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ELICITING RISK AND TIME PREFERENCES UNDER INDUCED MOOD STATES

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Abstract

We test whether induced mood states have an effect on elicited risk and time preferences. Risk preferences between subjects in the control, positive mood, and negative mood treatments are neither economically nor statistically significant. However, we find that subjects induced into a positive mood exhibit higher discount rates and that subjects under negative mood do not differ significantly with a control group. Results also suggest that irrespective of mood state, introducing a cognitively demanding task before risk preference elicitation increases risk aversion and females are less risk averse when in all-female sessions than when in mixed-gender sessions.

Keywords: discount rates, risk aversion, lab experiment, mood, affect

JEL codes: D81, C91, D00

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1. Introduction

In the beginning of the 20th century, economics was generally devoid of psychological concepts by basing economic theory on the principles of rational choice (see Bruni and Sugden 2007 for a historical perspective). However, with the advent of "behavioral economics", there has been considerable effort lately in bringing out psychological concepts in economics. Hence, economics and psychology no longer stand in complete isolation. Reviews of the fruitfulness of this interaction have appeared in core economic journals. For example, Elster (1998) brought out the interesting features of "emotions" in the development of economic theory and in explaining human behavior.

The literature in economics usually confounds emotions and mood in an almost indistinguishable way. However, there are stark differences between emotions and moods, as described in the psychology literature. Emotions tend to be extremely brief, lasting for a few seconds (Izard 1991; Larsen 2000) while moods typically last longer (Watson and Vaidya 2003). To quote the example provided in Watson and Vaidya (2003), the full emotion of anger might last for only a few seconds while an annoyed or irritable mood may persist for several hours or even for a few days. In essence, the concept of mood subsumes all subjective feeling states, not simply those experiences that accompany classical, prototypical emotions such as fear and anger (Watson and Vaidya 2003). Therefore, it appears that in order to explore all aspects of affective states on human behavior it would be necessary to go beyond the narrow boundaries of emotions by examining the much broader concept of mood.

In this study, we examine the role of mood in joint elicitation of risk and time preferences. Studies in the literature that examine the role of mood on risk and time preferences have looked over only one of these dimensions but not both at the same time. The examination of risk and time preferences is important since they are fundamental economic preferences that have been found to influence many facets of economic decision-making and human behavior. For example, risk and time preferences have been shown to influence self-control problems that could lead to negative health outcomes (e.g., Fudenberg and Levine 2009; Benhabib and Bisin 2005; Bernheim and Rangel 2004).

The hypothesis that people tend to make judgments that are mood congruent, dates back to Johnson and Tversky (1983). Johnson and Tversky (1983) found that bad mood increased subjective probabilities of risk assessments while positive mood produced a comparable decrease in subjective probabilities. This hypothesis of mood congruent judgments implies that moods may affect preference formation by influencing judgments.

In psychology, two models of decision making which relate mood states with risk-taking, predict the exact opposite things. One of these models is the Affect Infusion Model (AIM) which suggests that positive mood increases risk-taking behavior while negative mood reduces the tendency to take risks (Forgas 1995). This is because individuals in an elated mood rely on positive cues in making judgments and thus are more likely to think about the positive aspects of risky situations than those in a negative mood. The other model is the Mood Maintenance Hypothesis (MMH) which asserts that people in elated moods may not want to risk losing the elated state and thus render themselves more risk averse (Isen and Patrick 1983). Hence, according to this model, people in negative moods will be willing to take more risk (be less risk averse) in order to obtain greater potential gains that may alter their mood upwards. Many studies in the literature have since then taken one side or the other. For example, Isen and Patrick (1983) found that subjects under positive affect were betting less chips (representing credit for participation) and also required a higher probability of winning as the minimum for taking the bet (Isen and Geva 1987).

Much of the literature on mood and risk aversion appeared only over the last decade and most of these studies can be found not in the economics but in the psychology literature[1]. For example, Hockey et al. (2000) examined the effect of naturally occurring and induced negative moods (in particular anxiety, depression and fatigue) on risk in every day (hypothetical) decision making and found that fatigue was more strongly linked to increased riskiness. In another study, Hills et al. (2001) examined the effect of mood states in persistence (duration) in playing

[1] We only focus on the literature on mood and risk/time preferences for brevity and due to journal page restrictions.

gambling games and found that negative moods had an inhibitory effect (which can be interpreted as less risk taking) but only for non-regular gamblers. Regular gamblers were completely unaffected. Similarly, Yuen and Lee (2003) found that people in induced depressed mood had lower willingness to take risk (where risk was defined based on hypothetical choices from everyday life dilemmas) than people in neutral and in positive mood and Williams et al. (2003) found that decision makers (managers) with high negative affect were more likely to avoid risk (as measured by hypothetical choices of actions to varied business scenarios). In a related study, Chou et al. (2007) reconfirmed that individuals in a negative mood are less willing to take up more risk (where risk was defined similar to Yuen and Lee 2003). However, they found an asymmetric age effect, where positive mood affects risk taking only for older individuals. More recently, Kugler, Connolly, and Ordóñez (2010) found that the impact of prototypical emotions such as fear and anger is contingent on the type of the risk. They found that fearful participants were *more* risk-averse than angry participants in lottery-risk tasks but in tasks where risk was generated by another person's uncertain behavior, fearful participants were *less* risk-averse than angry participants.

Kim and Kanfer (2009) offered a bridge that addresses the inconsistencies between AIM and MMH by evaluating what they called "an integrative explanation". Specifically, they showed that if a cognitive demanding task intervenes between negative mood induction and risk-taking judgments (defined as choices over dilemmas) the observed trend reverts: subjects exhibited lower levels of risk-taking judgments (offering support for AIM) as opposed to higher levels of risk-taking when there is no intervening cognitive task (offering support for MMH).

Grable and Roszkowski (2008) found that incidental positive mood was positively associated with having a higher level of financial risk tolerance (as measured on a financial risk tolerance scale). In a laboratory experiment, Helga et al. (2007) showed that incidental (not induced) good mood has a significant effect on the shape of the probability weighting function for women (but not men); that is, women weighed probabilities of gains and losses relatively more optimistically than men. In contrast, Walser and Eckel (2010) found no effect of mood on risk preferences.

As discussed above, although there have been a few studies in the economics literature that examined the relation between mood and risk preferences, there have been only two studies that explored the link between mood and time preferences. Specifically, McLeish and Oxoby (2007) found evidence that inducing subjects with negative mood results in greater impatience (i.e., increased discount rates) but only among women and Ifcher and Zarghamee (2010) found that mild positive affect significantly reduces time preference, that is, increases the present value of a future payment. In the marketing literature, Pyone and Isen (2011) found that subjects in a positive mood were more forward looking.

In this study, we revisit the issue of determining the effect of mood states on risk and time preferences but in contrast to previous studies, we jointly elicit measures of risk and time preferences using a conventional lab experiment (according to the terminology of Harrison and List 2004). This is an important topic that has not been examined in the literature since joint (as opposed to separate) elicitation of risk and time preferences could potentially provide a different set of results on mood effects than what has been found in previous studies that did not jointly elicit these preferences. Andersen et al. (2008) have shown that joint elicitation of risk and time preferences results in significantly different discount rates than separate elicitation. They then conclude that credible estimation of discount rates rely on the joint estimation of risk and time preferences.

In addition to joint elicitation of risk and time preferences, we also utilise the statistical specification and theoretical framework of Andersen et al. (2008). Moreover, unlike much of the previously cited literature (with the exception of McLeish and Oxoby 2007; Ifcher and Zarghamee 2010; Walser and Eckel 2010; Helga et al. 2007; Hills et al. 2001), we use non-hypothetical elicitation procedures and use real monetary incentives for recruitment and elicitation of risk and time preferences. We also explore if a cognitively demanding task right after mood inducement could affect risk preferences as suggested in the literature and whether there are gender differences in elicited risk and time preferences.

To further assess the contribution of our study in the literature and be able to compare our findings with other studies, we developed a table (see Table A1 in the Appendix) that summarizes the relevant literature that relates mood states with risk or time preferences. From the 15 studies we identified, only five of them used real financial commitments to elicit risk or time preferences and none conducted joint elicitation of risk and time preferences. Of the five studies that used real financial commitments, one did not induce mood (Helga et al. 2007) but rather examined incidental moods and only one study (Walser and Eckel 2010) used validated scales from psychology to measure the success of the induction procedure (i.e., mood measurement). In terms of the employed risk and time preference tasks, our study uses similar procedures used in four out of these five studies (McLeish and Oxoby 2007; Ifcher and Zarghamee 2010; Walser and Eckel 2010; Helga et al. 2007). In terms of the results, one of the studies found no effect of mood (Walser and Eckel 2010), two of the studies found mood effects but only for women (McLeish and Oxoby 2007; Helga et al. 2007), one study found that a significant effect of mood holds only for a sub-sample (i.e, non-gamblers) (Hills et al. 2001) and only one of the studies found their results to hold across all subject groups (Ifcher and Zarghamee 2010).

In our study, although we find some differences in risk preferences between subjects in the control, positive mood, and negative mood treatments, these are not statistically significant similar to the results obtained by Walser and Eckel (2010). However, we find both economically and statistically significant effects of positive mood (but not of negative mood) on elicited discount rates. Specifically, in contrast to Ifcher and Zarghamee (2010), we find that positive mood induces higher discount rates. Our sample size is comparable to most of the above cited studies.

In addition, we extend our design in two directions. First, we inserted a cognitively demanding task (preference reversals phase) in half of the sessions, following Kim and Kanfer (2009). Consistent with Kim and Kanfer (2009), our results suggest that subjects become more risk averse when an intervention stage is used under a negative mood, offering support for the AIM. However, subjects become less risk averse when there is no intervening stage, offering support for the MMH. We also found that the intervening stage explanation of Kim and Kanfer (2009) does not hold under positive mood. We find that under positive mood subjects become more risk averse when a cognitively demanding task is intervened (which offers support for the MMH) but are less risk averse when the cognitively demanding task is not intervened (which offers support for the AIM). Hence, our results do not confirm the integrative intervening explanation of Kim and Kanfer (2009). However, we note that their study did not use real monetary incentives.

Secondly, we use our experiment to examine gender differences on choice under risk by employing gender-specific sessions and contrasting these with mixed gender sessions. We find evidence that a same-gender environment can alter elicited risk preferences (but not discount rates) for females (but not males). This effect holds irrespective of the induced mood state.

In the next sections we describe in detail our experimental procedures, present the framework for the analysis and then the results and discussion.

2. Experimental procedures

The experiment we designed was part of a larger project on choice under risk that also involved a lottery choice task and a lottery auction task aimed at identifying preference reversals. In this paper, we used the preference reversal task as a cognitive intervening stage before risk elicitation to check if this intervening stage would make a difference in the measurement of risk preferences under different mood states as has been proposed in the literature (Kim and Kanfer 2009). Following Andersen et al. (2008), the time preference task was placed at the very end of each session since it involved winning a considerable amount of money and we did not want to risk contaminating the previous tasks with income effects. Andersen et al. (2010) found in one of their treatments that there are no statistically or economically significant order effects in the risk and time preference tasks. Order effects are more likely to appear in situations where a similar task is repeated twice (or more) as in Harrison et al. (2005). Since our risk and time preference tasks both involve lotteries and might be considered similar, we presented them to subjects in alternating order between sessions.

Due to the widespread evidence of gender differences on choice under risk (e.g., Niederle and Vesterlund 2007; Gneezy, Leonard, and List 2009; Booth and Nolen 2009b, 2009a) we also tested whether risk and time preferences might be affected when we alter the environment of the session in terms of gender. Therefore, we conducted additional sessions with males only and females only.

To minimise the number of sessions that we would need to run for the full design, we decided to induce different mood states to subjects in the same session. Given that our computer lab is equipped with private booths and no communication between subjects was aloud, we were certain that no mood contagion took place. Our mood inducement technique is described in detail below.

Our full design involved six treatments in six sessions[2]. In the first two treatments we induced half of the subjects with positive mood and half of the subjects with negative mood. The only difference between the first two treatments was that the order of the preference reversals and risk preferences task were alternated. In treatments 3 and 4, our control treatments, mood was only measured and not induced. The order of the preference reversals and the risk preferences task was also alternated in these treatments. Treatments 5 and 6 were similar to treatment 1 except that subjects in these treatments were all females and males, respectively. Table I shows the experimental design. We only used one proctor or monitor (i.e., one of the authors) for all sessions. To isolate the role of mood and order of the tasks on risk and time preferences we first analyzed treatments 1 to 4 together and then analyzed treatments 1, 5, and 6 together to explore gender differences in our data.

[2] In our very first session a couple of things went wrong which prompted us to rerun this session with a completely different set of subjects. First, one of the subjects could not keep himself quiet during the experiment although we pointed out the necessity of no communication. Improper behavior resulted in early termination of his participation in the session. In addition, a server failure resulted in having subjects wait for more than 10 minutes doing nothing. Since the necessary control was lost and given the sensitivity of our design to contaminating mood behavior, we decided to dismiss all data from this session. Therefore, in total we ran seven sessions, the seventh being a re-run of treatment one. We dismissed data from session 1 from all further analysis.

2.1. Description of the experiment

The conventional lab experiment was conducted using the z-Tree software (Fischbacher 2007).[3] Subjects consisted of undergraduate students at the AAA University (removed for peer review; to be adjusted upon publication). During the recruitment, the nature of the experiment and the expected earnings were not mentioned. However, subjects were told that they will be given the chance to make more money during the experiment. Stochastic fees have been shown to be able to generate samples that are less risk averse than would otherwise have been observed (Harrison, Lau, and Rutström 2009).

Each subject participated in only one of the treatments exhibited in Table I. The size of the groups varied from 15 to 18 subjects per treatment. Each treatment lasted a little more than an hour. In total, 101 subjects participated in our experiments, which were conducted in March 2010. This number does not include 15 subjects from session 1 that were dismissed from any further data analysis. We considered these data contaminated as noted in footnote 2.

Each session consisted of different phases: the mood induction phase, the lottery choice phase, the lottery auction phase, the mood measurement phase, the risk preferences phase, the time preferences phase and the post-auction phase[4]. The lottery auction and choice phases are not part of the research agenda of this paper and will not be given further consideration. Subjects were given prior instructions on the overall layout of the session and were also reminded about the procedures at the beginning of each phase. Experimental instructions are available at the anonymous website https://sites.google.com/site/risktimemood/.

[3] z-Tree is a software package designed to facilitate computer-based economic experiments. It has been used in numerous experiments as evident by the more than 1800 citations that the paper documenting the software has collected in Google scholar.

[4] We also measured the rate of preference reversals using lottery choice tasks and lottery auction tasks but since these phases are not part of this paper's research focus, we are not giving a detailed discussion. Prior to the auction phase there was also significant training with the auction mechanism which included hypothetical as well as real auctions. These phases of the experiment are discussed in .....(REMOVED FOR PEER REVIEW).

2.2. The mood induction phase

Mood induction procedures have been widely used by psychologists and have also been adopted by economists (e.g., Kirchsteiger, Rigotti, and Rustichini 2006; Capra 2004). Capra et al. (2010) give a brief summary of the different methods used in the psychology literature. In this study we used experience of success/failure as our mood induction procedure, similar to what was used in many other studies (Barone, Miniard, and Romeo 2000; Swinyard 1993, 2003; Capra 2004; Capra, Lanier, and Meer 2010; Hill and Ward 1989; Curtis 2006). Specifically, subjects in the mood induction treatments were given a MENSA test that had to be completed within 6 minutes. Half of the subjects received a 16-question *hard* MENSA test and half of the subjects received an *easy* MENSA test (the tests are available at https://sites.google.com/site/risktimemood/).

The questions were first *pretested* in an online survey with a convenience sample using snowballing methods. Subjects were randomly exposed to one of the two versions. After taking the MENSA test, we then measured subjects' moods (see next subsection). In the *online* hard version, the pretest subjects answered on average 4.5 questions correctly while in the *online* easy version, the pretest subjects answered 12.9 questions. Their scores were displayed right after the time to complete the test expired, along with a phrase stating that a person between 18-55 years old normally answers about 10 questions correctly, that 95% of the people answer at least 6 questions correctly and that only 5% answer more than 12 questions correctly. While this phrase was adopted from previous research on mood inducement, subjects in our online survey also got an average of 10 correct questions and have the same age distribution when averaging across both versions of the test. Since the phrase was effective in inducing mood (see next paragraph) and generally corresponded with the actual distribution of correct answers, we decided to use the same phrase for the lab experiment.

Given subjects' scores in the two versions, this feedback immediately placed the average subject in the *hard* version to the low 5% of the population while the average subject in the easy version was placed at the top 5%. This way subjects in the hard version experienced failure and subjects in the easy version experienced success. In a sample of 49 subjects in the online *pretest*, the two versions of the test were adequate in inducing different levels of positive affect (the null of equal scores on the positive affect scale was highly rejected on a t-test with a p-value of 0.02).

The procedure we discussed above is not new, has been validated, and has been used in several other studies (e.g., Swinyard 1993; Barone, Miniard, and Romeo 2000; Swinyard 2003). To successfully complete the inducement phase in the lab, we did not tell subjects that they were being randomly exposed to different versions of the MENSA test nor that the reference phrase given to them corresponded to the average of two versions of an online test. Subjects were only told that this phrase corresponds to the results obtained from another subject pool[5]. Subjects that answered the hard version of the test, scored significantly lower in the positive affect scale (discussed in the next paragraph). There was no significant difference between subjects with respect to the negative affect scale.

2.3. The mood measurement phase

To find ways to measure mood, we turned to the psychology literature for guidance. Watson and Vaidya (2003) provided a comprehensive overview of the dimensionality of the

[5] Another method for inducing moods is the use of film clips. However, an important limitation of the use of films is that there are no widely accepted sets of mood eliciting film stimuli, not to mention the challenge of finding film stimuli for culturally different or non-English speaking subjects.

mood construct as well as on ways to measure its dimensions. Mood is usually depicted as a circular scheme with four bipolar dimensions that are spaced 45 degrees apart. The positive affect and negative affect dimensions are considered the most important measures of the higher order dimension.

The PANAS scale (Positive Affect Negative Affect Schedule; which was later subsumed into the PANAS-X) (Watson 1988) emerged as the standard measure of these constructs and has been widely used in the literature (Pocheptsova and Novemsky 2010; Bono and Ilies 2006; Pelled and Xin 1999; de Ruyter and Bloemer 1998; Pugh 2001). The terms comprising the PANAS-X Positive Affect scale are *active, alert, attentive, determined, enthusiastic, excited, inspired, interested, proud,* and *strong;* the items included in the Negative Affect scale are *afraid, ashamed, distressed, guilty, hostile, irritable, jittery, nervous, scared,* and *upset.* Subjects rated the extent to which they experienced each term right after inducement on a 5-point scale (1 = *very slightly or not at all,* 5 = *extremely*). In the lab the order of appearance of these terms was completely randomized. The scale has been thoroughly tested for reliability and validity (see Watson and Vaidya 2003).

2.4. The risk preferences phase

To elicit risk preferences we used the multiple price list (MPL) design devised by Holt and Laury (2002). In this design each subject is presented with a choice between two lotteries, A or B as illustrated in Table II. In the first row the subject is asked to make a choice between lottery A, which offers a 10% chance of receiving €2 and a 90% chance of receiving €1.6, and lottery B, which offers a 10% chance of receiving €3.85 and a 90% chance of receiving €0.1. The expected value of lottery A is €1.64 while for lottery B it is €0.475, which results in a difference of €1.17 between the expected values of the lotteries. Proceeding down the table to the last row, the expected values of the lotteries increase but increases much faster for lottery B.

For each row, a subject chooses A or B and one row is then randomly selected as binding for the payout.[6] The last row is a simple test of whether subjects understood the instructions correctly. A risk neutral subject should switch from lottery A to lottery B at the 5th row. In our experiments subjects undertook three risk aversion tasks: they made choices fromError! Reference source not found. Table II (the 1x table), a table where payoffs were scaled up by 10 (the 10x table) and a table similar to Table II but without the last three rows (the 1x-framed table). The order of appearance of the tables for each subject was completely randomized to avoid order effects (Harrison et al. 2005). The 10x table served as an elicitation vehicle of risk when larger payoffs are involved while the 1x-framed table was used as an alternate format since subjects could be drawn in the middle of the ordered table irrespective of their true value (Andersen et al. 2007). One of these tables was chosen at the end as binding for the payout. Thus, to infer risk preferences, subjects were asked to provide 27 binary choices from the risk preference task.

2.5. The time preferences phase

The experimental design for measuring discount rates is based on the experiments of Coller and Williams (1999), Harrison, Lau, and Williams (2002) and Andersen et al. (2008). Subjects are confronted with payoff tables similar to Table III and made choices from three tables with different time horizons: the 3-month time horizon table (Table III), the 6-month time horizon table (payment option B pays in 7 months) and the 12-month time horizon table (payment option B pays in 13 months). At the end of the experiment only one table and one row

[6] In every step that involved random drawings by the computer, we reassured subjects that the drawing was fair and that extra care was taken by the programmer to make sure that this is the case.

were randomly drawn as binding. Financial constraints precluded us from paying every single subject in each session and hence only one subject was randomly drawn as the winner.

In Table IIITable, option A offers 300 € in 1 month and option B offers 300 € +*x* € in 4 months, where *x* ranged from annual interests rates of 5% to 50% on the principal of 300 €, compounded semi-annualy to be consistent with national banking practices on savings accounts. The table also includes the anual and annual effective interest rates to facilitate comparisons between lab and field investments (Andersen et al. 2008). The tasks provided two future income options instead of one instant and one future option. This front-end delay on the early payment has two advantages: it holds the transaction costs of future options constant (see Coller and Williams 1999 for a discussion) and it avoids the passion for the present that decision makers exhibit when offered monetary amounts today or in the future. Future payments were guaranteed by means of a postdated check with a national bank serving as the third party guarantee. Thus subjects provided 30 binary choices for the time preference task that are used to infer time preferences.

2.6. The post-auction phase

Subjects provided information about their age, household size and income. Experimental instructions are available at https://sites.google.com/site/risktimemood/.

3. Identification of risk and time preferences

The identification of risk and time preferences follows closely the framework of Andersen et al. (2008), so we will only repeat the basic information here. Andersen et al. (2008) discussed in detail how to put parametric structure on the identification of risk and time preferences, the theoretical issues involved, and the statistical specification.

Let the utility function be the constant relative risk aversion (CRRA) specification[7]:

$$U(M)=\frac{M^{1-r}}{1-r} \tag{1}$$

for $r\neq1$, where r is the CRRA coefficient. In (1), r=0 denotes risk neutral behavior, r>0 denotes risk aversion behavior and r<0 denotes risk loving behavior.

In addition, if we assume that Expected Utility Theory (EUT) holds for the choices over risky alternatives and that discounting is exponential then the subject is indifferent between two income options M_t and $M_{t+\tau}$ if and only if:

$$U(M_t)=\frac{1}{(1+\delta)^{\tau}}U(M_{t+\tau}) \tag{2}$$

where $U(M_t)$ is the utility of monetary outcome M_t for delivery at time t, δ is the discount rate, τ is the horizon for delivery of the later monetary outcome at time $t+\tau$, and the utility function is separable and stationary over time. δ is the discount rate that equalizes the present value of the two monetary outcomes in the indifference condition (2).

[7] One may argue that the risk aversion tasks are done over a different prize domain than the discount rate tasks. This would cause no problem for the assumption of the CRRA function, given that risk aversion is then constant. It would pose a problem however, if other forms are assumed. To allow for the possibility that the relative risk aversion is not constant we also tried a more flexible functional form by adapting the hybrid expo-power function of Saha (1993). The expo-power function can be defined as $u(M)=\left(1-\exp\left(-aM^{1-r}\right)\right)/a$, where M is income and a and r are parameters to be estimated. Relative risk aversion (RRA) is then $r+a(1-r)M^{1-r}$.
Given that the model did not converge for the joint estimation of risk and time preferences, we then estimated the model for risk aversion only. We allowed each parameter r and a to be a separate linear function of the control variables that are used in latter estimations. The estimates indicate that there is no statistically significant deviation in a from zero for any of the variables controlled for, or for the constant. We can therefore conclude that there is no evidence to reject CRRA as a general characterization for this specific sample and this income domain. Similar conclusions were drawn in Harrison, Lau and Rutstrom (2007).

The binary choices of the subjects in the risk preference tasks can be explained by different CRRA coefficients. For example, a subject that made four safe choices (i.e., choosing option A) and then switched to option B would have revealed a CRRA interval of -0.15 to 0.4. The intervals are reported in Table II. Similarly, the binary choices in the time preference tasks can be explained by different discount rates. A subject that chose 300 € in 1 month would have revealed a discount rate higher than $(x/300)\cdot 100\%$; otherwise she would have revealed an annual discount rate of $(x/300)\cdot 100\%$ or less[8].

Andersen et al. (2008) explicitly write the likelihood function for the choices that subjects make in these tasks and jointly estimate the risk parameter *r* and the discount rate *δ*. The contribution to the overall likelihood from the risk aversion responses can be written for each lottery *i* as:

$$EU_i = \sum_{j=1,2} \left(p\left(M_j\right) \cdot U\left(M_j\right) \right) \tag{3}$$

where $p(M_j)$ are the probabilities for each outcome M_j that are induced by the experimenter (i.e., columns 1, 3, 5 and 7 in Table II). To specify the likelihoods conditional on the model, a stochastic specification from Holt and Laury (2002) is used. The expected utility (EU) for each lottery pair is calculated for candidate estimate of *r* and the ratio:

$$\nabla EU = \frac{EU_B^{1/\mu}}{EU_A^{1/\mu} + EU_B^{1/\mu}} \tag{4}$$

[8] The fact that the whole experiment was computerized allowed us to impose monotonic preferences (i.e., subjects could only switch once to option B and could not go back and forth). We did not allow for indifference between A and B choices either. Subjects had to clearly state whether they preferred option A or B.

is then calculated where EU_A and EU_B refer to options A and B respectively, and μ is a structural noise parameter. The index in (4) is linked to observed choices by specifying that the option B is chosen when $\nabla EU > \frac{1}{2}$.

The conditional log-likelihood can then be written as:

$$\ln L^{RA}\left(r,\mu;y,\mathbf{X}\right)=\sum_i\left(\left(\ln\left(\nabla EU\right)\mid y_i=1\right)+\left(\ln\left(1-\nabla EU\right)\mid y_i=-1\right)\right) \qquad (5)$$

where $y_i = 1(-1)$ denotes the choice of the option B (A) lottery in the risk preference task *i*.

The conditional log-likelihood for the time preference task can be written in a similar manner if we write the discounted utility of each option as:

$$PV_A=\frac{M_A^{1-r}}{1-r} \qquad \text{and} \qquad PV_B=\frac{1}{\left(1+\delta\right)^{\tau}}\frac{M_B^{1-r}}{1-r} \qquad (6)$$

and the index of the present values as:

$$\nabla PV=\frac{PV_B^{1/\nu}}{PV_A^{1/\nu}+PV_B^{1/\nu}} \qquad (7)$$

where ν is a noise parameter for the discount rate tasks. The log-likelihood will then be:

$$\ln L^{DR}\left(r,\delta,\nu;y,\mathbf{X}\right)=\sum_i\left(\left(\ln\left(\nabla PV\right)\mid y_i=1\right)+\left(\ln\left(1-\nabla PV\right)\mid y_i=-1\right)\right) \qquad (8)$$

and the joint likelihood will be:

$$\ln L\left(r,\delta,\mu,\nu;y,\mathbf{X}\right)=\ln L^{RA}\left(r,\mu;y,\mathbf{X}\right)+\ln L^{DR}\left(r,\delta,\nu;y,\mathbf{X}\right) \qquad (9)$$

Each parameter in equation (9) can be allowed to be a linear function of treatment effects. Equation (9) can be maximised using standard numerical methods. We used the routines made available as a supplemental material in Andersen et al. (2008). For a more thorough and pedagogical treatise on maximum likelihood estimation of utility functions, see Appendix F in

Harrison and Rutstrom (2008). The statistical specification also takes into account the multiple responses given by the same subject and allows for correlation between responses.

4. Estimation and results

Each subject in our experiment responded to 57 binary tasks (27 for the risk preference tasks and 30 for the time preference tasks). Data from subjects that chose lottery A over the last row of Table II were dismissed since this is a sign that they failed to comprehend the task. Therefore, 15 subjects were further dropped which resulted in a sample size of 86 subjects, with 2322 risk aversion choices and 2580 discount rate choices. As mentioned previously, since this paper has a twofold goal, we first analyze treatments 1 to 4 together and then examine treatments 1, 5 and 6.

4.1. Was the mood induction successful?

Figure I displays kernel density estimates of the affect scores for positive and negative affect respectively. The vertical lines depict mean estimates of the scores per treatment.

Remember that a hard MENSA test aims to induce a negative mood to subjects and an easy MENSA test aims to induce a positive mood state through experience of failure and success, respectively. We are certain that our subjects experienced success or failure given that those exposed to the easy MENSA test in the lab answered on average 12.9 questions correctly (out of 16) while those exposed to the hard MENSA test answered only about 6 questions correctly.

It is obvious from panel A that the density function of positive affect for those exposed to the hard MENSA test is slightly shifted to the left implying lower scores for those exposed to the hard test. The density function of those exposed to the easy test has a slightly larger peak but is otherwise very close to the density function of the control group. One could tell a similar story based on the means (vertical lines) of the positive affect scores across treatments.

Panel B shows that both densities associated with the negative affect scores of those exposed to the easy and hard test are shifted right with respect to the control group. The density function of those exposed to the hard test is slightly more to the right but is practically indistinguishable from the density function of those exposed to an easy test. Comparing the means just reconfirms the above.

These results also hold up in a regression context. We run separate regressions for the positive affect and negative affect scales which are depicted in Table IV. The list of covariates includes dummies for those exposed to the easy and hard MENSA tests (the control treatments, where mood was not induced, serve as the base category). We used demographic variables as additional control variables. Variable description is exhibited in Table V.

Results are in agreement with Figure I. Subjects that were exposed to a *hard* test scored significantly lower (by almost 4 points) in the positive affect scale compared to subjects in a control group and those who took the *easy* test. No statistically significant differences are observed between those answering an easy test and those in the control group and the magnitude of the difference in the scores is negligible. In all, it seems that our mood induction procedure was able to induce *lower* levels of positive affect to those that took the *hard* test.

On the other hand, both the *easy* and *hard* tests induced higher negative affect with respect to the control group by as much as 5 points, which is also evident in Figure I where both density functions are shifted to the right. The *Hard* coefficient is larger than the *Easy* coefficient by one point (i.e., those exposed to a hard test had on average higher levels of negative affect) although their difference is not statistically significant. So why did both procedures induce higher negative affect? One explanation could be that the quiz-type procedure resembles exams that associate negatively with students' mood e.g., test anxiety. It is also important to remember that positive affect and negative affect are two dimensions of mood that can co-exist. The overall conclusion is that subjects that took the *hard* test had lower positive affect than subjects that took the *easy* test and there was no statistically significant difference in their negative affect level. They also exhibited less positive affect and higher negative affect than the control group.

4.2. Risk aversion and discount rates under induced mood states

We first analyze data from treatments 1 to 4 to examine whether mood states can affect risk and time preference elicitation. Also, since we alternated the order of the preference reversal task and the risk preference task after mood inducement, we are able to test the AIM vs. MMH issue; that is, examine the effect of an intervening cognitive demanding task before risk elicitation. Kim and Kanfer (2009) found that this procedure makes a significant difference when evaluating risk-taking judgments.

Table V exhibits the maximum likelihood estimates of risk and time preferences. We allowed the δ and r parameters of equation (9) to be linear functions of treatment effects. One could in principle allow several variables to enter the linear specification of δ and r but this comes at the cost of convergence, at least with our data. Given our random assignment to treatments we can safely assume that our effects are causal. There are also no significant differences in the socio-demographic profile of our subjects between the treatments. We used chi-square and Fischer's exact tests to check the variables depicted in Table IV (t-tests were used for the continuous variables like age and household size). None of the differences was statistically significant.

Panel A presents maximum likelihood estimates allowing for risk aversion (joint estimation of risk and time preferences) and Panel B shows the corresponding estimates when assuming risk neutrality[9]. What is evident at first glance is that joint elicitation of risk and time preferences results in much lower discount rates, which is exactly what motivated the study of Andersen et al. (2008). For example, one of the estimates drops sharply from about 89.4% to 13.8%.

The results in panel A show two things. The first one reconfirms Kim and Kanfer's (2009) "integrative explanation" in the sense that when a cognitively demanding task (i.e., preference reversal in our case) is introduced before risk elicitation, the subjects under negative mood become more risk averse. This is evident from the higher risk aversion rates in the upper part of panel A. The differences are statistically significant across mood states with a p-value of 0.024. However, this is also true for subjects under positive mood. Based on the integrative intervening explanation of Kim and Kanfer (2009) one would expect the exact opposite results for positive mood. Our results therefore question the intervening stage explanation offered by Kim and Kanfer (2009) which was based on the use of hypothetical elicitation of risk and time preferences.

The fact that subjects that had an intervening task just before risk elicitation are more risk averse, has a direct effect on discount rates. It implies that subjects have more concave utility functions and thus lower discount rates. This is evident when comparing the top and bottom parts

[9] Note that some confidence intervals for δ include a negative lower bound. This is because we imposed $\delta > 0$ by allowing non-linear transforms of the parameters to be estimated. This allowed the Stata program to maximize over some unconstrained variable and to constrain the underlying parameter to be non-negative and non-zero. Table IV presents standard errors and confidence intervals that are transformed back using the Delta method (see Oehlert 1992) which is an approximation.

of panel A for discount rates. Although these differences look stark, they are not statistically significant given the dispersions. We get p-values in the range of 0.43 to 0.52 when testing whether the observed differences are statistically different from zero.

The second thing that is evident in Table V is that positive mood induces a 4.8% to 6.4% higher discount rate than the control treatment depending on whether a cognitive demanding task was introduced before risk elicitation. The difference is significantly different from zero with a p-value of 0.049 and 0.068, respectively. On the other hand, negative mood induces marginally lower discount rates than the control treatment but the difference is neither economically nor statistically significant. It is interesting to note that in the risk neutral case (panel B), the differences in discount rates between treatments are stark although not statistically significantly different from zero. The effect of negative mood is significantly different from the effect in the control treatment in contrast to results under risk neutrality. One would then incorrectly infer from the risk neutral estimates that mood does not have a statistically significant effect on discount rates or that negative mood has an economically significant effect. Both of these results do not hold when risk aversion is allowed.

Table VII shows the estimates when considering an alternative discounting function, namely a hyperbolic discounting function. As discussed in Andersen et al. (2008), the use of the quasi-hyperbolic specification is not possible due to the existence of a front end delay in our tasks. One would then need to replace (6) with:

$$PV_A = \frac{M_A^{1-r}}{1-r} \quad \text{and} \quad PV_B = \frac{1}{(1+\gamma\tau)}\frac{M_B^{1-r}}{1-r} \tag{10}$$

for $\gamma > 0$. Qualitatively, we get similar results for the hyperbolic discounting model and quantitatively, we get slightly larger estimated discount rates and slightly lower CRRA coefficients. Overall, we find that mood has no effect on CRRA coefficients but that positive induced mood results in higher discount rates. We also find that having a cognitively demanding task preceding risk elicitation results in higher CRRA coefficients; that is subjects become more risk averse irrespective of the mood state.

4.3. Risk aversion, discount rates and mood: Are there gender differences?

To test for gender differences on choice under risk, we ran gender-specific sessions represented by Treatments 5 and 6 in Table I. We did not alternate the order of the tasks as done in Treatments 1 to 4, since we have tested and demonstrated this effect in the previous section. To explore for gender differences, we compared Treatments 1, 5 and 6 and used the data from these treatments only. Table VIII and Table IX show the maximum likelihood estimates from these treatments using exponential and hyperbolic discounting respectively[10]. We allowed the δ, γ and r parameters of equation (9) to be linear functions of treatment effects (namely the *Positive*, *FemTreat* and *MaleTreat* variables; remember there is no control treatment for these data) and gender.

The general observation that joint elicitation of risk and time preferences results in lower discount rates and that hyperbolic discounting leads to slightly higher discount rate estimates and slightly lower CRRA coefficients, holds with these data as well. With respect to the CRRA estimates we find that subjects under positive mood are less risk averse than subjects under negative mood by approximately 7 points. However, the difference is not statistically significantly different from zero at conventional statistical levels (p-value=0.324 and 0.291 for the exponential and hyperbolic discounting models respectively). We can also observe that

[10] These represent results using the entire sample of Treatments 1, 5 and 6 using dummies (i.e., not using subsamples).

discount rates elicited under positive mood are higher than discount rates elicited under negative mood. Although we cannot reject the null of a zero difference, the null is marginally not rejected in some cases (p-value=0.110 and 0.117 for the exponential and hyperbolic discounting models respectively).

Interesting differences come up when comparing between the gender-specific sessions and the mixed-gender session. In the gender specific sessions, the CRRA coefficients are practically identical in the only-males session and the only-females session. However, when examining for differences between the mixed and the gender-specific sessions, males (females) appear to be more (less) risk averse in the gender-specific session than in the mixed sessions. We reject the hypothesis that females in the mixed sessions provided the same CRRA coefficient as the females in the gender-specific session (p-value=0.003 and 0.002 for the exponential and hyperbolic discounting models respectively) but not for males. Thus it appears that females are significantly less risk averse in the gender-specific sessions and this effect is consistent across mood states i.e., either positive or negative mood.

With respect to the discount rates, it is obvious that discount rates elicited from gender-specific sessions and mixed sessions both for males and females do not differ in terms of economic significance. For example, we elicit a discount rate of 22.7% (13.9%) for males under positive (negative) mood in the gender-specific session and a rate of 20.1% (12.3%) for males in the mixed session. The differences are not statistically significant either in any of the comparison groups. Note that in the risk neutral case one would have wrongly assumed that there are economically significant gender differences. For example the elicited discount rate for males under positive mood in the gender-specific session (77.9%) is almost double the discount rate elicited in the mixed session (41.5%).

5. Conclusions

Our objective in this study is to assess the effect of mood states on risk and time preferences. Our paper differs from previous studies in two important ways. First, we jointly elicited measures of risk and time preferences. Credible estimates of risk and time preferences have been found to rely on the joint estimation of risk and time preferences (Andersen et al. 2008). Yet, none of the previous studies jointly elicited these preferences when examining mood effects. Second, a vast majority of the studies that examined whether risk or time preferences can be affected by mood states was conducted in hypothetical contexts. We conducted our risk and time elicitation tasks non-hypothetically. Our results generally suggest that moods do not affect risk aversion coefficients, consistent with Walser and Eckel (2010). However, we found ample evidence that positive mood positively affects discount rates. This result is in contrast to Ifcher and Zarghamee (2010) that found that mild positive affect significantly increased the present value of a future payment. This finding seemed surprising at first, given the many similarities in the experimental procedures followed (e.g., paid for recruitment, real elicitation context, student sample etc.) in their study and ours. However, Ifcher and Zarghamee (2010) did not consider the simultaneous determination of risk and time preferences. Thus, they implicitly assumed risk neutrality in eliciting time preferences. While we cannot be completely certain that this is the reason for the difference in the results between our study and theirs, we can offer some hints based on some of our estimates. Specifically, we found economically significant differences between the negative induced mood and control treatments when risk neutrality is assumed (see panel B, Table VI and Table VII) but these differences disappeared when we allowed for risk aversion (see panel A, Table VI and Table VII). This result reflects the importance of the joint elicitation of risk and time preferences.

Given the increasing attention that economists are putting on examination of affect on risk and time preferences, future research should be cognizant of the role and the importance of joint and non-hypothetical elicitation of risk and time preferences. Future research should also test the robustness of our findings and examine the reasons why positive mood would increase discount rates or time preferences. It is possible that positive mood may substitute for income today (Ifcher and Zarghamee 2010). Hence, subjects in the positive mood would require less money today to be indifferent to more money in the future. It is also possible that positive mood enhances current levels of happiness (Lyubomirsky, King, and Diener 2005; Diener and Seligman 2004) and that current happiness makes people think less about the future; hence, the increase in time preference when under positive mood.

Considering the robust finding in the literature of the general effect of risk and time preferences on human behavior and health outcomes (e.g., Fudenberg and Levine 2009; Benhabib and Bisin 2005; Bernheim and Rangel 2004), the issue examined in our study has significant implications for assessment of the potential mechanisms through which risk and time preferences affect behavior and health outcomes. Our study also generally reinforces the argument offered in Ifcher and Zarghamee (2010) that affect should be neutralized before elicitation of time preferences since uncontrolled affect may be partially responsible for the wide range of time preference values estimated in past time preference studies. This issue is important in economics considering the large literature devoted to estimating and analyzing time preferences.

6. Appendix

Table A1. Literature on mood and risk and time preferences

Study	Paid for participation?	Elicitation context (real vs. hypothetical)	Type of sample	Was mood induced? (Yes, No)	How was mood induced?	Type of mood induced (Positive, negative, neutral)	Mood measurement	How were risk or time preferences elicited?	Did the study find significant association with mood?
(Johnson and Tversky 1983)	Yes	Hypothetical	Recruited from university's newspaper, probably students	Yes	By having subjects read stories	Negative, positive affect, neutral	9-point scale anchored by negative-positive	Were asked to estimate the risk (probability) for a list of death causes	Negative (positive) mood increased (decreased) subjective probability of death causes
(Isen and Patrick 1983)	No	tive risk on-financial participation course credit Study 2: Hypothetical	Students	Yes	By unexpected gift	Positive affect, neutral	NA	Study 1: bets on a roulette with varying chances of winning Study 2: Likelihood of taking the chance (1-10 scale) in hypothetical dilemmas of varying risk level	Study 1: Positive mood decreased bets (level of risk) Study 2: No effect
(Isen and Geva 1987)	No	non-financial participation	Students	Yes	By unexpected gift	Positive, neutral	NA	Subjects indicated minimum probability of winning for taking	Positive mood increased minimum level of probability

		course credit						the bet on a roulette with varying chances of winning	of winning for taking the bet
(Hockey et al. 2000)	No	Hypothetical	Study 1, 2: Students Study 3: Young management trainees of a chemical company[1]	Study 1, 2: No Study 3: Yes	Study 1, 2: incidental moods (not induced) Study 3: by giving a set of demanding tasks as part of the coursework	Study 3: negative mood (increased fatigue)	Mood diary for 3 times a day for 14 days (28 days in Study 2, 3 weeks in Study 3). 12 adjectives measured anxiety, depression and fatigue	Choice between 13 hypothetical dilemmas with one safe and one risky choice each, score of riskiness	Fatigue more strongly correlated with higher riskiness
(Hills et al. 2001)	Yes	Real	Students	Yes	By showing 10 minute videos	Positive, negative, neutral	By placing a mark on a 10-cm bipolar visual analogue scale with the words *sad* and *happy* at either end	Number of trials subjects played in a computerized gambling game (subjects could stop at their own choice)	Negative mood decreased number of trials played in the gambling game (which can be interpreted as less risk taking) for non-regular gamblers only. No effect for regular gamblers.

(Yuen and Lee 2003)	NA	Hypothetical	Students	Yes	By showing 22-26 minute videos	Positive, negative, neutral	By a 4-item 11 point likert scale (anchored by unpleasant–pleasant, tense–relax, tiresome–energetic, anxious-calm)	Choice between 3 hypothetical dilemmas with one safe and one risky choice each	Positive (negative) mood increased (decreased) risk taking tendency.
(Chou, Lee, and Ho 2007)			Members of community and youth centers						Negative mood decreased risk taking tendency. Positive mood increased risk taking for older but not younger people.
(Williams, Zainuba, and Jackson 2003)	No	Hypothetical	Company managers	No	NA	NA	A 14 item precursor of the PANAS scale	Self-reported likelihood of choosing each of a number of business risk scenarios	Negative affect decreased risk taking.
(Helga et al. 2007)	Yes	Real	Students	No	NA	NA	On a 6 likert scale anchored by bad-very good	Choices between lotteries and certainty payoffs	Women in positive mood (and not men) weigh probabilities more optimistically.
(Grable and Roszkowski 2008)	No	Hypothetical	Non-students	No	NA	NA	Self-evaluation to either happy, neutral or gloomy.	A 13-item risk-tolerance scale was used	Positive mood was associated with higher level of risk tolerance.

(Walser and Eckel 2010)	Yes	Real	Recruited from university's movie theater, probably students	Yes	By showing movies in a movie theater	Whatever the movie induced (subjects self-selected to attending the movie)	Several: PANAS scale, 10-point likert scale anchored by bad-good mood	Choices between lotteries and certainty payoffs	No significant effect
(Kim and Kanfer 2009)	No	Hypothetical	Students	Yes	By showing an 8 minute video	Negative	20 item PANAS scale	Choice between 10 hypothetical dilemmas in the form provided by Kahneman and Tversky (1979)	Negative mood increased risk-taking in one task but reduced risk-taking when a cognitive demanding task preceded risk elicitation.
(McLeish and Oxoby 2007)	Yes	Real	Students	Yes	Combinining feedback (success/failure) and gifts	Positive, negative, neutral	No	Choices between sum of moneys in different payout periods	Negative mood increases discount rate but only for women
(Ifcher and Zarghamee 2010)	Yes	Real	Students	Yes	By showing short video clips	Positive, neutral	Subjects were asked whether the film made them happier, sad or neither	Subjects were asked to state the amount of money they preferred today to make them indifferent to another amount of money in	Positive affect reduces time preference (increases the present value of a future payment)

								the future	
(Pyone and Isen 2011)	No (course credit)	Hypothetical	Students	Yes	Study 2: by showing picture slides Study 3, 4: by word tasks	Positive, neutral	Study 2: 7-point likert scales anchored by positive-negative, pleasant-unpleasant, happy-sad Study 3, 4: external judges scored input provided by subjects in word tasks	Study 2: Subjects filled in a self-reported future-time perspective questionnaire Study 3, 4: Subjects chose between instant and future rebates for a DVD player	Study 2: Subjects in positive mood scored higher in the future-time scales Study 3, 4: Subjects in positive mood chose more often the future rebate

[1] The trainees participated in two successive five-day professional development courses and in one sense can be considered students.

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Table I. Experimental design

Treatments	Mood inducement	Subject pool	Order of Tasks
1	Yes, Positive-Negative	Mixed	Preference Reversals – Risk Preferences
2	Yes, Positive-Negative	Mixed	Risk Preferences – Preference Reversals
3	No	Mixed	Preference Reversals – Risk Preferences
4	No	Mixed	Risk Preferences – Preference Reversals
5	Yes, Positive-Negative	Females	Preference Reversals – Risk Preferences
6	Yes, Positive-Negative	Males	Preference Reversals – Risk Preferences

Table II. Sample payoff matrix in the risk aversion experiments

Lottery A				Lottery B							Open CRRA interval if subject switches to Lottery B and background consumption=0	
p	€	*p*	€	*p*	€	*p*	€	EV^A (€)	EV^B (€)	Difference (€)		
0.1	2	0.9	1.6	0.1	3.85	0.9	0.1	1.640	0.475	1.17	-∞	-1.71
0.2	2	0.8	1.6	0.2	3.85	0.8	0.1	1.680	0.850	0.83	-1.71	-0.95
0.3	2	0.7	1.6	0.3	3.85	0.7	0.1	1.720	1.225	0.50	-0.95	-0.49
0.4	2	0.6	1.6	0.4	3.85	0.6	0.1	1.760	1.600	0.16	-0.49	-0.15
0.5	2	0.5	1.6	0.5	3.85	0.5	0.1	1.800	1.975	-0.18	-0.15	0.14
0.6	2	0.4	1.6	0.6	3.85	0.4	0.1	1.840	2.350	-0.51	0.14	0.41
0.7	2	0.3	1.6	0.7	3.85	0.3	0.1	1.880	2.725	-0.85	0.41	0.68
0.8	2	0.2	1.6	0.8	3.85	0.2	0.1	1.920	3.100	-1.18	0.68	0.97
0.9	2	0.1	1.6	0.9	3.85	0.1	0.1	1.960	3.475	-1.52	0.97	1.37
1	2	0	1.6	1	3.85	0	0.1	2.000	3.850	-1.85	1.37	+∞

Note: Last four columns showing expected values and implied CRRA intervals were not shown to subjects.

Table III. Payoff table for 3 month horizon in discount rate experiments

Payoff alternative	Payment option A in € (Pays amount below in 1 month)	Payment option B in € (Pays amount below in 4 months)	Annual interest rate in %	Annual effective interest rate in %
1	300	304	5	3.4
2	300	308	10	6.8
3	300	311	15	10.1
4	300	315	20	13.5
5	300	319	25	16.9
6	300	323	30	20.3
7	300	326	35	23.6
8	300	330	40	27.0
9	300	334	45	30.4
10	300	338	50	33.8

Table IV. Regression results for positive and negative affect

	Positive affect		Negative affect	
	Coef.	Std.Error	Coef.	Std.Error
Constant	**43.577****	**17.847**	**45.698*****	**13.765**
Easy	0.549	1.711	**3.917*****	**1.319**
Hard	**-3.776****	**1.703**	**5.013*****	**1.313**
Age	-0.078	0.944	**-1.796****	**0.728**
Gender	0.566	1.394	**2.277****	**1.075**
Hsize	-0.187	0.671	-0.325	0.518
$Educ_2$	-1.287	2.485	0.908	1.916
$Educ_3$	-3.092	2.756	**3.779***	**2.126**
$Educ_4$	-2.239	3.858	**5.124***	**2.976**
$Educ_5$	-1.917	4.926	**7.057***	**3.799**
$Income_2$	-4.826	2.990	1.320	2.306
$Income_3$	-5.018	3.187	3.394	2.458
$Income_4$	-0.334	3.164	0.387	2.440
R-squared	0.187		0.254	
Adj. R-squared	0.076		0.153	

Note: ***, **, * = Significance at 1%, 5%, 10% level.

Table V. Variable description

Variable	Variable description	Mean	SD
Age	Subject's Age	20.523	1.636
Gender	Dummy, 1=male	0.442	0.500
Hsize	Household size	4.279	1.059
$Educ_1$*	Dummy, 1st year student	0.221	0.417
$Educ_2$	Dummy, 2nd year student	0.128	0.336
$Educ_3$	Dummy, 3rd year student	0.349	0.479
$Educ_4$	Dummy, 4th year student	0.186	0.391
$Educ_5$	Dummy, 5th year student	0.116	0.322
$Income_1$*	Dummy, Household's economic position is good, very good or above average	0.070	0.256
$Income_2$	Dummy, Household's economic position is average	0.512	0.503
$Income_3$	Dummy, Household's economic position is below average	0.221	0.417
$Income_4$	Dummy, Household's economic position is bad or very bad	0.198	0.401
Positive (*Hard*)	Dummy, Subject is induced into positive mood (exposed to hard MENSA test)	0.384	0.489
Negative (*Easy*)	Dummy, Subject is induced into negative mood (exposed to easy MENSA test)	0.349	0.479
*Control**	Dummy, Subject's mood is not induced	0.267	0.445
Order	Dummy, Preference reversal task is conducted first	0.686	0.467
FemTreat	Dummy, only females in the session	0.186	0.391
MaleTreat	Dummy, only males in the session	0.198	0.401
*Mixed**	Dummy, mixed gender sessions	0.616	0.489

* Removed for estimation purposes.

Table VI. Estimates of risk and time preferences assuming exponential discounting

		CRRA coefficient (r)				Individual discount rate (δ)			
		Estimate	Std. Error	Lower 95% CI	Upper 95% CI	Estimate	Std. Error	Lower 95% CI	Upper 95% CI
A. Allowing a concave utility function (risk aversion)									
Risk preferences elicited after intervening stage	*Positive mood*	0.796	0.058	0.682	0.909	0.138	0.054	0.032	0.245
	Negative mood	0.874	0.062	0.753	0.996	0.087	0.039	0.012	0.163
	Control Treatment	0.883	0.093	0.699	1.066	0.090	0.045	0.003	0.177
Risk preferences elicited right after inducement	*Positive mood*	0.612	0.095	0.426	0.798	0.175	0.053	0.072	0.279
	Negative mood	0.690	0.115	0.465	0.915	0.111	0.060	-0.007	0.228
	Control Treatment	0.699	0.123	0.457	0.941	0.114	0.047	0.022	0.207
	μ	0.085	0.021	0.044	0.126				
	ν					0.033	0.011	0.011	0.056
B. Assuming a linear utility function (risk neutrality)									
Risk preferences elicited after intervening stage	*Positive mood*					0.894	0.307	0.292	1.496
	Negative mood					0.556	0.193	0.178	0.934
	Control Treatment					0.681	0.195	0.299	1.063
Risk preferences elicited	*Positive mood*					0.658	0.180	0.305	1.011
	Negative mood					0.409	0.161	0.094	0.724

right after inducement	*Control Treatment*					0.502	0.126	0.255	0.748
	ν					0.148	0.035	0.080	0.216

Table VII. Estimates of risk and time preferences assuming hyperbolic discounting

		CRRA coefficient (r)				Individual discount rate (γ)			
		Estimate	Std. Error	Lower 95% CI	Upper 95% CI	Estimate	Std. Error	Lower 95% CI	Upper 95% CI
		A. Allowing a concave utility function (risk aversion)							
Risk preferences elicited after intervening stage	*Positive mood*	0.788	0.063	0.665	0.911	0.146	0.060	0.028	0.264
	Negative mood	0.868	0.065	0.740	0.996	0.092	0.041	0.012	0.172
	Control Treatment	0.876	0.104	0.671	1.081	0.095	0.050	-0.002	0.193
Risk preferences elicited right after inducement	*Positive mood*	0.597	0.092	0.416	0.778	0.184	0.054	0.077	0.291
	Negative mood	0.677	0.114	0.453	0.902	0.116	0.063	-0.007	0.239
	Control Treatment	0.685	0.126	0.438	0.931	0.120	0.050	0.023	0.217
	μ	0.088	0.022	0.045	0.130				
	ν					0.035	0.012	0.012	0.058
		B. Assuming a linear utility function (risk neutrality)							
Risk preferences elicited after	*Positive mood*					0.931	0.341	0.263	1.600
	Negative mood					0.574	0.208	0.166	0.981
	Control Treatment					0.704	0.218	0.276	1.131

intervening stage					
Risk preferences elicited right after inducement	*Positive mood*	0.682	0.198	0.293	1.071
	Negative mood	0.420	0.173	0.081	0.759
	Control Treatment	0.515	0.136	0.249	0.782
	ν	0.149	0.038	0.075	0.223

Table VIII. Estimates of risk and time preferences assuming exponential discounting (gender differences)

Type of session		CRRA coefficient (r)				Individual discount rate (δ)			
		Estimate	Std. Error	Lower 95% CI	Upper 95% CI	Estimate	Std. Error	Lower 95% CI	Upper 95% CI
A. Allowing a concave utility function (risk aversion)									
Males only	*Positive mood*	0.603	0.195	0.222	0.984	0.227	0.098	0.035	0.420
	Negative mood	0.672	0.179	0.320	1.024	0.139	0.085	-0.028	0.307
Females only	*Positive mood*	0.600	0.084	0.435	0.764	0.266	0.090	0.090	0.442
	Negative mood	0.669	0.073	0.526	0.812	0.163	0.062	0.042	0.284
Mixed session	*Positive mood-Males*	0.436	0.104	0.231	0.640	0.201	0.091	0.022	0.380
	Negative mood-Males	0.505	0.100	0.309	0.700	0.123	0.053	0.020	0.226
	Positive mood-Females	0.813	0.053	0.710	0.917	0.276	0.138	0.006	0.547
	Negative mood-Females	0.882	0.075	0.735	1.030	0.169	0.109	-0.045	0.383
	μ	0.086	0.020	0.047	0.126				
	ν					0.060	0.021	0.019	0.101
B. Assuming a linear utility function (risk neutrality)									
Males only	*Positive mood*					0.779	0.319	0.153	1.405
	Negative mood					0.508	0.198	0.119	0.896
Females only	*Positive mood*					0.906	0.394	0.133	1.679
	Negative mood					0.590	0.203	0.193	0.987

Mixed session	*Positive mood-Males*					0.415	0.277	-0.128	0.959
	Negative mood-Males					0.271	0.151	-0.024	0.566
	Positive mood-Females					1.352	0.691	-0.003	2.707
	Negative mood-Females					0.881	0.439	0.020	1.742
	ν					0.184	0.045	0.096	0.273

Table IX. Estimates of risk and time preferences assuming hyperbolic discounting (gender differences)

Type of session		CRRA coefficient (r)				Individual discount rate (γ)			
		Estimate	Std. Error	Lower 95% CI	Upper 95% CI	Estimate	Std. Error	Lower 95% CI	Upper 95% CI
	A. Allowing a concave utility function (risk aversion)								
Males only	*Positive mood*	0.580	0.174	0.239	0.921	0.246	0.100	0.051	0.441
	Negative mood	0.655	0.161	0.338	0.971	0.148	0.085	-0.018	0.315
Females only	*Positive mood*	0.584	0.080	0.428	0.740	0.288	0.105	0.083	0.493
	Negative mood	0.658	0.071	0.520	0.797	0.174	0.065	0.046	0.302
Mixed session	*Positive mood-Males*	0.427	0.102	0.226	0.627	0.208	0.099	0.013	0.402
	Negative mood-Males	0.502	0.099	0.308	0.695	0.125	0.054	0.019	0.232
	Positive mood-Females	0.805	0.052	0.702	0.908	0.302	0.153	0.001	0.602

	Negative mood-Females	0.880	0.076	0.730	1.029	0.182	0.116	-0.044	0.408
	μ	0.088	0.019	0.050	0.126				
	ν					0.064	0.022	0.021	0.106
B. Assuming a linear utility function (risk neutrality)									
Males only	*Positive mood*					0.843	0.401	0.056	1.629
	Negative mood					0.530	0.227	0.084	0.975
Females only	*Positive mood*					1.017	0.541	-0.043	2.077
	Negative mood					0.639	0.259	0.131	1.148
Mixed session	*Positive mood-Males*					0.435	0.315	-0.182	1.051
	Negative mood-Males					0.273	0.161	-0.042	0.588
	Positive mood-Females					1.511	0.864	-0.183	3.205
	Negative mood-Females					0.949	0.500	-0.031	1.929
	ν					0.193	0.060	0.077	0.310

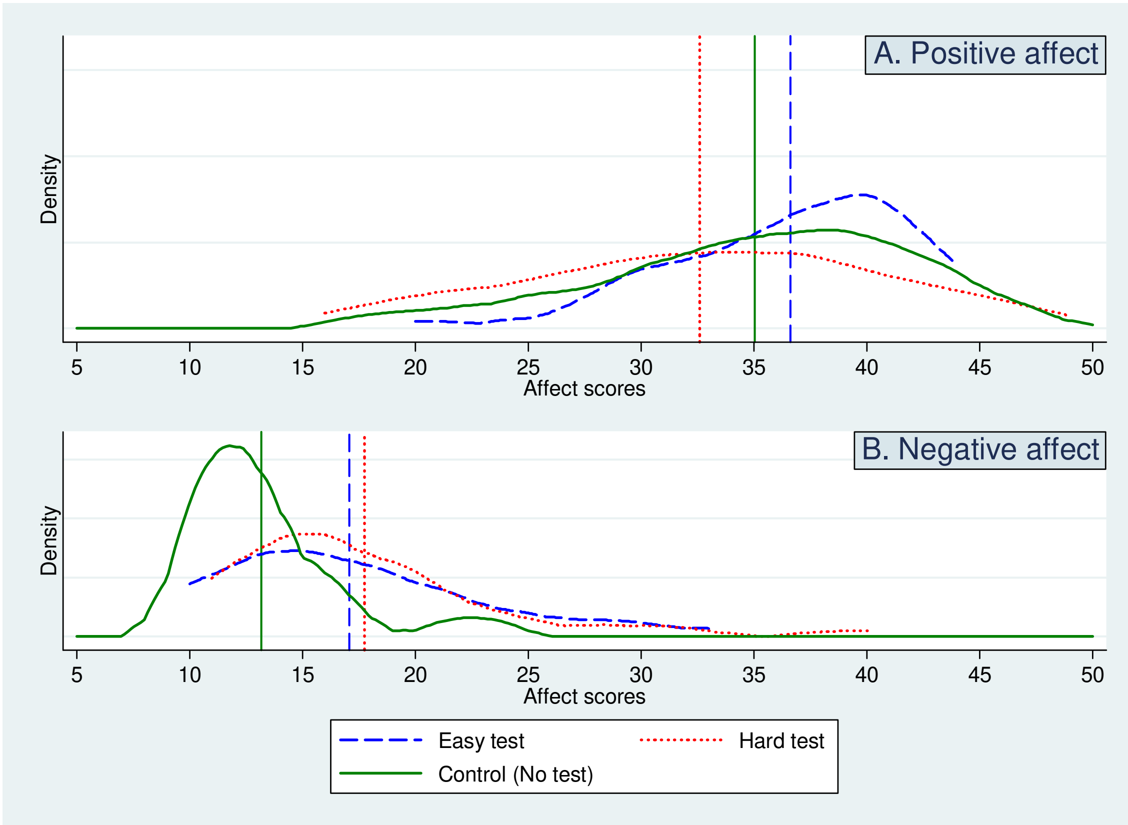

Figure I. Kernel density estimates for affect scores