joviality factor includes “cheerful”, “delighted”, “happy”, “joyful”, “excited”, “lively”, “enthusiastic”, and “energetic” (Cronbach's

$\alpha \geq 0.90$ in both parts of the experiment). The sadness factor includes "sad", "blue", "alone", "lonely", and "downhearted" ($\alpha \geq 0.77$ in both parts). The fear factor includes "afraid", "shaky", "nervous", "jittery", "scared", and "frightened" ($\alpha \geq 0.78$ in both parts). Finally, the anger factor includes "disgusted", "scornful", "irritable", "angry", "hostile", and "loathing" ($\alpha \geq 0.76$ in both parts). All factors display a good level of internal consistency reliability.[17]

To analyze emotions' data and to exploit the within-subject design, we proceed as follows. First, we create 25 indicator variables, one for each of the 25 aforementioned items. Each indicator variable takes value 1 if the participant rates the corresponding item higher in the second part of the experiment (after the emotion manipulation) than in the first part, 0 otherwise. Once we have coded (as 0 or 1) each individual item, we proceed to the second step. For each subject, we aggregate the indicator variables into four emotional classes, each containing the items specified above. We aggregate by summing the indicator variables that refer to the items in the same emotion. Taking, for example, 'joviality' which is made up of 8 items, each subject's aggregate indicator variable for joviality can range from 0 (if the subject rates no item higher in Part 2) to 8 (if the subject assigns a higher score to all 8 items in Part 2). For each emotion, we can thus construct a vector with length equal to the number of subjects in each treatment, whose components indicate how many items a subject rates higher in Part 2. The vectors so obtained identify the joviality, sadness, fear, and anger factors that we compare across treatments and within each treatment. The across-treatment comparisons enable us to check whether a specific emotion is more present in the corresponding treatment than in the other treatments. The within-treatment comparisons shall reveal whether the right emotion has been induced in a specific treatment.

Factor			Treatment		
	Joviality	Sadness	Fear	Anger	Neutral
Joviality	2.02 (1.76)	1.03 (1.22)	1.08 (1.50)	0.61 (0.61)	1.92 (1.55)
Sadness	0.44 (0.94)	1.94 (1.61)	1.00 (1.04)	1.22 (1.44)	0.57 (0.84)
Fear	1.06 (1.26)	1.48 (1.29)	2.00 (1.47)	1.56 (1.42)	0.63 (0.88)
Anger	0.54 (1.13)	0.74 (1.00)	0.96 (1.10)	2.00 (2.09)	0.29 (0.54)

Table 3: Average number of items that are rated higher after the emotion manipulation by emotional factor and treatment (standard deviations in parentheses).

Summary statistics of the emotional factors are reported in Table 3, separately for each treat-

[17] Further details on the construction of the joviality, sadness, fear, and anger factors can be found in Watson and Clark (1999). In some sessions, due to a bug in the software, an item for each subject was recorded as missing value. To undertake a conservative approach, the missing data were treated as zeros.

ment. On average, participants in the joviality treatment assign a higher score to 2.02 items of the joviality factor in Part 2. Participants in the other treatments increase the rating of less items of the joviality factor; the difference across treatments is statistically significant according to a Kruskal-Wallis (KW) rank-sum test (p-value = 0.0004). Moreover, in the joviality treatment, following the emotion induction, more items are rated higher for the joviality factor than for any other emotional factor (one-sided Wilcoxon signed-rank tests comparing the joviality factor with each one of the other emotional factors, all p-values ≤ 0.001). We take this as an indication that "When Harry met Sally" successfully induced joviality.

Turning to our manipulation of negative emotions, "The Champ" leads participants in the sadness treatment to increase the score of 1.94 items of the sadness factor, on average. This is significantly more than the number of items of the sadness factor that are rated higher in all the other treatments (KW = 29.35, p-value = 0.0001). After watching the film clip, more items of the fear factor (2 on average) are rated higher in the fear treatment than in any other treatment (KW = 23.79, p-value = 0.0001). In Part 2 of the anger treatment we obtain a similar result. In particular, a larger number of items of the anger factor (2 on average) are rated higher in the anger treatment than in any other treatment (KW = 19.37, p-value = 0.001).[18] Within-treatment comparisons show that participants in the sadness, fear, and anger treatments increase the score of more items of the manipulated emotion than of any other emotion. According to a series of Wilcoxon signed-rank tests, in each treatment, there are significantly more increased items for the manipulated emotion than for the other emotions; the difference is significant at the 5% level in almost all comparisons, except for (i) the comparisons between the sadness factor and the fear factor in the sadness treatment, and between the anger factor and the sadness factor in the anger treatment, which are significant at the 10% level, and (ii) the comparison between the anger factor and the fear factor in the anger treatment, which is not significant. Based on these findings and on the restriction of our sample to those who declared to have felt the appropriate emotion, we are confident about the efficacy of our negative emotion induction.

4.3 Risk preferences

Table 4 presents the maximum likelihood estimates of the four preference functionals described in Section 3. The estimated models are displayed in the following order: EU, RDEU with the Kahneman and Tversky (KT) specification of the weighting function, RDEU with the power

[18] All results remain qualitatively the same when one-way ANOVA tests, rather than KW tests, are used.

specification, RDEU with the Prelec specification. For each model, there are two columns of estimated coefficients, labeled "Part 1" and "Part 2". Part 1 (Part 2) indicates that the model has been fitted on the 100 choices faced before (after) stimulating subjects' emotions. Part 1 data are estimated without distinguishing between emotions because emotions are manipulated at the end of the first part. Part 2 data are estimated, instead, allowing the means of the relevant coefficients (α in the EU case, and both α and γ in the RDEU cases) to vary with the treatment. In Part 2, the constant represents the mean estimated from the control treatment (with no emotion elicitation) while the estimated coefficients on the treatment dummies are deviations from the control attributable to the effect of emotions. We distinguish the two parts because we want to verify whether there is a "physiological" change in such means in some particular direction. This change may be due to subjects getting used to the choice task, subjects' inconsistencies, or whatever other reason that cannot be directly attributable to the emotion manipulation.

Let us first consider the goodness of the fits. According to the likelihood-ratio test, each of the estimated RDEU models fits better than the EU model, both for Part 1 and Part 2 data. We can thus focus only on the alternative specifications of the RDEU model. Since all the considered specifications have the same number of parameters, any criterion of the AIK or BIC type would apply the same penalization factor to all of them. What matters, when all is said and done, is the log-likelihood of the fits. According to such a measure, the RDEU specification that fits the data best is the RDEU/Power for both Part 1 and Part 2. Consequently, we will concentrate the following discussion on this specification. As already argued, testing alternative theories and specifications on these data is crucial in that both different theories and different specifications of the model can lead to very different results.

Concerning the specification that fits our data best, we have to observe that the Power is the only RDEU specification of the three which does not entail a S-shaped or inverse S-shaped weighting function. It, instead, applies a monotonically increasing or decreasing weight on probabilities. Hence, when $\gamma < 1$, people tend to overvalue (undervalue) the probability of the largest (smaller) outcome(s), whereas, when $\gamma > 1$, people tend to underweight (overweight) the largest (smaller) outcome(s).

The RDEU/Power estimates show that the mean of the risk attitude parameter does not change significantly between Part 1 and Part 2 of the experiment (2-sided z-test, p-value=0.226), as it can be deduced by comparing the estimate of μ_α in Part 1 and the constant component (which refers to the control group) of μ_α in Part 2. Conversely, a comparison between μ_γ in Part 1 and the constant of μ_γ in Part 2 indicates that the mean of the weighting function parameter changes between the two parts (p-value=0.000).[19] The parameters' variability is quite substantial for both parameters: although σ_γ significantly reduces in Part 2 compared to Part 1, it still accounts for a large amount of heterogeneity across subjects. The correlation coefficient ρ is estimated to be positive, statistically significant, and quite large (it is around 0.30 in both Part 1 and Part 2). The implication of this finding is rather interesting. This is telling us that those who have a small α tend to have also a small γ and viceversa. In other words, the more risk-averse people are, the more they tend to overweight large outcomes.

Coming to the main purpose of the paper – that is if and how emotions change risk preferences – we can see that all the emotions increase the mean of the risk attitude parameter compared to the control group (which is captured by the constant of μ_α in the third to last column of Table 4). These findings imply that joyful, sad, fearful, and angry subjects tend to be less risk-averse (or more risk-seeking) than subjects in a neutral affective state. Furthermore, our results show that joviality and fear have some influence on the mean of the weighting function coefficient, μ_γ.

It is worth noting that, had we used other RDEU models, we would have reported different estimates and different statistically significant effects of some emotions on the mean of the risk attitude parameter, meaning that the significance of our results depends on the model we chose. For instance, the treatment dummies in the RDEU/KT specification present signs different from the RDEU/Power specification. Specifically, in that model, both joviality and anger decrease the participants' risk aversion compared to the control, while fear increases risk aversion. This highlights the importance of selecting the model that best represents the data and might provide an explanation for the opposite effects we can find in the literature.

There is evidence that gender plays an important role in decision making under risk. In particular, women are found to be more risk-averse than men (see the review on gender differences by Croson and Gneezy 2009). To verify whether the effects spotted from the entire sample hold for both males and females or whether emotions affect risk attitudes differently for men and women, we divide the sample by gender. Results are reported in the first four columns of Table 5: the first two columns are devoted to males, and the third and fourth columns to females. The labels Part 1 and Part 2 have the usual meaning. It turns out that the analysis is meaningful: gender differences show up. Specifically, while sadness strongly increases male risk aversion, joviality has a significant impact on female risk attitudes only. Fear increases both male and female risk attitudes. Anger,

[19] Note that, when we talk about the means of α and γ, we always refer to the mean of the underlying bivariate Normal distribution. For further details, see Section 3. In effect, μ_α and μ_γ are the logarithm of the medians of the joint distribution of α and γ, which is assumed to be bivariate lognormal.

		EU		RDEU/KT		RDEU/Power		RDEU/Prelec	
		Part 1	Part 2	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2
μ_α	Joviality		0.300 ***		0.293 ***		0.197 **		0.252 *
			(0.103)		(0.063)		(0.099)		(0.135)
	Sadness		-0.200		-0.057		0.240 **		-0.135
			(0.122)		(0.065)		(0.120)		(0.114)
	Fear		0.093		-0.156 **		0.626 ***		0.185
			(0.160)		(0.072)		(0.115)		(0.203)
	Anger		0.085		0.300 ***		0.592 ***		-0.061
			(0.116)		(0.077)		(0.125)		(0.118)
	Constant	-1.128 ***	-1.234 ***	-0.951 ***	-1.087 ***	-1.327 ***	-1.426 ***	-1.145 ***	-1.134 ***
		(0.065)	(0.096)	(0.052)	(0.062)	(0.058)	(0.081)	(0.060)	(0.119)
σ_α		0.800 ***	0.873 ***	0.699 ***	0.788 ***	0.806 ***	0.864 ***	0.783 ***	0.838 ***
		(0.044)	(0.046)	(0.036)	(0.034)	(0.041)	(0.047)	(0.050)	(0.051)
μ_γ	Joviality				-0.164 ***		0.232 **		-0.016
					(0.054)		(0.115)		(0.022)
	Sadness				0.121 *		0.180		0.002
					(0.062)		(0.126)		(0.030)
	Fear				-0.161 **		0.277 **		-0.009
					(0.079)		(0.129)		(0.030)
	Anger				0.280 ***		0.161		0.012
					(0.073)		(0.134)		(0.032)
	Constant			0.156 ***	0.383	-0.735 ***	-0.201 **	-0.071 ***	0.004
				(0.043)	(0.044)	(0.044)	(0.100)	(0.010)	(0.017)
σ_γ				0.439 ***	0.559 ***	0.896 ***	0.661 ***	0.130 ***	0.128 ***
				(0.033)	(0.023)	(0.036)	(0.027)	(0.009)	(0.009)
ρ				-0.207 ***	-0.442 ***	0.306 ***	0.306 ***	0.055	0.239
				(0.078)	(0.042)	(0.056)	(0.064)	(0.077)	(0.074)
σ_ϵ		0.089 ***	0.071 ***	0.084 ***	0.071 ***	0.055 ***	0.057 ***	0.084 ***	0.066 ***
		(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Number of observations		17100	17100	17100	17100	17100	17100	17100	17100
Number of subjects		171	171	171	171	171	171	171	171
Log- likelihood		-6174.32	-5443.94	-5991.93	-5256.77	-5780.55	-5171.97	-5966.56	-5243.26

Table 4: Maximum likelihood estimates of the structural models' parameters (the log-likelihoods are maximized using sequences of 100 shuffled Halton draws) in Section 3. Standard errors are reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

		Males		Females		Inexperienced		Experienced	
		Part 1	Part 2	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2
μ_α	Joviality		0.193		0.482 ***		0.315 *		0.201 *
			(0.123)		(0.168)		(0.167)		(0.121)
	Sadness		-0.372 **		0.059		0.213		-0.098
			(0.158)		(0.158)		(0.180)		(0.142)
	Fear		0.521 ***		0.613 ***		0.446 ***		0.094
			(0.196)		(0.198)		(0.161)		(0.164)
	Anger		0.240		0.174		0.209		0.254
			(0.256)		(0.163)		(0.172)		(0.204)
	Constant	-1.206 ***	-1.164 ***	-1.590 ***	-1.647 ***	-1.363 ***	-1.471 ***	-1.403 ***	-1.139 ***
		(0.084)	(0.099)	(0.087)	(0.113)	(0.092)	(0.137)	(0.069)	(0.090)
σ_α		0.824 ***	0.615 ***	0.836 ***	0.897 ***	0.913 ***	0.841 ***	0.813 ***	0.540 ***
		(0.066)	(0.055)	(0.076)	(0.051)	(0.083)	(0.054)	(0.054)	(0.046)
μ_γ	Joviality		-0.068		-0.061		0.002		0.045
			(0.117)		(0.173)		(0.137)		(0.153)
	Sadness		-0.222		0.059		0.278 *		-0.146
			(0.137)		(0.148)		(0.156)		(0.165)
	Fear		0.325 **		0.387 **		0.034		0.010
			(0.158)		(0.196)		(0.141)		(0.182)
	Anger		0.221		-0.033		-0.157		0.791 ***
			(0.135)		(0.158)		(0.151)		(0.204)
	Constant	-0.356 ***	-0.114	-0.681 ***	-0.105	-0.658 ***	-0.032	-0.439 ***	-0.069
		(0.071)	(0.084)	(0.065)	(0.134)	(0.057)	(0.117)	(0.065)	(0.126)
σ_γ		0.838 ***	0.642 ***	0.777 ***	1.045 ***	0.782 ***	0.936 ***	0.830 ***	0.650 ***
		(0.050)	(0.036)	(0.036)	(0.050)	(0.046)	(0.041)	(0.036)	(0.035)
ρ		0.651 ***	0.481 ***	0.285 ***	0.531 ***	0.400 ***	0.643 ***	0.419 ***	-0.045 ***
		(0.040)	(0.058)	(0.093)	(0.037)	(0.073)	(0.038)	(0.052)	(0.083)
σ_ϵ		0.056 ***	0.055 ***	0.056 ***	0.052 ***	0.060 ***	0.053 ***	0.053 ***	0.055 ***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Number of observations		6000	6000	11100	11100	8700	8700	8400	8400
Number of subjects		60	60	111	111	87	87	84	84
Log-likelihood		-2069.01	-1849.79	-3701.87	-3304.82	-3041.41	-2719.88	-3731.20	-2426.95

Table 5: Maximum likelihood estimates of the RDEU models' parameters with a Power weighting function (the log-likelihoods are maximized using two sequences of 100 shuffled Halton draws). Standard errors are reported in parentheses. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

on the other hand, does not affect significantly either male or female risk attitudes. Moreover, in line with previous studies, females are estimated to be significantly more risk-averse than males in both parts of the experiment (p-value = 0.000 in both cases). Concerning the weighting function parameter, we notice that both males and females exhibit a "physiological" increase in μ_γ from Part 1 to Part 2 of the experiment (2-sided z-test, p-value = 0.004 for male and 0.000 for female). Fearful males and females experience an even bigger increase in the mean of the weighting function parameter. The heterogeneity in the parameters of the model is still substantial, notwithstanding having divided the sample into two groups according to gender.

Table 5 also reports the estimates obtained by dividing the sample according to subjects' previous participation in laboratory experiments. We refer to subjects who participated in at most 6 experiments as *inexperienced*, and to subjects who took part in more than 6 experiments as *experienced*.[20] Somewhat in line with our expectation that emotions would affect less the experienced's risk preferences, we find that while joviality positively influences the risk attitudes of both inexperienced and experienced subjects, fear leads only the inexperienced to be less risk-averse. As to μ_γ, whereas the inexperienced's weighting parameter is affected positively by sadness, the experienced's weighting parameter is influenced by anger.

For all the considered subsamples, the correlation coefficient ρ is estimated to be positive and significant. In all the models reported in Tables 4 and 5, the standard deviation of the Fechner error term, σ_ϵ, is rather small (≤ 0.057). These error values are consistent with those observed in previous empirical studies.

5 Conclusions

Our study contributes to the literature on the role of emotions in decision making under risk. By means of an experiment providing participants with substantial financial incentives and meeting state-of-the-art methodological criteria, we find that a positive emotion (namely joviality) as well as three negative emotions (namely sadness, fear, and anger) instigate risk-seeking behavior. We obtained this result by estimating an econometric model that controls for heterogeneity both within subjects and between subjects. We select the model that fits the pooled data best from a set of four different specifications of the functional form.

The finding that joyful participants are more risk-seeking than participants in a neutral affective

[20]The threshold was set to 6 in order to obtain groups of similar sizes, i.e., 6 is the median participation in previous experiments.

state provides partial support for the affect infusion model (Forgas 1995), asserting that individuals who are in a positive emotional state rely on positive cues when making judgments, and thus tend to perceive a risky task as favorable. The affect infusion model is not fully supported by our data because it predicts that individuals who are in a negative emotional state should behave in the opposite way and thus be more likely to make conservative risky decisions.

We observe, instead, that sad, fearful, and anger participants are more prone to take risk compared to participants in a neutral affective state, therefore acting in line with the mood maintenance hypothesis (Isen and Patrick 1983). The general claim of this hypothesis is that the effect of mood on risk preferences can be explained through a desire to maintain a positive affective state or to mitigate a negative one. Along this line of reasoning, people experiencing negative emotions should be willing to take risk because they hope to improve their state.

We focused on specific negative emotions, rather than on global negative and positive affect, because previous studies (like, e.g., Raghunathan and Pham 1999, Lerner and Keltner 2001, Kugler et al. 2012) indicate that affective states of the same valence can induce opposing risk attitudes. Remarkably, our results suggest otherwise: different negative emotions have the same effect on risk taking behavior. This finding is however consistent with the mood repair hypothesis, according to which people in negative affective states are willing to make risky choices to obtain an outcome that would make them feel happy.

Our data therefore show that positive and negative emotions involve separate cognitive processes, so that different models are needed to explain their effect on risk preferences. Joyful participants, who are in a positive emotional state, seem to be likely to appraise the risk positively. Sad, fearful, and anger participants, who are in a negative emotional state, rather than behaving in an opposite way and evaluating the risk negatively, appear to be willing to change this undesired state. After all, maintaining negative affective states is probably not a goal for most people. Understanding the reasons for the different cognitive mechanisms induced by negative and positive emotions would enrich the picture painted here, but is beyond the scope of the current study.

We confirm the result (see, e.g., Croson and Gneezy 2009) that female are more risk-averse than males; in our sample, this holds true both before and after the emotion manipulation. Moreover, in line with Fehr-Duda et al. (2011), we show the existence of gender differences in the role of emotions in risk taking behavior. We find that the male willingness to take risk is positively influenced by sadness, while only joviality affects the female risk attitudes. Finally, our analysis of whether emotions impact risk preferences differently depending on subjects' previous laboratory experience indicates that the only difference between experienced and inexperienced participants is in that the latter (but not the former) are affected by fear.

Our results are only partially consistent with previous research on emotions. This inconsistency may be due to the method we employed to identify and estimate risk attitudes. Future research will have to assess the robustness of our findings using the same econometric technique, but different sample pools and/or different emotions.

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Appendix. Experimental Instructions

In this appendix we report the instructions (originally in German) that we used for our experiment. The instructions were the same in all treatments.

INSTRUCTIONS

Welcome! You are about to participate in an experiment funded by the Max Planck Institute of Economics. Please remain silent and switch off your mobile. If you have any questions during the experiment please raise your hand.

You will receive €7.50 for participating in this experiment. Beyond this you can earn more money, depending partly on the decisions that you take during the experiment and partly on chance. There are no right or wrong ways to complete the experiment, but what you do will have implications for what you are paid at the end of the experiment. So it is in your interest to

read these instructions carefully before you turn to the computer.

The experiment consists of two parts. The instructions for the first part follow on the next page. The instructions for the second part will be distributed after all participants have completed the first part.

At the end of the experiment, we will randomly invite one participant to draw one ball from a bag containing two balls labeled 1 and 2.

- If the ball labeled 1 is drawn, all of you will be paid your earnings in part 1.
- If the ball labeled 2 is drawn, all of you will be paid your earnings in part 2.

Thus, you will be paid your earnings in part 1 OR your earnings in part 2, and both parts will have an equal chance of being selected for payment.

The €7.50 participation fee and any additional amounts of money you may earn will be paid to you in cash at the end of the experiment. Payments are carried out privately, i.e., without the other participants knowing the extent of your earnings.

In the course of the experiment you will be asked to fill in some questionnaires that have no effect on your earnings.

Instructions for Part 1

The first part of the experiment consists of 100 choice tasks. During all tasks, there will be no interaction between the participants, meaning that your decisions have no influence on the decisions and earnings of other participants and viceversa. In the following we provide a detailed description of the choice tasks.

The choice tasks

In each one of the 100 tasks you will have to choose between lotteries with varying chances of winning different amounts. You will be presented with two lotteries at a time and must choose one of them. For each pair of lotteries, you should choose the lottery you prefer to play.

In the experiment lotteries will be presented as circles divided into segments representing possible outcomes from the lottery. The number written next to each segment is the monetary value of each outcome in euros. Over all 100 tasks the possible outcomes are €0, €8, €16, and €24. The size of each segment indicates the chance of each outcome occurring. Such chances are also reported below each lottery and are all multiples of one-eighth. An example of how a pair of lotteries will be displayed on your screen is shown in the following figure:

Figure 1: An example of a task

In this figure, there are two lotteries – that on the left and that on the right. The LEFT lottery provides a 3/8 chance of winning 8 Euros and a 5/8 chance of winning 16 Euros. This means that the size of the €8 segment corresponds to 3/8 of the total circle, and the size of the €16 segment corresponds to 5/8 of the total circle. The RIGHT lottery provides a 4/8 (or 1/2) chance of winning 8 Euros, a 1/8 chance of winning 16 Euros, and a 3/8 chance of winning 24 Euros. As with the LEFT lottery, the circle segments represent the chances of occurrence of each possible outcome; for example, the size of the €16 segment is 1/8 of the total circle.

The outcome of the lotteries will be determined by the roll of an unbiased eight-sided die.

In the above figure for example:

- the LEFT lottery leads to a gain of 8 Euros if the die lands on number 1, 2 or 3, and to a gain of 16 Euros if the die comes up with a number between 4 and 8. Thus, there are THREE CHANCES OUT OF EIGHT that your prize will be 8 Euros, and FIVE CHANCES OUT OF EIGHT that your prize will be 16 Euros.

- the RIGHT lottery leads to a gain of 8 Euros if the die shows a number between 1 and 4, to a gain of 16 Euros if the die shows number 5, and to a gain of 24 Euros if the die comes up with number 6, 7 or 8. Thus, there are FOUR CHANCES OUT OF EIGHT that your prize will be 8 Euros, ONE CHANCE OUT OF EIGHT that your prize will be 16 Euros, and THREE CHANCES OUT OF EIGHT that your prize will be 24 Euros.

Please note that we assign the faces of the dice to prizes in an ascending order. For instance, in the above figure, in the LEFT lottery the first three faces (1 to 3) are assigned to the smaller prize (8 Euros) and the last five (4 to 8) to the larger prize (16 Euros). Similarly, in the RIGHT lottery faces 1 to 4 are assigned to the smallest prize (8 Euros), face 5 is assigned to the medium prize (16 Euros) and faces 6 to 8 are assigned to the largest prize (24 Euros).

You have to decide for each choice task whether you prefer the lottery on the left or that on the right. You should indicate your choice by clicking on the box below the appropriate lottery.

Your earnings

As we have already noted, you are guaranteed a €7.50 participation fee. You may also win an additional amount of money which depends on your choices. How this works is as follows. At the end of the experiment, if part 1 is randomly selected for payment, we will ask a participant to select one of the 100 tasks at random, by drawing a ticket from an opaque bag containing 100 tickets numbered from 1 to 100. The computer will recall that task and your choice for that task.

An experimenter will then come to your place and your choice will be played out for real. You will roll an eight-sided die to determine the outcome of the lottery you chose. For instance, suppose you chose the LEFT lottery in the above example. Then, if the die shows 2, you win 8 Euros; if it shows 7, you get 16 Euros. If you chose the RIGHT lottery and the outcome of the die roll is 2, you get 8 Euros; if the outcome of the die roll is 7, you get 24 Euros.

Therefore, if part 1 is selected for payment, your earnings are determined by

- which task is randomly selected;
- which lottery you chose in the randomly selected task, the left or the right, and
- the outcome of that lottery when you roll the eight-sided die.

As you do not know in advance which task will be selected, you should think carefully about which lottery you prefer in each and every task.

Instructions for Part 1 are over. If you have any doubts or queries please raise your hand. Before starting the experiment, we will ask you to answer a questionnaire about feelings. Your answers to these questions will not affect your payoffs. When you have finished reading the instructions for the present part, click "OK" (on your computer screen).

Instructions for Part 2

In the second part of the experiment you will face a situation similar to that encountered in the first part. As before:

- you will face 100 choice tasks;
- your decisions in all tasks have no effect on the decisions and earnings of other participants and viceversa;
- each task requires you to choose between lotteries with varying prizes and chances of winning;
- the possible monetary prize amounts are €0, €8, €16, and €24, and the chances of occurrence of each prize are multiples of one-eighth;
- the two lotteries will be called the LEFT lottery and the RIGHT lottery;
- you should always choose the lottery you prefer to play.

If part 2 is selected for payment, your earnings will be determined like in the previous part.

- A randomly selected participant will choose one of the tasks you face in part 2 by drawing a ticket from an opaque bag containing 100 tickets numbered from 1 to 100.
- You will then play out your preferred choice on that task in the manner described above (i.e., rolling an eight-sided die).

Before starting the second part of the experiment, you will be shown a film clip. Before the film clip starts, the computer screen will be black for 30 seconds. In this period of time, you should clear your mind of all your thoughts, feelings, and memories. Please get involved in the feelings suggested by the situation in the film clip and keep them in mind for the remainder of the experiment.

If you have finished reading the instructions for the present part and have no questions, please wear the headphones and click "OK".