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# The Role of Emotions on Risk Preferences: An Experimental Analysis <sup>\*</sup>

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## Abstract

In the last decades, there has been 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 behaviour 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 behaviour. Furthermore, we show that there are some differences across gender and across participants' experience in lab experiments.

*Keywords:* Risk aversion, Emotions, Structural models

*JEL Classification:* D81, C91, D00

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# 1 Introduction

Traditionally, researchers tend to emphasize the role of rationality and to overlook the role of emotions (such as anger, sadness, anxiety, fear, frustration, happiness, etc.) in the decision making process.<sup>1</sup> Only in the last decades, there has been a large volume of recent 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 behaviour, their intertemporal choices (such as saving attitudes), and enter into their decision-making under risk and uncertainty. The latter is object of investigation in the present work.

Psychologists have a long tradition of studying emotions. [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 concentrate our attention solely on immediate emotions. Indeed, it is not unusual to observe that a person, when faced with the same decision problem at different moments in time, may end up by making opposite choices. One of the possible explanations for this empirical finding is connected with the emotional status of the decision maker, which may have influenced his/her decision.

Empirical research in psychology and, more recently, in economics have demonstrated that affect can somewhat influence individual risk preferences, but these studies are still inconclusive. 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 suggests that positive affect induces risk-averse behaviour, while negative affect leads to risk-seeking behaviour. On the other hand, there is the Affect Infusion Model (AIM), proposed by [Forgas \(1995\)](#), which supposes the exact opposite effects. Some authors (e.g., [Kliger and Levy, 2003](#); [Zhao, 2006](#)) find empirical support to 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 unhappy managers are significantly less risk seeking, while happy managers are not more likely to seek risk.

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<sup>1</sup>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". In this work, the terms "emotion", "affective state" and "emotional states" are used interchangeably.

[Drichoutis and Nayga \(2013\)](#) find that both positive and negative mood increase risk aversion. Finally, [Treffers et al. \(2012\)](#) do not find any effect of emotions on risk preferences.

We contribute to the existing literature along several directions. First of all, most of the studies cited above follow a valence-based approach, that is they merely contrast the effect of positive moods altogether with that of negative moods altogether. Grouping moods can generate perverse effects in that, as some authors point out, affective states of the same valence (e.g., sadness, fear and anger) might arouse conflicting effects on risk preferences, which may even cancel out one another (see [Raghunathan and Pham, 1999](#)). In this regard, [Lerner and Keltner \(2001\)](#) find that fearful people, when asked to assess the risk level of a certain situation, express pessimistic risk estimates and are less prone to take risk. The exact opposite behaviour has been observed in angry people. These authors conclude that angry subjects' risk assessment more closely resemble that of happy individuals than that of fearful people. Similarly, the study by [Kugler et al. \(2012\)](#) reveals that, in comparison with angry participants, fearful participants are more risk-averse in lottery-risk tasks. For these reasons, we consider discrete emotions instead of distinguishing only between positive mood and negative mood. In particular, our purpose is that of gauging the impact of four specific emotional states - joviality, sadness, fear, and anger - on risk attitudes.

We also depart from the aforementioned literature in what concerns the incentive scheme. Most psychological studies in this area provide small financial incentive (if any) to experimental subjects. All these studies find significant effects of affect on risk. However, it might be the case that introducing *tempting* financial incentives makes people ponder their decisions more carefully, so leaving no space to emotions. Therefore, we want to verify if those results hold over, once salient monetary incentives are introduced in the experimental framework.

Furthermore, we implement a different experimental design. All previous experiments apply a between-subject design, but, as [Friedman and Sunder \(1994\)](#) point out, preferences toward risk are the most important characteristic that economic theory recognizes to vary across individuals. To prevent the confounding effect of subjects' heterogeneity in preference to disturb the effect of emotions on willingness to take risk, in each experimental session we opt for a within-subject design. This enables us to measure, and compare, individuals' risk preferences both before and after their affective states are manipulated.

We distinguish from earlier studies also about the way risk attitude is measured. Previous economic studies measure individual risk preferences mainly looking at people's choices when faced with multiple price lists (MPL). The main advantage of the MPL is that it is simple and

transparent to subjects, but it has several disadvantages. For instance, [Andersen et al. \(2006\)](#) remark that a MPL: (i) only elicits interval responses and not point ones; (ii) admits of multiple switching points, thus leading to potentially inconsistent behaviors; (iii) may be susceptible to framing effects. Recently, [Bosch-Domènech and Silvestre \(2012\)](#) also find that the MPL suffers from *embedding bias*, i.e., the removal of some pairs at the beginning and/or at the end of the list yields to a decrease in risk aversion. These problems are overcome by presenting subjects with a single binary choice task at a time, as in [Hey \(2001\)](#). Therefore, we decided to measure risk preferences implementing exactly the 100 pairwise choice tasks proposed therein. This approach enables us to collect several observations from each experimental subject and, consequently, to estimate precisely the individual risk attitude and how it varies with the emotional state.

Hey's 100 choice tasks are performed both before and after participants' emotions have been manipulated. The four affective states (joviality, sadness, fear, and anger) are induced using short film clips.<sup>2</sup> Subjects participate in either one of the treatment groups (where the manipulation 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 if the affect manipulation procedures have been effective using the Positive and Negative Affect Schedule (PANAS-X; [Watson and Clark, 1999](#)).<sup>3</sup>

The aim of the paper is to check whether an economic experiment, which departs from previous studies in all the elements listed above, is able to find empirical support for one of the two theories proposed by psychologists (i.e., the MMH and the AIM). Going beyond this mere distinction, we try to disentangle whether there are gender differences in the role of emotions on risk taking. Previous literature suggests that males and females might have different attitudes toward risk (e.g., see [Hudgens and Torsani Fatkin, 1985](#); [Powell and Ansic, 1997](#)) and conventional wisdom suggests that women are more "emotional" than men. However, with the exception of [Fessler et al. \(2004\)](#), little is known about the (potentially) different effects of emotions on males' and females' risk preferences. This paper is an attempt to fill in this gap.

In addition, to further deepen the knowledge in this research area, we want to verify if there are differences according to individuals' laboratory experience. As far as we know, nobody has investigated the impact of emotions on risk preferences distinguishing between experienced and inexperienced people, but we believe it might be interesting. [Levin et al. \(1988\)](#) posit that previous experience in laboratory experiments might help people to concentrate more on the main part

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<sup>2</sup>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), but film clips have turned out to be one of the most powerful methods ([Westermann et al., 1996](#)).

<sup>3</sup>In particular, we use the German translation of the PANAS-X, due to [Röcke and Grünh \(2003\)](#).

of the experiment (that is, in our case, the lottery choice tasks) and to pay less attention to aspects that are peripheral to the decision task (such as, in our case, emotions). Following this reasoning, one should expect experienced subjects' risk attitude to be less affected by emotions than inexperienced subjects'. The purpose of our detailed analysis is to check if this prediction is correct or if, on the contrary, both experienced's and inexperienced's risk preferences are affected by emotions.

To sum up, as it might already be clear, the current work wants to answer the following research questions: (1) do emotions affect an individual's risk attitude when substantial financial incentives are at stake and, if so, in which ways?; (2) are there differences according to gender?; and (3) are there differences according to subjects' laboratory experience?

In order to answer these questions, 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 "heterogeneity between individuals" by allowing the parameters of the model to vary between subjects and for "heterogeneity within individuals" (inconsistency of choices over repetitions) by means of a Fechnerian stochastic term. Fitting different choice models of behaviour under risk under different functional form 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 may bias the results concerning our main hypothesis under investigation, that is the effect of emotions on attitude to risk.

When considering the entire sample, our results indicate that all the manipulated emotions instigate risk-seeking behaviour. In particular, we show that there are stark differences across gender: males' risk preferences are influenced by all emotional states, while females' propensity toward risk is merely affected by joviality. Finally, we empirically demonstrate that joviality impact on experienced participants' risk attitude, while fear affects inexperienced participants'. Sadness and fear, instead, influence the risk attitude of both groups.

The paper is organised as follows. The next Section describes the experimental design; Sections 3 verify if the emotions' manipulation has been effective; Sections 4 and 5 describes the econometric model and presents the results, respectively; finally, Section 6 summarizes the main findings of the study and offers concluding remarks.

## 2 Experimental design

The computerized experiment was conducted in the experimental lab of the Max Planck Institute in Jena (Germany). The experiment was programmed using the z-Tree software ([Fischbacher, 2007](#)). Participants were undergraduate students from different disciplines at the University of Jena and were recruited by the ORSEE system ([Greiner, 2004](#)).

The experiment was divided into two identical parts, separated by the affect manipulation (i.e., the film clip participants had to watch). Each part was made by a questionnaire about feelings (i.e., the PANAS-X) and the main experimental task, which was aimed at measuring participants' risk attitude. The first part started out with the PANAS-X questionnaire and continued with the risk preferences measurement, while, in the second part, the order of the two tasks was reversed as we wanted to measure risk attitudes immediately after the target emotion had been induced. Subjects completed the experiment individually at separated computer terminals. After being seated, they received written instructions for the first part.<sup>4</sup>

Risk attitudes were measured using lotteries. In each experimental part, subjects were presented with 100 pairwise risky-choice questions (portrayed on the computer screen in the form of segmented circles) and were asked to indicate which lottery they preferred ([Hey, 2001](#)).<sup>5</sup>

All the questions involved probabilities that were multiples of one-eighth, and subjects were informed about this (though we were careful to avoid the use of the word “probability” in the instructions). Over all the 100 questions the possible outcomes were €0, €8, €16 and €24. A pairwise lottery question involved a choice between two gambles which between them involved at most three outcomes. The 100 questions in each of the two parts were the same, but the order was randomized, and the left/right positioning of the circles was also randomized.

Overall, ten experimental sessions were run and 236 participants took part in our experiment. Each session implemented either one of the four affect treatments (joviality, sadness, fear, and anger) or a control treatment (i.e., no affect induction). Emotions were manipulated using short film clips, which have been tested on Germans by [Hewig et al. \(2005\)](#). In particular, joviality, sadness, fear, and anger were induced using film clips from “When Harry met Sally”, “The Champ”, “The Silence of the Lambs”, and “My Bodyguard”, respectively. The neutral-affect film clip was taken from “All the president’s men”. The success of the emotion manipulation was measured

<sup>4</sup>Instructions for the second part were distributed at the end of the first part, i.e., immediately before the film clip started. An English translation of the instructions is reported in Appendix A.

<sup>5</sup>Since previous research has demonstrated that colors can affect individuals' emotions, mood and feelings and we did not want them to confound our emotion manipulations, segmented circles were displayed on the grey scale. On this regard, useful references are [Cimbalo et al. \(1978\)](#) and [Bellizzi and Hite \(1992\)](#).

using the PANAS-X, which was administered both before and after the treatment. Moreover, at the end of the experiment subjects responded to a questionnaire in which we asked about some demographic characteristics and participation to previous experiments.

In order to prompt participants to truthfully report their preferred lottery, an incentive mechanism was used. Subjects were informed that, after having completed the second part, one of the 200 lotteries (100 on each of the two parts) would be chosen at random and paid accordingly. The incentive mechanism worked as follows. At the end of the experiment a randomly selected participant was asked to draw a ball from an urn containing two balls labelled 1 or 2. If ball 1 was selected, all participants were paid their earnings in part 1, while if ball 2 was selected for payment all participants received their earnings in part 2. Then, in order to pick one of the 100 tasks in the selected part, the same participant was required to draw a ticket from an opaque bag containing 100 tickets numbered from 1 to 100. At this point the computer screen recalled to each individual the choice (s)he made in the selected task and each participant played out the preferred lottery for real using an eight-sided die. Each experimental 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. It was considerably more than a local student assistant's hourly compensation and thus generated salient incentives.

### 3 Emotions manipulation

According to the participants' answers to the PANAS-X questionnaire, we are able to check whether the emotions' manipulation has been effective.<sup>6</sup> This psychometric scale includes 60 items and subjects scored the extent to which they experienced each item on a 5-point scale (1=very slightly or not at all, 5=extremely). All terms appeared in the same screen, but their order was randomized across the two parts of the experiment and across subjects.<sup>7</sup>

Participants who watched the joyful film clip (i.e., "When Harry met Sally") reported that the average joviality before the induction was 22.2, while it was 22.36 after the manipulation. Thus, joviality moved in the right direction, but, unfortunately, implementing a paired t-test, we see

<sup>6</sup>Details on the construction of the joviality, sadness, fear, and anger scores can be found in [Watson and Clark \(1999\)](#).

<sup>7</sup>Due to a bug in the experiment's program, an item for each subject was recorded as missing value. The analysis in this Section has been carried out following two approaches, which led to the same results. In the first, and more conservative, approach the missing data were treated as zeros. On the contrary, in the second method, each score was constructed by averaging the responses of the items in the score that were not missing and multiplying this value by the total number of items in the score (see [Hartz et al., 2003](#)). This Section reports the results obtained from the former approach.



that the increase is not statistically significant ( $t[df = 44] = -0.2406$ ,  $p\text{-value} = 0.4055$ ). On the contrary, “The Champ” successfully induced sadness. Indeed, the difference between participants’ sadness before (7.64) and after (9.14) the film clip is statistically significant ( $t[df = 43] = -2.8863$ ,  $p\text{-value} = 0.0030$ ). Similarly, the film clip extracted from “The Silence of the Lambs” significantly increased fear ( $t[df = 42] = -2.3303$ ,  $p\text{-value} = 0.0123$ ), which passed from 8.44 to 9.56. Finally, participants who watched “My Bodyguard” reported a significantly higher score in hostility ( $t[df = 43] = -2.9968$ ,  $p\text{-value} = 0.0023$ ), which increased from 7.48 to 9.14.<sup>8</sup>

The neutrality of the movie clip “All the President’s Men” could not be checked referring to a specific scale in the PANAS-X questionnaire and therefore we constructed a variable defined by the difference between the positive (joviality) and the negative (sadness, fear, and anger) emotions we are considering in the present work.<sup>9</sup> As expected, the film clip turned out to be neutral ( $t[df = 60] = 0.5900$ ,  $p\text{-value} = 0.5574$ ).<sup>10</sup>

The internal consistency reliability of each score has been checked looking at the Cronbach’s alpha. All the values were around or higher than 0.70 (ranging from 0.69 to 0.90) thus showing an acceptable level of reliability.

To summarize, we found that, according to the PANAS-X, we elicited only 3 out of the 4 target emotions and that the neutral movie clip was indeed “neutral”. However, it might be argued that positive emotions (in our case, joviality) might last for a shorter period of time compared to negative ones. So, it might be the case that the PANAS-X questionnaire does not capture a significant increase in joviality just because this positive emotional state vanished during the lottery tasks. Our data, indeed, suggests that joviality do play a role in the first 60 tasks of the second part, while it is no more significant in the last 40 tasks.<sup>11</sup> This corroborates our intuition.

## 4 The Econometric Model

In round  $t$ , let us consider a choice task 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  $y_1$ ,  $y_2$ ,  $y_3$

<sup>8</sup>Anger and hostility are not exactly the same and so we double checked this result by looking at the single term “angry”. The effectiveness of the affect manipulation is confirmed ( $t[df = 43] = -2.1401$ ,  $p\text{-value} = 0.0190$ ).

<sup>9</sup>The PANAS-X questionnaire also includes other discrete emotions (e.g., self-assurance, guilt, shyness, serenity, surprise and attentiveness), but we decided to exclude them as it might be difficult that these emotions arise by watching a movie clip. Indeed, [Hewig et al. \(2005\)](#) did not tested film clips directed at manipulating them.

<sup>10</sup>The same results are obtained implementing non-parametric Wilcoxon matched-pairs signed-rank tests.

<sup>11</sup>Results are reported in Appendix B.

and  $y_4$ , occurring with probability  $q_{1t}$ ,  $q_{2t}$ ,  $q_{3t}$  and  $q_{4t}$ , respectively, with  $q_{1t} + q_{2t} + q_{3t} + q_{4t} = 1$ .<sup>12</sup>

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

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

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

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 normalised so that  $u(0) = 0$  and  $u(\max(Z)) = 1$ . The parameter  $\alpha_i > 0$  is less than 1 for risk-averse agents, equal to 1 for risk-neutral agents, and greater than 1 for risk-loving agents.

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

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

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

We test different alternative functional form for  $w_i(r)$ . It can either be linear or non-linear. If it is linear so that  $w_i(r) = r$ , 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:  $w_i(r) = \exp[-(-\ln(r))^{\gamma_i}]$ ;

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.

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<sup>12</sup>Note that, in our experiment,  $x_1 = y_1 = \text{€}0$ ,  $x_2 = y_2 = \text{€}8$ ,  $x_3 = y_3 = \text{€}16$  and  $x_4 = y_4 = \text{€}24$ .

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  $\gamma_i > 1$ , the probability weighting function takes on a s-shape.

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

The third functional form was introduced by [Prelec \(1998\)](#). As  $\gamma_i \rightarrow 0$ ,  $w_i(r)$  becomes a step function, that is flat everywhere except 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 characterising the EU model are:

$$(4) \quad \begin{aligned} \ln(\alpha_i) &\sim N(\mu_\alpha, \sigma_\alpha^2) \\ \gamma_i &= 1. \end{aligned}$$

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

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

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

The joint lognormal density function evaluated at  $(\alpha, \gamma)$  will be denoted as  $g(\alpha, \gamma; \mu_\alpha, \sigma_\alpha, \mu_\gamma, \sigma_\gamma, \rho)$ . The parameter  $\alpha_i$  in the EU model and the parameters  $\alpha_i$  and  $\gamma_i$  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 choice task with error,  $\epsilon_t$ , 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:<sup>13</sup>

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

Here,  $V_{xt}$  and  $V_{yt}$  represent Eqq. (1) and (2), respectively.

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

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<sup>13</sup>From now on, having made already clear which components of the model will be treated as individual-specific, we suppress the subscript  $i$ .

theory, is:

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

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

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

Considering the 100 choice tasks each subject faces in both parts of the experiment altogether and integrating the unobserved heterogeneity out, we get the individual likelihood contribution under the EU theory:

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

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

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

In order to capture the effect of emotions on the mean of the population, in part 2, we allow  $\mu_\alpha$  in the EU case and both  $\mu_\alpha$  and  $\mu_\gamma$  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  $\alpha$  in Eq. (9) and  $\alpha$  and  $\gamma$  in Eq. (10), we use sequences of 100 (shuffled) Halton draws.<sup>14</sup> The programs are written in Stata 13.

<sup>14</sup>For details on both Maximum Simulated Likelihood techniques and Halton sequences, see Train (2003).

## 5 Estimates results

Table 1 presents the maximum likelihood estimates of the 4 preference functionals described in Section 4. The estimated models are displayed in the following order: EU, RDEU with the Kahneman and Tversky specification of the weighting function, RDEU with a power specification, RDEU with the Prelec specification. For each model, there are two columns of estimated coefficients, labelled “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, since the first part of the experiment (the first 100 choice tasks) is exactly the same in all treatments. Part 2 data are estimated, instead, allowing the means of the relevant coefficients ( $\alpha$  in the EU case and both  $\alpha$  and  $\gamma$  in the RDEU cases) to vary with treatment. There, the constants represents such means estimated from the control treatment (with no emotion elicitation), the estimated coefficients on the treatment dummies are, instead, deviations from the control attributable to the effect of emotions. We distinguish the two parts simply because we want to verify whether there is a “physiological” change in such means in some particular direction that is due to subjects getting used to the choice task, afterthoughts, inconsistencies or whatever other reason that cannot be directly attributable to the effect of emotions on risk preferences.

Let us concentrate, for the time being, on the log-likelihood of the fits. Note, first, that EU is nested in all the RDEU specifications (when  $\gamma=1$  the weighting function becomes linear, so that there are no probability distortions). 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 then concentrate only on the alternative specifications of the RDEU model. All the considered specifications have the same number of parameters. Hence, any criterion of the AIK or BIC type would apply the same penalisation factor to all the specifications. What matter, 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 data. We will then focus the following discussion on that specification. As already argued, testing alternative theories and specifications on these data is crucial in that both different theories and different specifications of the models can lead to very different results.

Concerning the specification that fits our data best, we have to observe that the Power specification 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, so that, when  $\gamma < 1$ , people are optimistic and tend to overvalue the probability of the largest outcome and undervalue the probability of smaller outcomes; when  $\gamma > 1$ , people are pessimistic and consequently tend to underweight the largest outcome and overweight smaller outcomes.<sup>15</sup>

The RDEU/Power estimates show that the mean of the risk attitude parameter changes significantly between part 1 and part 2 of the experiment (p-value=0.0001), as it can be deduced by comparing the estimate of  $\mu_\alpha$  in part 1 and the constant component (which refers to the control group) of  $\mu_\alpha$  in part 2. In particular, it can be noticed that participants in the control group tend to become more risk averse in the second part of the experiment. With a similar comparison, we can infer that the mean of the weighting function parameter does not change, instead, between part 1 and part 2 of the experiment (p-value=0.3330).<sup>16</sup> The parameters' variability is quite substantial for both parameters. Both  $\sigma_\alpha$  and  $\sigma_\gamma$  significantly reduce in part 2 with respect to part 1, but they account for a large amount of heterogeneity across subjects in any case. The correlation coefficient  $\rho$  is estimated to be positive, statistically significant and quite large (it is around 0.70 in part 1 and reduces to 0.30 in part 2). The implications of this finding is quite interesting. This is telling us that those who have a small  $\alpha$  tend to have also a small  $\gamma$  and viceversa. In other words, risk averse (loving) people tend to be optimistic, and overweight large outcomes.

Coming to the main purpose of the paper – that is if and, in case, the way 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 term in the third to last column of Table 1). These findings imply that joyful, sad, fearful, and angry subjects tend to be more risk seeking than subjects in a neutral affective state. Interestingly, the estimated coefficients on the joviality and anger dummies are pretty similar. Furthermore, our results show that joviality and anger have some influence on the mean of the the weighting function coefficient,  $\mu_\gamma$ .

It is worth noting that, had we used any of the other two RDEU models, we would have reported exactly the same statistically significant effect of all the emotions on the mean of the risk attitude parameter (except for sadness in the RDEU/Prelec specification), meaning that the significance of our results does not depend on the model we chose. However, the treatment dummies present different signs across the models. This is a potential explanation for the opposite effects we can find in the literature and, once again, highlights the importance of selecting the model that best

<sup>15</sup>For a similar interpretation, see [Diecidue and Wakker \(2001\)](#).

<sup>16</sup>Note that, when we talk about the means of  $\alpha$  and  $\gamma$ , we always refer to the mean of the underlying bivariate Normal distribution. For further details, see Section 4. In effect,  $\mu_\alpha$  and  $\mu_\gamma$  are the logarithm of the medians of the joint distribution of  $\alpha$  and  $\gamma$ , which is assumed to be lognormal.

	EU		RDEU/KT		RDEU/Power		RDEU/Prelec	
	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2	Part 1	Part 2
Joyality		0.002 (0.068)		0.392 *** (0.059)		0.594 *** (0.117)		-0.175 ** (0.072)
Sadness		0.025 (0.079)		-0.226 *** (0.065)		0.241 ** (0.114)		-0.031 (0.058)
Fear		0.534 *** (0.078)		0.326 *** (0.056)		0.522 *** (0.105)		0.172 *** (0.061)
Anger		-0.372 *** (0.064)		0.272 *** (0.064)		0.547 *** (0.101)		-0.165 *** (0.060)
Constant	-0.991 *** (0.044)	-1.274 *** (0.062)	-0.736 *** (0.049)	-0.975 *** (0.049)	-1.120 *** (0.041)	-1.426 *** (0.080)	-1.079 *** (0.045)	-1.024 *** (0.048)
$\mu_\alpha$	0.837 *** (0.035)	0.745 *** (0.029)	0.828 *** (0.041)	0.733 *** (0.029)	1.123 *** (0.038)	0.777 *** (0.052)	0.824 *** (0.033)	0.855 *** (0.031)
$\sigma_\alpha$								
Joyality				-0.211 *** (0.056)		0.274 ** (0.114)		-0.012 (0.024)
Sadness				-0.015 (0.063)		0.096 (0.115)		0.014 (0.024)
Fear				0.049 (0.055)		0.110 (0.102)		-0.001 (0.024)
Anger				-0.068 (0.059)		0.547 *** (0.099)		0.008 (0.023)
Constant			0.123 *** (0.024)	0.295 *** (0.046)	-0.290 *** (0.036)	-0.215 *** (0.078)	-0.057 *** (0.008)	-0.002 (0.016)
$\mu_\gamma$			0.434 *** (0.019)	0.545 *** (0.024)	0.893 *** (0.028)	0.696 *** (0.029)	0.109 *** (0.007)	0.109 *** (0.007)
$\sigma_\gamma$								
$\rho$			-0.295 *** (0.078)	-0.328 *** (0.039)	0.721 *** (0.019)	0.308 *** (0.072)	0.032 (0.077)	0.138 (0.090)
$\sigma_\epsilon$	0.091 *** (0.001)	0.072 *** (0.001)	0.088 *** (0.001)	0.071 *** (0.001)	0.058 *** (0.001)	0.058 *** (0.001)	0.087 *** (0.001)	0.068 *** (0.001)
Number of observations	23600	23600	23600	23600	23600	23600	23600	23600
Number of subjects	236	236	236	236	236	236	236	236
Log-likelihood	-8633.62	-7600.62	-8432.32	-7308.88	-8116.03	-7185.88	-8431.27	-7375.99

Table 1: Maximum likelihood estimates of the structural models' parameters (the log-likelihoods are maximized using sequences of 100 shuffled Halton draws) in Section 4. 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
$\mu_\alpha$	Joviality	0.599 *** (0.150)	0.439 *** (0.144)			0.169 (0.129)		0.537 *** (0.136)
	Sadness	0.068 (0.163)	-0.098 (0.185)			0.250 * (0.139)		0.270 * (0.146)
	Fear	0.968 *** (0.140)	0.278 (0.179)			0.596 *** (0.123)		0.431 *** (0.145)
	Anger	0.435 *** (0.147)	0.190 (0.153)			0.511 *** (0.129)		0.221 (0.153)
	Constant	-0.819 *** (0.070)	-1.085 *** (0.125)	-1.390 *** (0.061)	-1.448 *** (0.116)	-1.005 *** (0.058)	-1.399 *** (0.059)	-1.383 *** (0.103)
$\sigma_\alpha$		1.089 *** (0.059)	0.963 *** (0.047)	0.825 *** (0.052)	0.825 *** (0.068)	1.047 *** (0.048)	0.948 *** (0.056)	0.725 *** (0.049)
	Joviality	0.446 *** (0.142)	0.349 ** (0.137)			-0.138 (0.115)		0.393 *** (0.124)
	Sadness	-0.113 (0.153)	0.167 (0.182)			0.017 (0.126)		0.361 *** (0.131)
	Fear	0.672 *** (0.132)	0.244 (0.189)			0.114 (0.116)		0.264 ** (0.123)
	Anger	0.071 (0.140)	0.382 *** (0.142)			-0.063 (0.121)		0.547 *** (0.133)
$\sigma_\gamma$	Constant	-0.320 *** (0.061)	-0.185 * (0.109)	-0.263 *** (0.049)	-0.284 ** (0.116)	-0.244 *** (0.062)	-0.560 *** (0.053)	-0.297 *** (0.092)
		0.833 *** (0.048)	0.697 *** (0.036)	0.772 *** (0.034)	0.901 *** (0.059)	0.848 *** (0.041)	0.870 *** (0.038)	0.778 *** (0.031)
		0.640 *** (0.043)	0.564 *** (0.044)	0.757 *** (0.027)	0.577 *** (0.047)	0.704 *** (0.030)	0.633 *** (0.031)	0.289 *** (0.055)
		0.065 *** (0.002)	0.061 *** (0.002)	0.055 *** (0.002)	0.050 *** (0.001)	0.064 *** (0.002)	0.050 *** (0.002)	0.055 *** (0.001)
	$\sigma_\epsilon$							
Log-likelihood	Number of observations	8600	8600	15000	15000	12200	12200	11400
	Number of subjects	86	86	150	150	122	122	114
	Log-likelihood	-3203.23	-2827.08	-4893.76	-4319.79	-4368.18	-3829.90	-3720.80
								-3329.42

Table 2: 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.



represents the data.

There is some evidence implying that gender plays an important role on preference toward risk and, in particular, it seems that females are more risk averse than males (e.g., see [Hudgens and Torsani Fatkin, 1985](#); [Powell and Ansic, 1997](#)). Along similar lines, we divide the sample by subjects' gender in order to verify whether the effects spotted from the entire sample hold for both males and females or if, on the contrary, some differences arise. Results are reported in the first four columns of Table 2: the first two are dedicated to males; the third and the fourth to females. The labels part 1 and 2 have the usual meaning. It turns out that this exercise is indeed meaningful. Joviality, fear and anger strongly decrease males' risk aversion, but only joviality seems to have a significant impact on females' risk attitude. Sadness has not an effect on both males' and females' risk attitude. Moreover, as suggested by previous findings, females are estimated to be significantly more risk averse than males in both parts of the experiment. Concerning the weighting function parameter, we notice that there is a physiological increase in  $\mu_\gamma$  from part 1 to part 2 of the experiment. Joyful and fearful males seem to experience an even bigger increase in the mean of the weighting function parameter. Essentially, the male control group becomes more pessimistic in part 2 and this effect is even more pronounced after experiencing either joviality or anger. A similar structural increase in  $\mu_\gamma$  is also estimated from females, but here only joviality seems to have an effect. The heterogeneity in the parameters of the model is still substantial, notwithstanding having divided the sample into two groups according to gender.

Table 2 also reports the estimate results obtained by dividing the sample into two subsamples discriminated according to subjects' laboratory experience. We define *inexperienced individuals* as subject who have participated at most to 6 experiments and *experienced individuals* as subjects who took part in more than 6 experiments.<sup>17</sup> Here, the effect we get about fear is allocated to inexperienced subjects. Instead, that about joviality is allocated to experienced subjects. On the contrary, sadness and fear exert a positive influence on both groups. The experienced's weighting function seems to be affected positively by all the elicited emotions, while any of them affect the inexperienced'. From all the considered subsamples, the correlation coefficient is estimated to be positive and significant. In all the models reported in Table 1 and 2, the standard deviation of the Fechner error term,  $\sigma_\epsilon$ , is rather small, taking values that are typically observed in empirical works of this sort.

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<sup>17</sup>The threshold was set to 6 experiments in order to obtain groups of a similar size.

## 6 Conclusions and Discussion

Previous experimental studies have demonstrated that affective states are important predictors of an individual's risk attitude, but their results are still inconclusive. This motivated us to further explore this research area by gauging the impact of four discrete emotions - joviality, sadness, fear, and anger - on risk preferences. In particular, the paper aims to address the following research questions: (1) do emotions affect an individual's risk attitude when substantial financial incentives are at stake and, if so, in which ways?; (2) are there differences according to gender?; and (3) according to subjects' laboratory experience?

To provide answers to these questions, we conducted an analysis directed at estimating the joint distribution of the relevant parameters of preference functionals over the population. Once selected the model which statically fits the data best (i.e., in our case, the RDEU/Power specification), we have observed how the means of such distributions vary when emotions are instigated.

Regarding our first research question, that is if, and how, emotions affect risk preferences in a setting with salient financial incentives, we prove that they do play a very important role on risk attitudes. We find that participants in the joviality treatment are more risk-seeking than those in the control group. A similar result is also obtained for both sad and angry agents: indeed, both groups of participants become more risk prone (compared to the control group) after the emotions' manipulation. Hence, our results validate the fact that angry individuals' behaviour resembles that of joyful people. Furthermore, and in contrast with previous findings, we show that fearful subjects tend to be more willing to accept risk compared to people in a neutral emotional state. We can think of at least two explanations which could justify fear to decrease risk aversion. First, in line with the mood repair hypothesis ([Clark and Isen, 1982](#)), it might be that individuals who are experiencing fear, i.e., a negative-valenced emotion, undertake more risky decisions because they hope that the outcome of the lottery will improve their affective state. In other words, it may be that, since they are in a bad emotional situation, they feel like they have less to lose by trying their luck and choosing more risky prospects. Second, there might be some emotion regulation processes under which participants cognitively reduce the experience of unpleasant emotions, such as fear, and this consequently promotes risky decision making ([Heilman et al., 2010](#)).

Our data also reconfirms a very well know result in the literature: female are more risk averse than males and this holds both before and after the emotion manipulation. Moreover, concerning our second research question, we show the existence of stark gender differences in the role of emotions on risk-taking. We find that men's willingness to take risk is positively influenced by all

induced emotions, while only joviality affects females'. Indeed, it could be that women are so risk averse that negative emotions do not influence their risk preferences.

Finally, and related to our third research question, we check whether emotions differently affect risk preferences according to subjects' previous laboratory experience. Our results suggest that sadness and fear decrease both inexperienced's and experienced's risk aversion. Anger increases only inexperienced's risk attitude, while joviality merely raises experienced's risk-taking. A potential explanation for these findings could be that inexperienced participants pay more attention to negative feelings, while experienced decision makers do focus more on positive emotions.

In conclusion, we experimentally show that all the considered emotions – joviality, sadness, fear, and anger – increase risk-taking. Therefore, our results are mixed: in line with the affect infusion model we find that a positive emotional state lead to risk seeking, but, in line with the mood maintenance hypothesis, we show that all negative emotions (sadness, fear, and anger) decrease risk aversion. Moreover, we prove that there are differences when discriminating among gender and previous experience in the lab. Our results are only partially consistent with the literature, but this might be due to the deeper analysis we conduct in order to select the model which fits our data best. We stress, once again, that this is a fundamental step in order to get reliable results.

In the present work we exogenously induced emotions through the watching of selected film clips. This serves mainly to show that different emotional states can trigger different effects on the risk taking, but it does not want to be a realistic example in everyday life. In real experience, it might be more likely that emotions are influenced by financial news released by, for example, the European Central Bank, the OECD, the FED, etc, and this, in turn, affects the investors' financial risk tolerance. Further research should be directed at understanding if this is indeed the case.

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## Appendix A 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".*

## Appendix B Manipulation Check

		First 60 tasks		Last 40 tasks	
		Part 1	Part 2	Part 1	Part 2
$\mu_\alpha$	Joviality		0.409 *** (0.125)		-0.035 (0.153)
	Sadness		0.219 (0.134)		-0.071 (0.139)
	Fear		0.542 *** (0.114)		0.276 * (0.147)
	Anger		0.235 * (0.122)		0.320 ** (0.132)
	Constant	-1.220 *** (0.054)	-1.440 *** (0.095)	-1.403 *** (0.096)	-1.212 *** (0.095)
		1.038 *** (0.047)	0.742 *** (0.047)	1.273 *** (0.063)	0.618 *** (0.052)
$\sigma_\alpha$	Joviality		0.297 *** (0.122)		0.042 (0.178)
	Sadness		-0.032 (0.136)		0.210 (0.135)
	Fear		0.134 (0.108)		-0.036 (0.147)
	Anger		0.194 (0.122)		0.555 *** (0.128)
	Constant	-0.387 *** (0.044)	-0.236 *** (0.089)	-0.435 *** (0.068)	-0.178 * (0.100)
		0.831 *** (0.031)	0.624 *** (0.029)	0.904 *** (0.037)	0.685 *** (0.049)
$\sigma_\gamma$		0.737 *** (0.025)	0.284 *** (0.068)	0.780 *** (0.029)	0.418 *** (0.074)
		0.054 *** (0.002)	0.055 *** (0.002)	0.048 *** (0.002)	0.057 *** (0.002)
$\rho$					
$\sigma_\epsilon$					
Number of observations		14160	14160	9440	9440
Number of subjects		236	236	236	236
Log-likelihood		-4937.88	-4394.42	-4094.67	-2998.56

Table B1: 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.