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ABSTRACT

Investment, Resolution of Risk, and the Role of Affect*

This experimental study is concerned with the impact of the timing of the resolution of risk on people's willingness to take risks, with a special focus on the role of affect. While the importance of anticipatory emotions has so far been only inferred from decisions regarding hypothetical choice problems, we had participants put their own money at risk in a real investment task. Moreover, emotions were explicitly measured, including anticipatory emotions experienced during the waiting period under delayed resolution (which involved two days). Affective traits and risk attitudes were measured through a web-based questionnaire before the experiment and participants' preferences for resolution timing, risk, and time were incentive compatibly measured during the experiment. Main findings are that delayed resolution can affect investment, that the effect depends on the risk involved, and that (among all the measures considered) only emotions can explain our results, albeit in ways that are not captured by existing models.

JEL Classification: C91, D81 and G11
Keywords: delayed resolution of risk, emotions, experiment and investment decision

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1 Introduction

Decision making under risk often involves a time dimension, in the sense that some time passes between the decision to take the risk and the resolution of that risk. Examples are decisions concerning investment, medical examinations, lotteries, stock options versus compensations in cash, and health or safety related activities. The time that elapses before resolution can be very short, as with on-the-spot lotteries, but it can also be very long, like in research for new drugs. In mainstream economics this time dimension does not play a part, except for planning reasons, because the knowledge of outcomes may facilitate consumption smoothing (Drèze and Modigliani, 1972; Spence and Zeckhauser, 1972).[1] However, there is a small but growing literature acknowledging that the timing of the resolution of risk can be important. A path-breaking theoretical study is Kreps and Porteus (1978) which formalizes preferences for early or later resolution. More recently, economists have begun to emphasize and to explore the role of anticipatory emotions in this context (see Loewenstein et al., 2001). For example, the arousal felt when looking at a spinning roulette wheel may add to the attractiveness of a gamble with delayed resolution. On the other hand, anxiety can cause people to prefer a larger immediate electric shock to a lesser shock that would be delayed (Cook and Barnes, 1964; Loewenstein, 1987). Some long-lasting uncertainties can even cause stress and anxiety that is not only unpleasant but even health-threatening (Lazarus, 1991).

Emotions have received some attention in the economic literature. However this attention was typically restricted to experienced emotions when outcomes are observed, particularly regret and disappointment (Bell, 1982, 1985; Loomes and Sugden, 1982, 1986). Given the consequentialist character of mainstream economic models, this was a natural focus. Moreover, allowing for anticipatory emotions stands in the way of maintaining the axiom of temporal consistency (as in the model of Kreps and Porteus), as the influence of anticipatory emotions might change (reverse) an individual's preferences when the time of resolution draws near. Recently, supported by substantial psychological and neuroscientific evidence (see, e.g., Chua et al., 1999; Critchley et al., 2001; Loewenstein et al., 2001; Wray and Stone, 2005), some economists have picked up the challenge to develop new models incorporating anticipatory emotions, focusing on anxiety (Wu, 1999; Caplin and Leahy, 2001). With these models, which will be discussed in greater

[1] For a critical discussion of the neglect in economics of different stages of decision making, see Pope (1985, 1995).

detail below, a novel perspective is offered on issues like the equity premium puzzle and the simultaneous occurrence of insurance and gambling.

However, what seems equally important in expanding our understanding of the impact of anticipatory emotions on decisions under risk, is the development of a rich set of experimental data. Experiments enable us not only to test theoretical hypotheses and predictions but also to explore the role of different (anticipated and experienced) emotions and how these are affected by the delayed resolution of risk. In this way, they can assist in testing and improving theoretical models. Moreover, by a systematic and gradually more complicated experimental approach fundamental knowledge may be gained about the typically more complex and dynamic emotional patterns occurring in the field.[2] A few earlier studies should be mentioned in this context. Chew and Ho (1994) investigated participants' resolution preference in an experimental study using different hypothetical contexts (scenarios). They found that enjoyment of delayed resolution (interpreted as hope) was more prevalent in case of a small probability of winning a large gain. Ahlbrecht and Weber (1997) – also using hypothetical contexts – found a general preference for early resolution, paired with a switching preference for late (early) resolution if the probability of winning (losing) is very small, which is interpreted as hope (fear). Lovallo and Kahneman (2000) asked participants about the attractiveness of different gambles and the acceptability of a delayed resolution of the risk involved (for an imaginary situation). They found that generally early resolution is preferred (for reasons other than planning), particularly for mixed gambles, which were also typically evaluated as unattractive. The interpretation is that people want to avoid dread and fear. To our knowledge there exist only two experimental studies using real monetary incentives. Noussair and Wu (2006), using the protocol of Holt and Laury (2002), found more risk-aversion for gambles resolved (and paid) in the present than in the future. Eliaz and Schotter (2007), eliciting willingness to pay for earlier resolution of risk, found some weak statistical evidence in support of the importance of earlier resolution, which is seen as favoring the hypothesis that anticipatory emotions may play a role.[3] We will return to these studies below.

The experimental study presented in this paper builds on this strand of literature in being also concerned with the question how the timing of risk resolution affects the attractiveness of a

[2] See, in this context, Cubitt and Sugden (2001).
[3] In their experiment 18% of the participants were willing to pay a fixed fee of \$0.50 to find out whether they won \$20 or were facing a probability of 60% (to be resolved in three weeks) to win \$20. In the control treatment, in which the waiting period was just a few minutes rather than three weeks, only 6% agreed to pay the fee. The difference in proportions is only significant at the 13 percent level.

gamble and the willingness to take risks. However, our experimental design is novel in several important respects. First of all, participants put their own money at risk in a real investment task. Thus, not only monetary incentives were provided, but also real (out of pocket) losses were made possible. Second, anticipated as well as experienced emotions were explicitly measured (as in Hopfensitz and van Winden, 2008). Moreover, for the first time, anticipatory emotions experienced during the waiting period under delayed resolution - which involved two days - were elicited. Furthermore, as detailed in the next section, we used the response to a web-based questionnaire administered before the experiment to obtain data on affective traits and risk taking in different life domains, while in an incentive compatible way participants' preferences for resolution timing, risk, and time were measured during the experiment.

Our main findings are that delayed resolution can affect investment, that the effect depends on the risk involved, and that (among all the measures considered) only emotions can explain our results, albeit in ways that are not captured by the few existing affect models.

The rest of the paper is organized as follows. Section 2 presents the experimental design and procedures, along with theoretical predictions derived from the main models of decision making under risk. Section 3 discusses the behavioral results. Then, section 4 goes into the role of affect. It extends the analysis by first extracting some predictions from the relevant literature, which are subsequently tested through a regression model incorporating our affect measures. A further analysis of the role of affect takes place in section 5 where the data on recalled emotions are considered. Section 6 concludes.

2 Experimental design, procedures, and predictions

2.1 Design

To investigate the relevance of the timing of the resolution of risk for investment behavior, the experiment comprises two sessions (two days apart). At the first session, participants are confronted with the following individual choice task. Each participant has to allocate *20* euro (of their own money) to two "projects", A and B, where Project A is safe while Project B is risky. The return from Project A is always *1.2* times the amount allocated to this project. The return from B depends on the experimental condition. There are two conditions in this respect. In the Low

Probability (*LP*) condition, Project B returns with probability $p = 0.2$, *9* times the invested amount and returns nothing with probability $(1\text{-}p) = 0.8$. In the High Probability (*HP*) condition, Project B returns with probability $p = 0.8$, *2.25* times the invested amount and nothing otherwise. For convenience, in the sequel, only the money that is allocated to the risky project B is called *investment*. Each of these two probability conditions is investigated for two further conditions concerning the timing of the resolution of the investment risk. The resolution either takes place in the same session immediately after the investment decision (*Imm*) or at the beginning of the second session (*Del*). Details are discussed when we deal with the procedures. Each participant in the experiment is randomly assigned to one of the resulting four treatments: LP-Imm, LP-Del, HP-Imm or HP-Del.

Apart from the main investment task, three other tasks are employed to elicit potentially relevant preferences of the participants concerning timing of resolution, risk, and the time of payment (discount rate). First, after the investment decision, the preference for the timing of the risk resolution is measured by having participants indicate how much higher (or lower) the probability of the outcome from the risky project would have to be for them to be willing to switch to the other timing option (using a Becker-DeGroot-Marschak method for incentive compatibility). Second, at the second session (after the resolution of the risk), risk aversion is measured by having participants make multiple choices between two lotteries (on four multiple price list, see Harrison et al., 2006 for details and exact values used). Finally, at the end of the second session participants' time preferences (discount rate) are elicited by having them indicate when they would like to receive their payout from the experiment. Participants could either decide to be paid out immediately (via a bank transfer the next day) or prefer to have their total earnings plus different levels of interest transferred in two months (also by bank transfer; design based on Coller and Williams, 1999). In all of these tasks one of the choices is randomly selected to be played out for real. See the Instructions in Appendix A for greater details.

In addition to these revealed preferences measures, survey and self-report techniques are used to collect data on individual characteristics and emotions. In a web-based survey, to be completed before the first session of the experiment, data are obtained regarding demographic variables (age, gender, field of study) and some psychological traits. In view of the hypothesized importance of anxiety for decision making under uncertainty the survey includes the well-known STAI trait scale (Spielberger et al., 1970). Because of their apparent predictive power for risk taking, it further contains a trait measure of sensation seeking (Arnett, 1994), a risk-propensity scale for various life domains (Nicholson et al., 2005) and a general risk attitude question (based on Dohmen et al., 2005). Details are provided in Appendix B.

Because of our special interest in the role of affect, self-reports are used to measure the intensity with which various emotions are (1) anticipated at the time of the investment decision, (2) experienced after the resolution of the investment risk, and (3) recalled at the second session concerning the two-days waiting period in the treatments with delayed resolution.[4] For the first two measures we rely on earlier work (Hopfensitz and van Winden, 2008), while a novel measure is developed to deal with recalled emotions. The affect measures are further discussed below.

For an overview of the nature and timing of the different tasks and measures, see Figure 1.

2.2 Procedures

The experiment was announced by email using a web-based recruiting system. Upon registration participants received a link to a web page with a series of questions, which they were required to fill out at least 24h prior to the start of the experiment. The collected information consisted of general demographic data, the STAI trait scale, the sensation seeking scale, and a series of questions to measure risk attitude, as discussed above. Responses were linked to behavior in the experiment through a password that each subject had to choose, to assure anonymity. Participants were required to sign up for two sessions, two days apart. These sessions took place either on a Monday and Wednesday, or on a Tuesday and Thursday. Participants were also informed that their earnings from the experiment would be transferred to their bank account after completion of the experiment.

[4] According to Robinson and Clore (2002) self-reports are "the most common and potentially the best way to measure a person's emotional experience".

First session

Upon arrival at the first session, participants were required to submit 20 euro in cash – which was explicitly mentioned in the announcement – and were asked to read and sign a participant consent form (see Appendix C). No one objected to this procedure. Subsequently, they were asked to draw a table number at random and to take their position in the lab, where they had to fill in immediately their password from the web questionnaire. Once everybody was seated, the instructions for the first part of the experiment were distributed and read aloud (see Appendix A). The instructions informed the participants about the investment task and the particular timing (Imm or Del) and probability (LP or HP) condition they would be facing. They then had to submit their investment decision with respect to their 20 euro on the computer. Immediately after their decision, participants were asked to rate the extent to which they had taken into account a number of anticipatory emotions (such as hope and worry) and a couple of other emotions related to how one would feel immediately after the resolution.[5] Subsequently, the instructions for the second part of the experiment were distributed.

In this part, we measured participants' preferred timing condition, using the procedure discussed above. Whether participants actually had to switch to the other timing condition was determined by the draw of a random number.[6] Participants in the immediate resolution condition subsequently had to roll two dice to resolve their investment risk, and were immediately after that asked to indicate the intensity with which they experienced a number of emotions (see Figure 1:A). For participants in the delayed resolution condition the session ended after the timing preference task. When all participants had finished, the first session ended and participants were reminded that they would only be paid after the second session two days later.

[5] The six questions that were asked concerned the following emotions: "worry about the outcome", "enjoying hope for success", "excitement", "desire to know approximate earnings to plan expenditure", "expectation to feel really good in case of success", and "expectation to feel really bad in case of failure". In the delayed resolution treatment it was added to the first four (anticipatory) emotions: "during the two days to come". In addition, they were asked to state (hypothetically) the certainty equivalent of their gamble (given their investment decision); we will not use these hypothetical data in this paper.
[6] In total, only 2 participants actually had to switch.

Second session

At the start of the second session participants had to present an ID before drawing a seat number for the lab. Once everybody was seated in the lab and had typed in their personal password, they were reminded of their respective decision or earnings from the first session. Participants who had their investment risk resolved at the first session were asked if knowing the outcome had influenced their spending behavior during the last two days. All others were asked to roll the dice to determine their investment outcome. Immediately after this dice roll, these participants had to indicate the strength of the emotions they experienced when observing the outcome. In addition, participants were asked to recall the intensity with which they had experienced a number of emotions during the two-day waiting period (see Figure 1:B).

When finished, the instructions for the third part of the experiment were distributed. In this part risk preferences were elicited, using the multiple price list method, with one of the choices being randomly selected to be played out for real. The outcome was determined by having one participant roll dice (for the relevant choice and payoff).

Finally, total earnings (from the first and third part of the experiment) were presented to the participants, followed by instructions for the fourth and last part of the experiment. In this part participants were asked to indicate for 17 different interest rates whether they would prefer to be paid out immediately (that is, through a bank transfer on the next day) or rather have their earnings plus interest transferred in two months. Which of the interest rates applied was again determined through a dice roll by one of the participants.

Participants were then called one by one to the reception room where, under the supervision of a cashier (not being an experimenter), they completed a money transfer form with their own bank account number and their total earnings. Dependent on their payment choice, the form was collected in a box labeled "tomorrow" or "in two months".

The experiment was conducted in September and October 2006 at the CREED laboratory of the University of Amsterdam. In total 127 mostly undergraduate students participated in 9 (double) sessions,[7] 26% percent of which were women and 52% percent came from economics or business,

[7] Data from one "second" session was lost. Missing values of risk aversion and time preference coefficients were replaced by sample means in regressions including these variables as explanatory variables, to make maximum use of the available data.

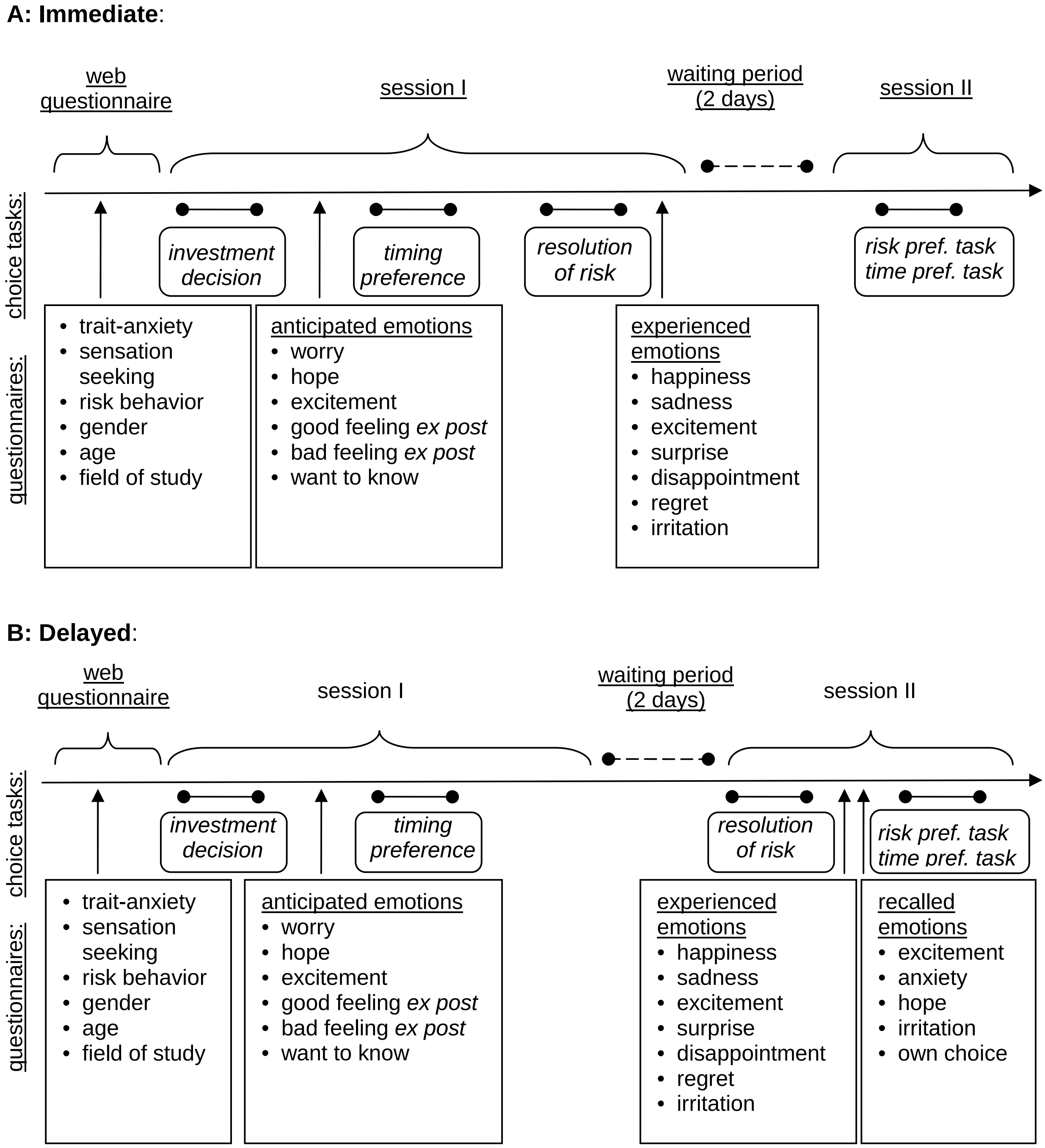

Figure 1. Order of events in the two timing treatments: Immediate (A) and Delayed (B)

while the others came from a variety of other disciplines. Each session took at most one hour and average (net) earnings amounted to about 25 euro.

2.3 Predictions of EUT and CPT

Splitting working money between two projects when all possible outcomes and associated probabilities are known can be analyzed with theories of decision making under risk. We start with predictions derived from Expected Utility Theory (EUT) and Cumulative Prospect Theory (CPT; Tversky and Kahneman, 1992). Some other theoretical models, taking direct account of the role of affect, will be considered in Section 4.

Expected Utility Theory. EUT predicts that the decision-maker chooses the investment level that maximizes his probability-weighed money-dependent utility. It has been argued (Rabin, 2000) that a utility function with wealth as argument should be virtually linear for amounts as small as those involved in our task. In that case, participants are predicted to invest everything in the risky project. On the other hand, taking experimental earnings as argument, many experimental studies show a non-trivial level of risk-aversion, with estimates of constant relative risk aversion roughly centered around the 0.3-0.6 range (Holt and Laury, 2002; Harrison et al., 2006). For this range, non-extreme investment is optimal under LP as well as HP. Furthermore, EUT would predict that risk-averse participants will find investment relatively more attractive under HP, as it involves a lower variance around the same mean, which suggests that investment under HP will be at least as large as under LP.

As for the timing of the resolution of risk, standard theory predicts that early resolution will be (weakly) preferred due to planning considerations, implying that investment will be at least as high under immediate resolution (treatment Imm) as under delayed resolution (treatment Del). However, this effect is expected to be negligible in the experiment, because the distance in time is very short (only 2 days) while the amount of money at stake forms only a minuscule fraction of a participant’s life-time wealth.

In short, EUT predicts maximal investment if utility is a function of wealth, while it is compatible with any level of investment if utility is a function of experimental earnings. Furthermore, it predicts higher investment under HP than LP and virtually no effect of the timing of the resolution of risk.

Cumulative Prospect Theory. In CPT (Tversky and Kahneman, 1992), it is important to know the decision maker's reference point defining losses and gains. While there is little theory to go by

(Koszegi and Rabin, 2006), in our case, the 20 euro that participants had to provide seems to be a natural reference point. Consequently earnings from the investment task falling short of 20 should be perceived as losses and earnings in excess of 20 as gains.[8] Note that in that case 3 euro is the highest investment level in the experiment for which the decision maker will certainly not make losses. Furthermore, empirical studies of CPT generally show an almost linear value function for small amounts. In our case, this would lead to an extreme prediction of either maximal investment (20 euro) or very low investment (0 or 3 euro). The probably most often employed parameterization, based on Tversky and Kahneman (1992), uses as value function a power function for gains and for losses (with a kink at the reference point representing loss aversion). The probability weighting function for gains is given by: $w^{+}(p) = p^{\gamma} / [p^{\gamma} + (1-p)^{\gamma}]^{1-\gamma}$, and a similar function is assumed to hold for losses (with δ substituted for γ). In this approach the parameters of the value function (denoted by α for gains and β for losses), the probability weighting functions (γ and δ) and loss aversion (λ) can vary across subjects. Taking median estimates of these parameters ($\alpha = \beta = 0.88$, $\gamma = 0.61$, $\delta = 0.69$, and $\lambda = 2.25$), investment of just 3 euro should be observed for either probability treatment (LP and HP). However, more recent studies suggest that median loss aversion may in fact be lower (see Abdellaoui et al., 2006, and references therein). If we set $\lambda = 1.75$ maximal investment under both probability conditions is predicted.

In general, the extreme nature of the prediction is neither idiosyncratic to the particular parameters of our gamble nor to the assumption regarding the reference point. As long as the value function has little curvature, the expected marginal utility of investment is nearly constant, which makes it typically optimal to either put everything in the risky project or nothing (or, perhaps, the highest amount that cannot lead to losses). Theoretically, CPT thus yields support for the wide-spread practice of presenting only binary choices to participants, because with a (quasi-) continuous investment space only the extremes are predicted to be chosen. It remains to be seen whether this holds empirically.[9]

Without assumptions imposed on the distribution of parameters among the participants, it is difficult to predict whether investment will be higher under HP or LP. Consider, for example, an individual with relatively low loss aversion ($\lambda = 1.75$) and a mildly concave value function ($\alpha = \beta$

[8] This should not be affected by the prospect of winning extra money during the second session as the latter was basically meant to cover the opportunity cost of participating in that session.
[9] Experimental findings with a similar investment task suggest, however, that a substantial proportion of non-extreme choices may be expected (Hopfensitz and van Winden, 2008)

$= 0.88$ or $\alpha = \beta = 0.8$). Then, if probabilities are heavily distorted (say, $\gamma = 0.5$), CPT predicts very high investment for LP but not for HP. If, however, the individual weighs probabilities in an almost linear manner ($0.8 < \gamma < 1$), exactly the opposite is true.

In short, CPT predicts extreme investment choices, given that the value function is supposed to have little curvature (for small stakes). Whether investment is higher under HP or LP depends on the particular distribution of the parameters. However, assuming commonly used parameter estimates, and 20 euro being the reference, an investment level of just 3 euro is predicted under both HP and LP. Furthermore, for the same reason as holds for EUT, no effect of the timing of the resolution of risk is expected.

3 Behavioral results

This section starts with our findings regarding participants' investment decisions in the different treatments. Then, we turn to the results of the tasks eliciting the preference for the timing of the risk resolution, risk aversion, and time preference. Finally, we will use these experimental findings to evaluate the theoretical predictions derived from EUT and CPT.

3.1 Investment

Figure 2 shows the distribution of investment in each of the four treatments: LP-Imm, LP-Del, HP-Imm, and HP-Del. It turns out that investment is higher under HP than LP in both timing conditions (Mann-Whitney-Wilcoxon test[10]: $p < 0.01$; Kolmogorov-Smirnov test: $p < 0.01$). More specifically, mean investment is nearly 5 euro (about 50%) higher under HP. Also, maximal investment (20 euro) is much more frequent under HP (48%) than under LP (23%), while investment below 10 euro is very rare under HP but not under LP. This leads to our first result.

RESULT 1 *Investment is higher under HP than LP.*

[10] All tests are two-sided, unless otherwise noted.

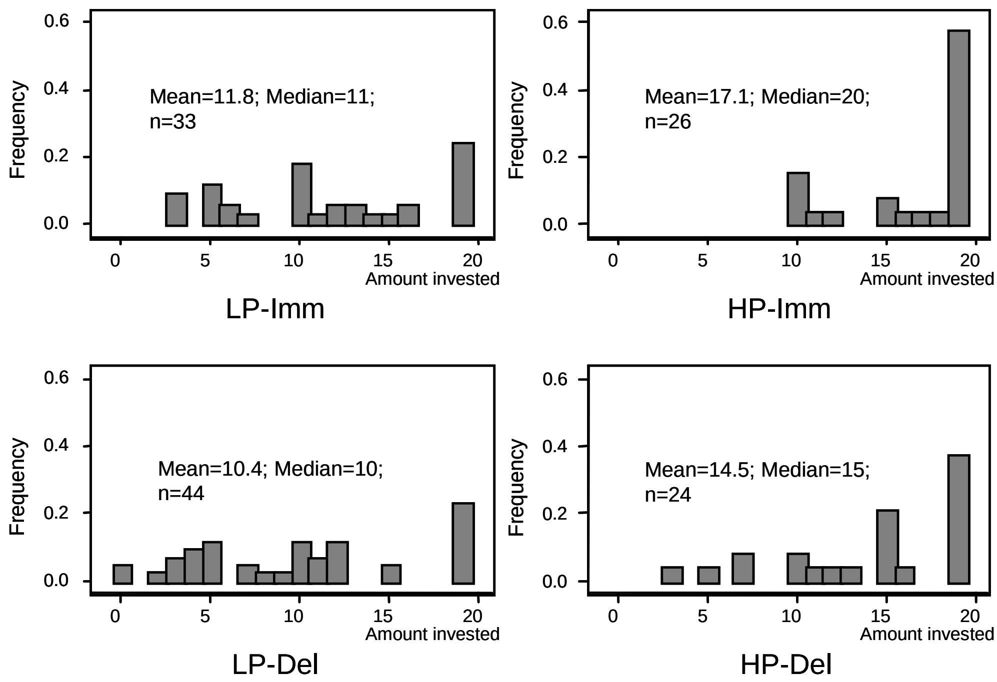

Figure 2. Distribution of investment in the different treatments

Next, we compare the invested amounts across the timing treatments. On average, investment is some 2.8 euro higher under the immediate resolution of risk. However, the effect is not equally strong for both probability treatments. For LP the difference is just 1.4 euro and statistically no difference in the distributions is observed (Mann-Whitney-Wilcoxon test: $p=0.27$; Kolmogorov-Smirnov test: $p = 0.71$). For HP, we find some weak evidence for higher investment under immediate resolution of risk (Mann-Whitney-Wilcoxon test: $p < 0.10$; Kolmogorov-Smirnov test: $p = 0.21$). The difference in mean investment is about 2.5 euro. Moreover, under delayed resolution median investment equals 15 euro, while the majority of the participants choose maximal investment under immediate resolution. Additional support for these results is obtained by combining all the data in a two-way ANOVA. Again, we find a clear effect of probability ($p < 0.01$) and a weaker impact of timing ($p = 0.056$), with no interaction effect. The following result summarizes.

RESULT 2 *In HP, investment is (weakly) higher under the immediate resolution of risk (Imm).*

Furthermore, though full investment is the mode in each treatment, a strong heterogeneity in investment choices, spread over the whole investment space, can be observed.

RESULT 3 *In all treatments except for HP-Imm, the majority of the participants choose intermediate investment levels.*

3.2 Preference for timing, risk aversion, and discount rate

In the experiment three different individual preferences – regarding the timing of the resolution, risk, and time – were elicited because of their potential relevance for observed investment. We first discuss our findings concerning these preferences. Their influence on investment behavior will be analyzed in the next subsection.

Participants' preferences for the timing of the resolution of the investment risk were elicited in the second part of the experiment. It turns out that about 50% of the participants are willing to take a "non-trivial" loss of at least 22.5 eurocents in expected terms (which corresponds to a decrease of one percentage point in the probability of winning in HP for an investment of 10 euro) in order to obtain (or keep) their preferred risk resolution condition.[11] However, if we take one euro as a non-trivial cutoff point (corresponding to a similar change in expected terms in LP) this proportion drops to about 10%. Although the proportion is larger in LP under both cutoff points, the difference is not significant. Moreover, using a Mann-Whitney test, we cannot reject a similar willingness to pay (in expected terms) in HP and LP. Furthermore, no correlation with investment is observed (see also below).

RESULT 4 *With an expected loss of at least 22.50 eurocents, about half of the participants show a preference for changing the timing of the risk resolution, virtually always in the direction of immediate resolution (Imm). With an expected loss of 1 euro, this share drops to 10%. No difference between the probability treatments (LP and HP) is observed.*

[11] More specifically, we have computed for each participant the expected loss resulting from accepting a lower probability of winning in the preferred timing condition. Suppose, for example, that someone invested 10 euro in the HP condition and was indifferent between an 80 percent probability of winning under immediate resolution and 82 percent probability of winning under delayed resolution of risk. This means that the additional gain of $10 \times 2.25 = 22.5$ euro is foregone with a probability of 2 percentage points. In other words, this person is willing to pay up to $0.02 \times 22.5 = 45$ eurocent in expected terms in order to obtain the preferred timing resolution. It turns out that the median of this highest acceptable loss is 22.5 eurocents.

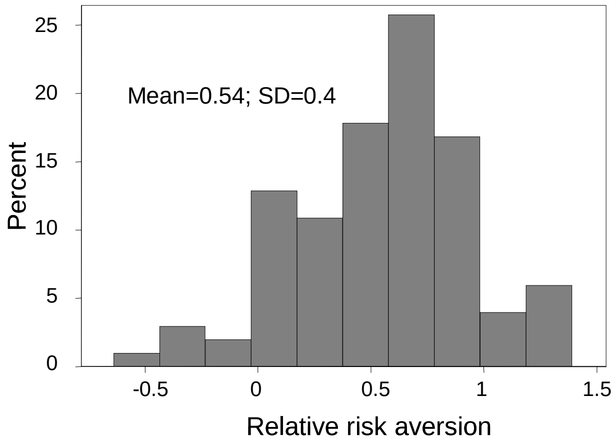

Figure 3. Distribution of estimated risk aversion (pooled observations).

The third and fourth part of the experiment concerned the elicitation of participants' risk aversion and time preference (discount rate). To obtain individual risk aversion estimates from the choices made in the risk preference task we follow the procedure used in earlier studies (Holt and Laury, 2002; Harrison et al., 2006).[12] The distribution of the estimated (constant) relative risk aversion parameters, across all treatments, is presented in Figure 3. Median estimated risk-aversion is about 0.595, which is between the estimates reported by Holt and Laury (2002) and Harrison et al. (2006). Thus, it seems that the fact that participants had to bring their own money did not lead to a substantial selection bias in this respect.

As behavior in the risk preference task could have been influenced by the outcome of the investment task, we checked whether winning or losing in the investment task influenced the estimated risk aversion. For example, as suggested by prospect theory, participants who lost some of their money in the investment task might have taken more risk in the risk preference task. To check for this possibility, we correlated the (exogenous) dummy variable indicating winning or losing in the investment task with estimated risk aversion. Even though our experimental design (playing with your own money) would seem to make losses particularly salient, no significant relationship is found (Spearman's $rho = 0.144, p = 0.151$). Below, we will therefore use estimated risk aversion as an exogenous variable to explain investment.

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[12] Assuming a CRRA utility function: $U(x) = x^{1-r}/(1-r)$, we compute for each of the four lists of binary choices the value of r corresponding to indifference in a particular row. Thus, switching at a given row is associated with an interval for the value of r. Midpoints of the relevant four intervals (corresponding to the four lists) are averaged to arrive at a single measure of risk aversion.

In the fourth and final part of the experiment, we measured participants' discount rates with the time preference task. Again, midpoints of the intervals consistent with switching at a given amount were used. The individual discount rates are roughly in line with those encountered in the literature. The median annual discount rate is 0.35. Coller and Williams (1999) obtain a value of about 0.2, depending on treatment, which would suggest that our participants were more impatient. However, note that the amounts involved in our study were substantially lower, which typically leads to heavier discounting (Frederick et al, 2002). Furthermore, the earlier payment was to be made "within about a week" rather than in a month time as in Coller and Williams' case, thus possibly leaving room for the immediacy effect (see e.g. Hoch and Loewenstein, 1991). Also in this respect, we do not think that our participants formed a biased sample.

We checked for correlation between estimated risk aversion and individual discount rates, and observe only a very weak positive correlation between the two parameters (Pearson's $r = 0.18$, $p = 0.084$; Spearman's $rho = 0.097$, $p = 0.362$). This seems in line with the mixed findings of some recent studies.[13] Moreover, estimated risk aversion is not correlated with the (self-reported) tendency to take risk in any of the five life domains considered or to take risk "in general". This is consistent with the notion that the propensity to take risk is a multi-faceted trait (MacCrimmon and Wehrung, 1986; Dohmen et al., 2005).

3.3 Findings versus predictions

Comparing first our Results 1-3 with the theoretical predictions, we find some mixed evidence for EUT but little support for CPT. While Result 1 (higher investment under HP than LP) and Result 3 (non-extreme investment) are compatible with EUT, both results fly in the face of CPT assuming standard parameter estimates.[14] On the other hand, Result 2, suggesting an impact of the timing of the resolution of risk, is hard to reconcile with both EUT and CPT as planning considerations do not seem to play a significant role (we will return to this issue below).[15]

Further evidence can be obtained by using the risk aversion (CRRA) estimates to generate predictions at the individual level (using the utility function: $U(x) = x^{1-r}$). Figure 4 presents the

[13] For example, Anderhub et al. (2001) find some positive correlation (with significance depending on the treatment of the data), while van Praag and Booij (2003) obtain a moderately negative correlation in their dataset.
[14] Also, we find little evidence of an investment of 3 being prominent. Only 7 out of 127 participants (5.5%) chose this particular level.
[15] This result further contrasts with Noussair and Wu's (2006) finding of more risk aversion when lotteries are immediately resolved. We will return to this study in the next section.

frequency distributions of actual investment and investment predicted by EUT, for LP and HP (pooled across timing). Although EUT correctly predicts a spike at maximal investment and, on average, a higher investment level under HP, nevertheless, for each probability treatment the hypothesis that actual and predicted investment come from the same distribution is rejected (Kolmogorov-Smirnov test: $p < 0.001$ for LP, and $p = 0.016$ for HP).

Moreover, EUT has little predictive power at the individual level. Even though predicted and actual investment levels are positively correlated under LP (Spearman's *rho*= 0.247, $p = 0.077$) this is not at all the case under HP (Spearman's *rho* = *0.018*, $p = 0.900$).[16]

Obtaining individual level predictions for CPT is much more difficult, as more parameters would have to be estimated from the risk-preference task, which is not well-suited for that purpose. Therefore we are not able to asses predictive success of CPT at the individual level. All we can say is that in view of its poor performance at the aggregate level, it is unlikely to do very well at the individual level.[17]

CONCLUSION 1 *Overall, the predictive power of both EUT and CPT turns out to be poor. Assuming standard estimates of (constant relative) risk aversion, EUT successfully predicts the higher investment in HP and the typical non-extreme investment levels in both HP and LP. However, it fails to predict the behavioral impact of (and preferences for) the timing of the resolution of the investment risk; also, an individually calibrated EUT model has to be rejected both at the aggregate and individual level. Assuming standard parameterizations, CPT fails to predict our findings, particularly those regarding intermediate investment and resolution timing.*

Given the weak predictive power of EUT and CPT, and to prepare the ground for a further analysis incorporating affect, we will now use a (censored Tobit) regression model to assess the influence of a number of exogenous variables on investment. Explanatory variable are: the different treatments (with HP-Imm taken as base category), estimated risk aversion, the estimated discount rate, the self-reported tendency to take risk (including the general risk question), gender, age, and field of study (economics or otherwise). Results are presented under Model 1 in Table 1. The reader is kindly requested to ignore for the moment the other two models in this table, which will be discussed in the next section.

[16] Results are not very different if the correlations are conditional on winning or losing in the investment task.
[17] For some other experimental evidence against CPT as a theory of risky decision making, see Birnbaum (2004).

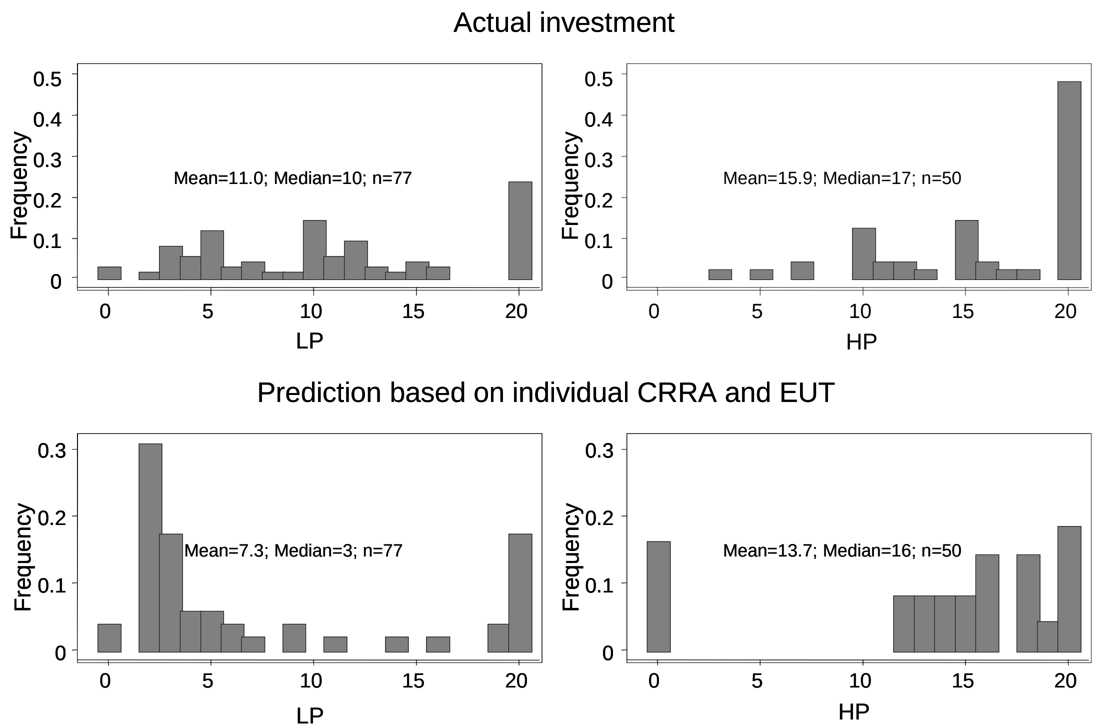

Figure 4. Actual versus predicted investment (using CRRA estimates and EUT) for LP and HP.

Note that only the three treatment dummies show significant coefficients. Neither estimated risk aversion, nor the individual discount rate, nor the self-reported risk attitude[18] show significance (and the same holds for gender, age, and being an economist or not). Only the probability and the timing of the resolution appear to matter, and the respective regression outcomes corroborate Results 1 and 2 above. In line with Result 2, investment in HP is lower under delayed resolution of risk (HP-Del), while no timing effect is observed for LP because the corresponding coefficients are not significantly different. Furthermore, since the coefficient of HP-Del is larger than the coefficients related to LP, investment is higher under HP than LP, in line with Result 1.

4 The role of affect

Our experimental results suggest that a model allowing for an intrinsic preference for the timing of the resolution of investment risk should be considered. Path-breaking in this respect is an early model of Kreps and Porteus (1978) which allows for such a preference. In their model, inter-temporal decisions obey a "temporal consistency" axiom, which requires that a choice at time *t*

[18] Similar results are obtained when general tendency to take risk is used instead.

between two lotteries that bring the same immediate consumption will not be reversed at time *t+1*. As a result, investment should only depend on the time between the resolution of risk and payment, not on the time between the decision and the resolution. Translated to our experiment, this model would predict no effect of the timing of the risk resolution on investment, unless being paid in about seven days (time consumed by the bank transfer) rather than nine days (including the two days in between the sessions) matters; which seems highly unlikely. Nevertheless, we find that the timing does influence investment, albeit only in the high probability treatment. The temporal consistency axiom effectively nullifies the potential impact of anticipatory emotions, like hope or worry (Wu, 1999). Because any delay in the resolution of risk can trigger anticipatory emotions, we now turn to a discussion of the potential role of affect, including some recent models that do take anticipatory emotions into account.

4.1 Predictions based on the literature

Based on the literature, affect can play a role in both dimensions of the investment task: risk and time of resolution. The former has been studied by Lovallo and Kahneman (2000) who regard both HP and LP as mixed gambles, characterized by the possibility of a loss[19]. They find that these gambles are less attractive to people than gambles with the same (positive) expected value but only positive outcomes: "The most striking effect of the data (…) is the dramatic effect of the possibility of a loss" (p. 183). Moreover, their data suggest that mixed gambles with a higher mean-preserving spread are less attractive, which in turn suggests that LP is experienced as less attractive than HP. Thus, we arrive at the following prediction:

P1 Under the immediate resolution of risk, investment is predicted to be higher in HP than LP, due to the greater attractiveness of the former type of gamble.

[19] The loss in Lovallo and Kahneman (2000) is hypothetical in contrast with our study.

Table 1. Regression modeling of investment choices (censored Tobit regression)

Explanatory variables:	Model 1 coefficient	St. Er.	Model 2 coefficient	St. Er.	Model 3 coefficient	St. Er.
LP_Imm	-9.04**	2.24	-4.78*	2.22	-4.61*	2.18
HP_Del	-4.96*	2.52	-4.41	2.34	-3.81	2.31
LP_Del	-10.33**	2.11	-7.18**	2.10	-6.83**	2.09
Risk aversion	-1.63	2.24	-0.97	1.83		
Discount rate	-0.97	1.24	-1.48	1.05		
Risk in life domains	1.32	1.05	0.37	0.96		
Anxiety trait			0.06	1.65	-0.67	1.60
Sensation seeking			-1.67	1.99	-1.35	1.84
HP-Imm x PAEF[a]			5.95**	2.11	5.70**	2.12
HP-Del x PAEF			0.39	1.47	0.73	1.44
LP-Imm x PAEF			1.83	1.21	1.97	1.23
LP-Del x PAEF			2.86*	1.19	3.24**	1.18
HP-Imm x NAEF[b]			-5.12*	2.18	-5.00*	2.12
HP-Del x NAEF			-3.97**	1.48	-3.98**	1.48
LP-Imm x NAEF			-4.64**	1.25	-4.42**	1.24
LP-Del x NAEF			-3.16**	0.96	-2.88**	0.95
Female	-1.61	1.68	-2.79	1.47	-2.79	1.48
Age	0.03	0.26	0.10	0.21	0.12	0.20
Economist	2.18	1.48	1.16	1.20	1.01	1.19
Constant	17.59	0.01	21.70	0.01	21.00	0.01
Pseudo R2	0.05		0.13		0.13	
N	117		117		117	
Model comparison	1 vs. 2		2 vs. 3			
LR chi2	55.64		2.82			
p-value	< 0.001		0.42			

* significant at 5% level ** significant at 1% level.
[a] PAEF stands for Positive Anticipated Emotions Factor; [b] NAEF stands for Negative Anticipated Emotions Factor.

With respect to the second dimension – the time of resolution – it is analytically useful to distinguish between three factors: (a) how people feel about a delay as such, (b) emotional arousal related to the length of the delay, and (c) the relative weight given to different future emotions. Lovallo and Kahneman's (2000) study suggests a general dislike for delayed resolution, especially for mixed gambles (see also Albrecht and Weber, 1997; Eliaz and Schotter, 2007). In the theoretical model of Caplin and Leahy (2001), anxiety arises when future consumption is uncertain, which in turn reduces the attractiveness of investment (because of the anticipated negative hedonic value of anxiety). As a result, immediate resolution is expected to be preferred while investment should be lower under delayed resolution. This leads to the next prediction:

P2 *In both HP and LP, investment will be negatively influenced by a delay in resolution because of a general dislike for delay.*

Regarding emotional arousal during the waiting period, psychological studies suggest that anticipatory emotions will show a U-shaped profile over the time interval, with the stronger intensities showing up immediately after the investment decision and just before the resolution of the risk (Caplin and Leahy, 2001). Moreover, a longer waiting period would result in a markedly greater buildup of anticipatory emotions than a shorter period (see also Wu, 1999). Assuming that people anticipate this greater buildup – as in the theoretical models of Caplin and Leahy (CL) and Wu (W) – a stronger role of affect is predicted with delayed resolution of risk. On the other hand, empirical findings by Loewenstein (L) and others suggest that people give lesser weight to, and underestimate the impact of their future emotions in decision making (Loewenstein, 1996; Loewenstein and Schkade, 1999). This suggest that the role of affect would be weaker under the delayed resolution of risk. Thus, we have the following two opposing predictions:

P3 (CL and W) *The role of affect is predicted to be stronger under delayed resolution of risk.*

P3 (L) *The role of affect is predicted to be weaker under delayed resolution of risk.*

Finally, regarding the relative weight given to different future emotions, again two opposing predictions can be derived from the literature. Based on Caplin and Leahy's model, negative (anxiety-related) emotions are predicted to be relatively more important, particularly in LP with its larger variance in outcomes. The theoretical model of Wu (1999), on the other hand, proposes that individuals overestimate very positive and very negative yet unlikely outcomes. In the first case, hope inflates the perceived chance of winning, while in the latter case anxiety inflates the perceived chance of losing. In our experiment, this would lead to a more positive assessment of investment in LP and a more negative one in HP. As a result, based on Wu's model, investment is predicted to be positively (negatively) affected in LP (HP). By the same token, immediate resolution would be preferred under HP, while delay would be welcomed under LP. Some experimental support for a switching preference for uncertainty resolution is provided by Albrecht and Weber (1996). Furthermore, Chew and Ho (1994) find that enjoyment of delayed resolution (hope) is more prevalent in case of small probability of winning.[20] The following prediction summarizes the two (partly) opposing predictions.

P4 (CL) *Negative (anxiety-related) emotions are predicted to be relative more important, particularly in LP, inducing a negative impact on investment.*

P4 (W) *Negative (anxiety-related) emotions are predicted to be relatively more important in HP, while positive (hope-related) emotions are predicted to be more important in LP. Consequently, anticipatory emotions are expected to have a negative impact on investment in HP and a positive impact in LP.*

Note that to the extent that P3 (CL and W) holds, the effects referred to under P4 should be expected to be stronger in HP-Del and LP-Del.

4.2 A regression model incorporating affect

We now turn to an analysis of how affect is related to investment in the experiment. We start with some general evidence of the role played by affective traits and states. Thereafter, the regression model of section 3 will be extended to incorporate our affect measures, followed by tests of the predictions presented in the previous subsection.

As discussed in the design section, we measured sensation seeking and trait anxiety (in the web-questionnaire) as potentially important affective traits. While sensation seeking is seen as a predisposition for excitement about taking risks (Arnett, 1994), the opposite holds for trait anxiety which predisposes people to experience anxiety under uncertainty (Spielberger et al., 1970). Therefore, we expect sensation seeking (trait anxiety) to be positively (negatively) correlated with investment. Moreover, because a prolonged waiting period gives anticipatory emotions more time to build up (see above), these correlations might be stronger under delayed resolution of risk.

[20] Both studies use hypothetical decision problems.

However, we find only a significant (negative) correlation for trait anxiety, and only in case of immediate resolution of risk (Spearman's *rho* -0.419, $p < 0.01$).[21] Sensation seeking shows a positive but insignificant correlation with investment under both timing conditions. Below, we will investigate via a regression analysis whether these unexpected findings are robust when we control for other factors.

For a first assessment of the importance of affective states across the resolution timing conditions, we simply look at the means of the self-reported intensity with which various anticipated emotions played a role when the investment decision was made. See Table 2.

For all these emotions it turns out that their role is (much) more pronounced in the treatments with immediate resolution of risk. Moreover, as the test results show, the difference in importance is significant for the anticipatory emotions: Hope, Excitement, and Worry. This is also true if we control for the probability of successful investment. In both HP and LP, the differences for the three anticipatory emotions stay significant ($p < 0.05$), except for Excitement under HP, where it becomes only weakly so ($p = 0.10$). In contrast, the prospect of feeling good or bad about the outcome of the resolution, and the measure of how much they Want To Know, appear to play a similar role in both timing conditions.[22] We will return to these findings below.

Because of the substantial correlations among the anticipated emotions, we performed a factor analysis to identify the main dimensions for the regression analysis below. It turns out that two factors represent more than 60 percent of the overall variance of the six emotion items; see Table 3. The first can be identified as a Positive Anticipated Emotions Factor (PAEF), with as prominent emotions Hope, Excitement, and Good Feeling Ex Post. The second can be identified as a Negative Anticipated Emotions Factor (NAEF), with as prominent emotions Worry, Bad Feeling Ex Post, and Want To Know. We expect PAEF (NAEF) to have a positive (negative) impact on investment.

[21] This outcome supports Hopfensitz and van Winden (2008) who find some weak experimental evidence for a negative effect of trait anxiety in a similar investment task with immediate resolution.

[22] The variable Want To Know stands for the statement: "I wanted to know approximately how much I would win to plan my expenses". The idea was to tap with this statement the importance of the economic planning consideration discussed in subsection 2.3. To our surprise, the mean response was higher for Immediate (where clearly no expenses can take place between the decision and the resolution) than for Delayed. Further, it did not correlate with the response to the question about actual changes in expenses asked during the second session. (The latter also suggested that the planning consideration was weak, with the majority of the subjects stating that they did not adjust their spending, choosing 0 or 1 on a 5-point scale). Given the correlation of Want To Know with Bad Feeling Ex Post (0.31, $p < .01$), but not with Good Feeling Ex Post, it seems to relate more to avoiding negative monetary surprises. See also the factor analysis below.

Table 2. Intensity of anticipated emotions under immediate and delayed resolution.

	Hope	Excitement	Good Feeling *Ex Post*	Worry	Bad Feeling *Ex Post*	Want To Know
Immediate resolution	4.101	3.288	4.338	2.542	4.338	3.254
Delayed resolution	1.500	2.294	4.176	1.294	3.029	2.852
Overall Average	2.708	2.755	4.251	1.874	2.881	3.039
Mann-Whitney test: Immediate vs. Delayed	*$p < 0.01$*	*$p < 0.01$*	*$p = 0.68$*	*$p < 0.01$*	*$p = 0.38$*	*$p = 0.31$*

To evaluate the role of affect and to test the predictions of subsection 4.1, we expand our regression model of subsection 3.3 (Model 1) by including the affective trait variables (sensation seeking and trait anxiety) and the two identified anticipated emotions factors: NAEF and PAEF. The latter are interacted with the treatment dummies.[23] The results are shown under Model 2 in Table 1. Note from the Pseudo-R^2 value and the likelihood ratio test, at the bottom of the table, that the new model performs significantly better. Moreover, leaving out the economic variables – see Model 3 in the table – does not affect its explanatory power (see the comparison of Model 2 and Model 3), and hardly affects the results in a qualitative sense. We focus, therefore, on the more parsimonious Model 3, and observe the following.

Table 3. Factor analysis of anticipated emotions

	Factor Loading	
	PAEF[a]	NAEF[a]
Hope	0.842	0.314
Excitement	0.830	0.003
Good Feeling *Ex Post*	0.613	- 0.244
Worry	0.274	0.796
Bad Feeling *Ex Post*	-0.310	0.725
Want To Know	-0.179	0.620
Proportion of variance explained[b]	0.329	0.284

[a] PAEF (NAEF) stands for Positive (Negative) Anticipated Emotions Factor.
[b] The proportions of variance explained by the third and fourth factor were only 13.1 and 12.2 percent, respectively.

[23] As in Model 1, willingness to pay in the resolution timing task shows no relation with investment if added as variable or interaction term. Note, in this context, that willingness to pay was measured after the investment decision, which should already have adjusted for emotions, including the unattractiveness of delay (they could not renew their investment decision). This may be the reason that relatively few people spend a non-trivial amount on switching (about 10% at least 1 euro). As a consequence, variation may be too little to capture an effect.

First, note that the importance of the treatment dummies has decreased substantially. More specifically, the coefficients of LP-Imm and LP-Del are about 40% smaller, while the coefficient of HP-Del is now only weakly significant ($p = 0 .10$).[24] Second, no direct effect is observed from the trait variables (trait-anxiety and sensation seeking). However, we notice that trait-anxiety is correlated with NAEF (Spearman's *rho = 0.2431, p = 0.006),* while sensation seeking is correlated with PAEF (Spearman's *rho = 0.1559, p = 0.0081)*, which is in line with emotion traits being dispositions for emotion states. Third, there appears to be an asymmetry in the impact of negative and positive anticipated emotions. While negative anticipated emotions (NAEF) always play a role, resolution timing and risk affect the impact of the positive anticipated emotions (PAEF). The latter are influential in HP only under immediate resolution and in LP only under delayed resolution.[25] Fourth, the impact of both NAEF and PAEF is weaker under delayed resolution, except for the effect of PAEF in LP-Del. Finally, investment now appears to be (weakly) lower for female participants, which supports earlier findings (e.g. Charness and Gneezy, 2004; Bajtelsmit et al, 1997). We next compare our results with the predictions presented in the previous subsection.

P1 Two pieces of evidence support the prediction concerning the relative attractiveness of HP-Imm compared to LP-Imm: *(i)* the positive influence of PAEF in HP-Imm, while in LP-Imm only NAEF shows an impact; *(ii)* the fact that the value of NAEF in LP-Imm is larger than in HP-Imm (Mann-Whitney-Wilcoxon test, $p = 0.027$), while there is no difference regarding the value of PAEF.

P2 Some support for the predicted general dislike for delay and its negative effect on investment is provided by the (weakly) negative effect of the dummy for HP-Del and the (non-significantly) larger coefficient of the dummy for LP-Del. Moreover, we observed before a predominant willingness to pay for switching to the early resolution timing condition (see subsection 3.2).

[24] Although the coefficient of LP-Imm is less negative, again, it does not significantly differ from that of LP-Del.

[25] Incidentally, the overall stronger impact of negative emotions is in line with many similar findings in the psychological literature (Baumeister et al., 2001).

P3 Substantial evidence is found for a weaker role of affect under delayed resolution, supporting P3 (L). The values of NAEF and PAEF are smaller under delayed resolution and, if anything, their impact tends to be weaker.[26]

P4 In support of Wu's model (W), we find a relatively stronger impact of negative emotions (NAEF) in HP-Del and of positive emotions (PAEF) in LP-Del. On the other hand, the relatively stronger effect of PAEF (NAEF) observed in HP-Imm (LP-Imm) runs against this model, while providing some support for Caplin and Leahy's model (CL) concerning LP.[27]

The next conclusion summarizes our explanation of the timing effect observed in the experiment.

CONCLUSION 2 *Predictions P1, P2, and P4 (W) find substantial support in our experimental data. Together they offer an affect-based explanation for the resolution timing effect observed in HP. Driving factor is the relative attractiveness of HP-Imm (P1). Under delayed resolution both in HP-Del and LP-Del investment is (weakly) negatively affected by a general dislike of delay (P2) and by negative anticipated emotions, which are only in LP-Del countered by a positive impact of positive anticipated emotions (P4 (W)). This results in a clear (negative) effect of delayed resolution in HP only. In addition, there is evidence of a weaker role of anticipated emotions under delayed resolution, supporting P3 (L).*[28]

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[26] The values of PAEF and NAEF are lower in the delayed treatment for each probability condition separately $p < 0.01$ in each pairwise comparison (Mann-Whitney-Wilcoxon test), except for NAEF under HP, where $p = 0.07$). The impact of PAEF is greater under immediate than delayed resolution for HP (t-test, $p = 0.05$) but not significantly different for LP. The impact of NAEF is lower (in absolute terms) under delayed resolution for both probability treatments, albeit not significantly so.

[27] Overall, we find only limited evidence in favor of the existing affect models of delayed resolution. As noted above, in contrast with Wu's model, for instance, we find a relatively stronger effect of PAEF (NAEF) in HP-Imm (LP-Imm). Against Caplin and Leahy's model appears to run the finding of a similar value of NAEF in both HP-Del and LP-Del, as well as the finding that the coefficients of the NAEF variables are not more negative in LP than HP. Moreover, against both models appears to run the observation of a generally weaker impact and lower intensity of anticipated emotions under delayed resolution. Finally, note from the components of NAEF and PAEF that it is not only anticipatory emotions that count, but also emotions experienced after the resolution, which are neglected in both models.

[28] Because of the observed role of affect, the experiment of Noussair and Wu (2006), who found greater risk aversion under immediate than under delayed resolution, seems problematic. Their experiment consisted of two rounds, with (always in the same order) the immediate resolution task in the first round, and the delayed resolution task in the second round (using Holt and Laury's (2002) design). However, the resolution under "immediate" in fact occurred *after* subjects had finished the second round. Consequently, subjects were presumably still experiencing anticipatory emotions when making their decisions in the second round, which may have influenced their decisions. Another, technically problematic issue is that they did not allow for indifference in their risk preference task, while only about one-step differences were found between switching in the immediate and the delayed resolution tasks.

The following section provides some further evidence of the differential role of emotions under the immediate and the delayed resolution of risk, based on the experimental data regarding experienced and recalled emotions.

5 Experienced and recalled emotions

Our experimental findings concerning the emotion factors NAEF and PAEF suggest that anticipatory and ex post (after resolution) experienced emotions play an important role in the investment decision. This supports theoretical modeling attempts to deal with prospect-based emotions like anxiety or regret. However, an open question is to what extent these anticipated emotions are later actually experienced (that is, well forecast) and whether there is an effect of the timing of the resolution of risk in this respect. Insight into this issue is important, because a discrepancy between anticipated and experienced emotions would point at a conflict between decision utility and experienced utility (cf. Kahneman et al., 1997). Another issue concerns the assumptions made in the recent affect models of decision-making under risk regarding the time-profile of anticipatory emotions, that is, the development of these emotions during the waiting period. Both issues will be investigated next, using our data on experienced and recalled emotions.[29]

First, we examine whether the anticipated "good feeling *ex post*" (in case of successful investment) and "bad feeling *ex post*" (in case of failure) were actually experienced. To analyze this issue we have constructed an index of "positive experienced emotions" (PEE) and one of "negative experienced emotions" (NEE), by summing up the intensity scores regarding the relevant emotions (for PEE: happiness and excitement; for NEE: sadness, disappointment, regret, and irritation). For subjects who actually observed a negative investment outcome, it turns out that NEE is not correlated with the extent to which they had taken into account the "expectation to feel really bad in case of failure" in their investment decision. On the other hand, for subjects who were successful, PEE is found to be highly correlated with the weight attached to the "expectation to feel really good in case of success", albeit only under the immediate resolution of risk (Imm) and only significantly

[29] The latter were only collected from the participants in the treatments with delayed risk resolution, to avoid an overload of emotion measures within a short time interval; see Figure 1.

so in case of HP-Imm (Spearman's *rho = 0.66, p < 0.01*). The correlation is also high in LP-Imm (*rho = 0.5*), but the small number of wins precludes statistical significance. Because the anticipation of feeling real bad in case of failure induces less investment (in line with the negative effect of NAEF in Table 1) while, if anything, investment will be reinforced by the expectation of feeling real good, the more interesting result seems to be the lack of correlation for PEE under the delayed resolution of risk.[30] In line with this outcome, we find at the single emotion level that five of the six significant correlations between (equally valenced) anticipated and experienced emotions concern Imm. It appears, therefore, that subjects were able to predict their emotions only when the resolution of the investment risk followed immediately, and more so in case of investment success than in case of failure.

Our data on recalled emotions allow us to explore the second issue, concerning the validity of assumptions made in models of decision-making under risk about the development of various anticipatory emotions during the waiting period. Based on Wu (1999) one can expect anxiety to be particularly prominent under HP, while this should hold for LP according to Caplin and Leahy (2001). In contrast with the latter prediction, Chew and Ho (1994) suggest that hope would be prominent under LP. Moreover, according to Wu emotional intensity should build up over the time interval (see also Loewenstein et al., 2001), while Caplin and Leahy suggest a U-shaped pattern with high intensities also immediately after the investment decision. However, in both cases a greater build up of emotional intensity is expected the longer the time interval. Our elicitation technique, to be discussed next, allows for a direct measure.

To identify the time pattern of anticipatory emotions experienced during the waiting period, we used an elicitation method, inspired by Sonnemans (1991), focusing on the four emotions: hope, excitement, anxiety, and irritation. For each emotion participants were shown a line representing the forty-eight hours between the moment the investment decision was made (at the first session) and the moment the resolution of the risk took place (at the second session). Participants were asked to report each instance they experienced the given emotion by clicking on one of the forty-eight line segments corresponding to the time at which the emotion was felt. Subsequently, they could rate the intensity of the experienced emotion on a seven-point scale.

[30] Similar results are found when we control for the amount invested.

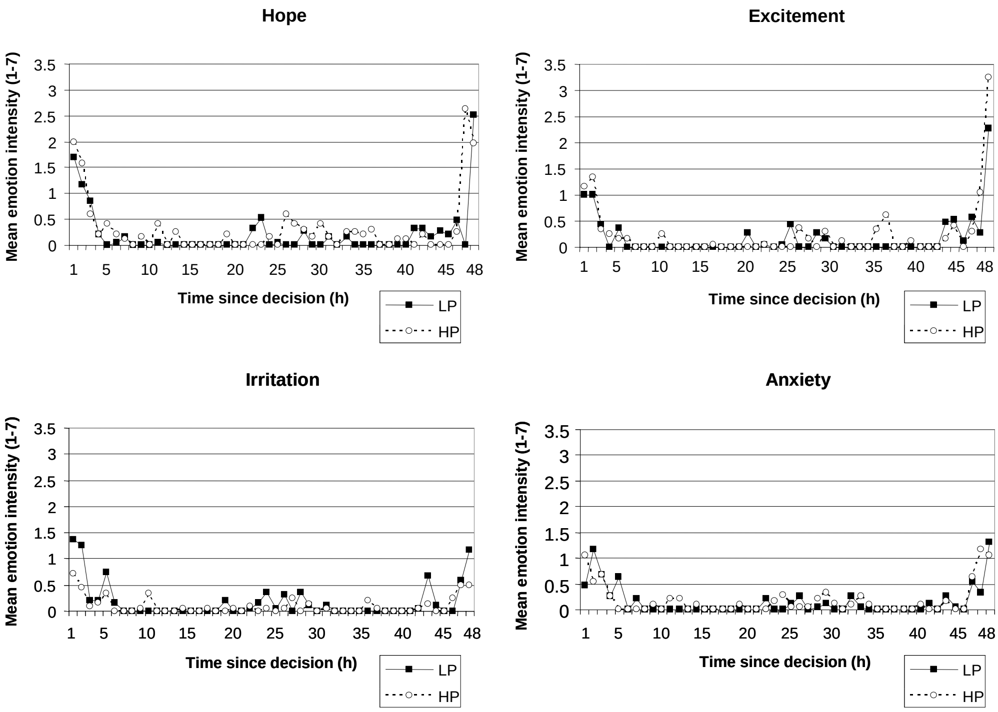


Figure 5. Time profiles of the mean intensity of recalled emotions.

For each of the four emotions, Figure 5 presents the development of the mean intensity scores over the forty-eight hour waiting period. A clearly U-shaped pattern shows up, in line with the predictions based on Caplin and Leahy (2001). The U-shaped pattern is especially prominent for Excitement and Hope. We also note that for Excitement, Hope and Anxiety, the peak observed in the last two hours (that is, just before the resolution of risk) is more pronounced than the peak in the first two hours (right after the decision). Only in case of Excitement the difference is (marginally) significant (sign test, $p = 0.068$). Furthermore, in contrast with the predictions based on the affect models, Hope is not more pronounced in LP, while Anxiety is similar under both HP and LP. In combination with result P3 of the previous section, showing that the anticipated emotions scores do not reflect any greater buildup of anticipatory emotions in Del compared to Imm, we find only limited support for the existing affect models regarding the (anticipated) development of anticipatory emotions during the waiting period.

Finally, we can investigate whether the anticipatory emotions anticipated at the time of the investment decision are in line with the emotions subjects recalled they had experienced during the waiting period (in Del). We focus on the three emotions covered by both measures, that is, hope, excitement, and anxiety. To measure the overall intensity of the recalled emotions we take a simple sum of all the forty-eight entries (scores) for each emotion. We find no significant correlation for any of the three anticipated-recalled emotion pairs. The same holds when we control for the probability condition and (by means of a regression) for the amount invested. Nor is it the case that anticipated emotions correlate with other equally valenced recalled emotions.

All in all, these results suggest a misalignment between anticipated and experienced emotions under the delayed resolution of risk, and hint at the underestimation of future emotions as discussed in the previous subsection. To the extent that delayed resolution increases perceived uncertainty, this may be due to a dampening of emotional reactions (van Dijk and Zeelenberg, 2006).

6 Conclusion

Over the last decade some theoretical and experimental studies of decision-making under risk have suggested that agents may be affected by anticipatory emotions, which may induce a preference for the timing of the resolution of risk that is not allowed for in standard economic theory. So far, however, experimental studies have only referred to emotions without actually measuring them. Moreover, typically hypothetical choice problems have been used. In this study, we had participants put their own money at stake in a real investment task and explicitly measured affect. In addition, we measured in an incentive compatible way participants' preferences for resolution timing, risk, and time, and collected via a web-based questionnaire data on affective traits and risk attitude in various life domains.

As main behavioral result we found a substantial resolution timing effect, but only if the chance of losing the invested amount of money is small (HP). It turned out that our affect measures were important for explaining these outcomes. In line with most earlier experimental studies we find some (weak) support for a general attractiveness of early resolution. Furthermore, supportive of Lovallo and Kahneman (2000) seems to be the result that, under immediate resolution (that is, within the same session), participants find the negatively skewed mixed gamble (HP) much more attractive than the positively skewed one (LP). In contrast with LP, in HP the impact of negative anticipated (anticipatory) emotions is compensated by strong positive emotions. To our knowledge it is a novel further finding that under delayed resolution the reverse is observed with positive anticipated emotions now compensating the impact of the negative emotions in LP but not in HP.

Together these results explain why a significant resolution timing effect shows up in HP (with less investment under delayed resolution) but not in LP.

The observed switch in the relative impact of positive versus negative anticipated emotions between the two timing conditions (in both HP and LP) cannot be explained by the theoretical affect models of Wu (1999) and Caplin and Leahy (2001). In particular, because, counter to the assumptions of these models, the intensity and general impact of anticipated emotions turned out to be weaker under delayed resolution. Although the Wu model has some relevance in linking positive (negative) anticipatory emotions to positively (negatively) skewed gambles, while Caplin and Leahy's model correctly emphasizes the role of negative emotions, overall, we did not find much evidence in support of these models.

Our results suggest that one should not focus too much on single emotions (like anxiety) but that both positive and negative anticipated emotions (related to anticipatory emotions as well as emotions experienced after the resolution of risk), should be taken into account. Moreover, the unexpected finding of a weaker, instead of stronger, role of affect under delayed resolution deserves further research. The data concerning recalled emotions support the hypothesis of a misalignment between anticipated and experienced emotions in case of a (substantially) delayed resolution of risk, with future emotions being underestimated. Whether this is related to a psychological effect, causing a dampening of emotions, is yet unclear. Also, it would be important to investigate to what extent our results are robust under repeated decision making. On the one hand, one can imagine that experience with the task at hand might make it less emotional. On the other hand, the experience of (sustained) losses or gains could easily fuel emotions or perhaps lead to moods with additional effects on decision making.

Finally, we notice that the tendency to prefer early resolution and to assume less risk under delayed resolution if the probability of losing is small, may help understand several phenomena observed in the field. For example, it would partly explain why individuals are willing to pay so much for insurance policies, even when the maximal possible loss is small. Also, it may shed a new light on why people seem reluctant to take on investment risks (e.g. the equity premium puzzle). Our results suggest that this would particularly hold for cases where the chances of running losses are relatively small and the resolution of risk is distant in time. In comparison, the resolution of a lottery risk typically occurs only some days or weeks after the purchase of a ticket. Interestingly, and in line with our findings, gambling devices such as scratching cards ("instants") or roulette, which offer "on the spot" resolution and less-skewed prospects (better odds of winning and lower maximal returns), are much less popular than lotteries (Forrest et al., 2001).

References

Abdellaoui, M., H. Bleichrodt, and C. Paraschiv (2007). Loss Aversion under Prospect Theory: A Parameter-Free Measurement, *Management Science*, 53(10): 1659-1674.

Ahlbrecht, M., and M. Weber (1997). Preference for Gradual Resolution of Uncertainty, *Theory and Decision,* 43:167-185.

Arnett, J., (1994). Sensation seeking: A new scale and a new conceptualization. *Personality and Individual Differences*, 16: 289-296.

Bajtelsmit, V. L., A. Bemasek, and N. A. Jianakoplos (1997). Gender differences in pension investment allocation decisions. *Journal of Risk and Insurance,* 16:135-147.

Baumeister, R. F., E. Bratslavsky, C. Finkenauer, and K. D. Vohs (2001). Bad Is Stronger Than Good, *Review of General Psychology*, 5:323-370.

Bell, D. E. (1982). Regret in decision making under uncertainty. *Operations research*, 30(5):961-981.

Bell, D. E. (1985). Disappointment in decision making under uncertainty. *Operations research*, 33(1):1-27.

Birnbaum, M. (2004). Tests of rank-dependent utility and cumulative prospect theory in gambles represented by natural frequencies: Effects of format, event framing, and branch splitting, *Organizational Behavior and Human Decision Processes,* 95: 40-65**.**

Caplin, A., and J. Leahy (2001). Psychological expected utility theory and anticipatory feelings. *The Quarterly Journal of Economics*, 116(1):55-79.

Charness, G., and U. Gneezy (2004). Gender Differences in Financial Risk-taking, *Working paper.*

Chua, P., M. Krams, I. Toni, R. Passingham, and R. Dolan (1999). A Functional Anatomy of Anticipatory Anxiety, *NeuroImage*, 9:563-571.

Chew, S.H., and J. L. Ho (1994). Hope: An empirical study of attitude toward the timing of uncertainty resolution, *Journal of Risk and Uncertainty*, 8:267-288.

Coller, M., and M. B. Williams (1999). Eliciting Individual Discount Rates, *Experimental Economics*, 2:107-127.

Cook, J., and L. W. Barnes (1964). Choice of delay of inevitable shock, *Journal of Abnormal Psychology*, 68:669-672.

Critchley, H., C. J. Mathias and R. J. Dolan (2001). Neural Activity in the Human Brain Relating to Uncertainty and Arousal during Anticipation, *Neuron*, 29: 537-545.

van Dijk, E., and M. Zeelenberg (2006). The Dampening Effect of Uncertainty on Positive and Negative Emotions, *Journal of Behavioral Decision Making*, 19:171-176.

Dohmen T., A. Falk, D. Huffman, U. Sunde, J. Schupp and G. Wagner (2005). Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey, *IZA working paper,* no. 1730.

Eliaz, K., and A. Schotter (2007). Experimental Testing of Intrinsic Preferences for Non Instrumental Information. *American Economic Review*, 97(2): 166-169.

Frederick, S., G. Loewenstein and T. O'Donoghue (2002). Time Discounting and Time Preference: A Critical Review. *Journal of Economic Literature*, 40(2):351-401.

Harrison, G.W., M.I. Lau, and E.E. Rutström (2006). Estimating Risk Attitudes in Denmark: A Field Experiment, *Working Paper.*

Hoch, S., and G. Loewenstein (1991). Time-Inconsistent Preferences and Consumer Self-Control, *Journal of Consumer Research*, 17:492 - 507.

Holt, C., and S.K. Laury (2002). Risk Aversion and Incentive Effect, *American Economics Review*, 92(5):1644-1655.

Hopfensitz, A., and F. van Winden (2008). Dynamic Choice, Independence and Emotions, *Theory and Decision*, 64: 249-300.

Kahneman, D., P.P. Wakker and R. Sarin (1997) Back to Bentham? Explorations of Experienced Utility, *The Quarterly Journal of Economics*, 112(2):375-405.

Koszegi B., and M. Rabin (2006). A Model of Reference-Dependent Preferences, *Quarterly Journal of Economics,* 121(4):1133-1166.

Kreps, D. M., and E. L. Porteus (1978). Temporal Resolution of Uncertainty and Dynamic Choice Theory, *Econometrica*, 46(1):185-200.

Lazarus, R. (1991). *Emotion and Adaptation*. Oxford University Press, New York.

Loewenstein, G., (1987). Anticipation and the Valuation of Delayed Consumption, *Economic Journal*, 47:666-684.

Loewenstein, G., (1996). Out of Control: Visceral Influences on Behavior, *Organizational Behavioral and Human Decision Processes*, 65:272-292.

Loewenstein, G.F., and Schkade, D (1999). Wouldn't it be nice? Predicting future feelings. In D. Kahneman, E. Diener, and N. Schwarz (Eds.), *Well-Being: The Foundations of Hedonic Psychology*. 85-105. New York: Russell Sage Foundation.

Loewenstein, G.F., E.U. Weber, C.K. Hsee, and E.S. Welch (2001). Risk as Feelings, *Psychological Bulletin*, 127(2):267-286.

Loomes, G., and R. Sugden (1982). Regret theory: an alternative theory of rational choice under uncertainty, *The Economic Journal*, 92:805-824.

Loomes, G., and R. Sugden (1986). Disapppointment and dynamic consistency in choice under uncertainty. *Review of Economic Studies,* 53:271-282.

Lovallo, D., and D. Kahneman (2000). Living with uncertainty: attractiveness and resolution timing. *Journal of Behavioral Decision Making*, 13(2):179-190.

MacCrimmon, K. R., and D. A. Wehrung (1986). *Taking Risks: The Management of Uncertainty,* Free Press, New York.

Nicholoson, N., E. Soane, M. Fenton-O'Creevy, and P. Willman (2005). Personality and domain-specific risk taking, *Journal of Risk Research*, 8(2):157-176.

Noussair, C. and P. Wu (2006). Risk tolerance in the present and the future: an experimental study, *Managerial and Decision Economics*, 27(6):401-412.

Rabin, M., (2000). Risk Aversion and Expected-Utility Theory: A Calibration Theorem, *Econometrica*, 68(5):1281-1292.

Sonnemans, J., (1991). *The Structure and Determinants of Emotional Intensity*, PhD dissertation, University of Amsterdam.

Spence, M., and R. J. Zeckhauser (1972). The Effect of the Timing of Consumption Decisions and the Resolution of Lotteries on the Choice of Lotteries, *Econometrica*, 40(2):401-403.

Spielberger, C. D., R. L. Gorsuch, and R. E. Lushene (1970). *State-trait Anxiety Inventory*. Consulting Psychologists Press.

Tversky, A., and D. Kahneman (1992). Advances in Prospect Theory: Cumulative Representation of Uncertainty, *Journal of Risk and Uncertainty,* 5**:**297-323.

Wray, B and A. Stone (2005). The Role of Self-Esteem and Anxiety in Decision Making for Self vs Other in Relationships, *Journal of Behavioral Decision Making*, 18(2):125-144.

Wu, G., (1999). Anxiety and Decision Making with Delayed Resolution of Uncertainty, *Theory and Decision*, 46(2):159-199.

Appendix A: Instructions (handouts; translated from Dutch)

[The handouts presented below were used for the Low Probability, Delayed resolution treatment (LP-Del). Instructions for other treatments, which involve minimal necessary changes, are available from the authors on request.]

Handout 1

Introduction
You have brought 20 euro as working money to this experiment. You may earn extra money with it but you may also lose money.

In today's session you will have to make a **single** decision concerning your working money. This will be further explained below. You will be also asked to answer a number of questions.

The decision that you must take concerns splitting your working money of 20 euro between two projects. We will refer to these projects as project A and project B. **The outcome of the projects will be decided at the beginning of the second session on _______**

Your total earnings from both sessions will be transferred to your bank account on the next working day after the second session on ___, that is on _____. Please take into account the delay involved in such operations. To make the transfer possible, you will have to give us your bank details during the second session.

Information about projects
You will now have to make a single decision concerning your working money. You have to allocate your 20 euro over two projects. These projects will be labeled on the computer screen, when you make your decision, with the letters A and B.

Project A: Investing in this project you will get **1.2 euro for every euro that you put into the project**. Thus, project A always gives a certain return (namely 1.2 times the invested amount).

Project B: For the amount that you put in project B the following holds. With probability one over five **(20 percent chance) you will get 9 times the amount you put into the project and** with probability four over five **(80 percent chance) you will lose this amount.**

You can allocate your working money in multiples of 1 euro over the projects A and B in any possible combination that adds up to 20 euro.

The table below shows for each possible combination that you can choose the earnings and corresponding probabilities. The **net** earnings are computed by subtracting 20 euro from the total earnings. All values are in euro.

Money in project A:	**Money in project B:**	**When project B succeeds (20 percent chance)**		**When project B fails (80 percent chance)**	
		Earnings (V)	**Net earnings (V-20)**	**Earnings (V)**	**Net earnings (V-20)**
20	0	24	4	24	4
19	1	31.8	11.8	22.8	2.8
18	2	39.6	19.6	21.6	1.6
17	3	47.4	27.4	20.4	0.4
16	4	55.2	35.2	19.2	-0.8
15	5	63	43	18	-2
14	6	70.8	50.8	16.8	-3.2
13	7	78.6	58.6	15.6	-4.4
12	8	86.4	66.4	14.4	-5.6
11	9	94.2	74.2	13.2	-6.8
10	10	102	82	12	-8
9	11	109.8	89.8	10.8	-9.2
8	12	117.6	97.6	9.6	-10.4
7	13	125.4	105.4	8.4	-11.6
6	14	133.2	113.2	7.2	-12.8
5	15	141	121	6	-14
4	16	148.8	128.8	4.8	-15.2
3	17	156.6	136.6	3.6	-16.4
2	18	164.4	144.4	2.4	-17.6
1	19	172.2	152.2	1.2	-18.8
0	20	180	160	0	-20

The result of project B will be determined at the beginning of the second session on ___. Each participant will receive two dice. Everyone will be asked to throw them once under supervision. Note that even if you have put nothing in project B, you will also have to throw the dice.

One of the dice shows tens: 00, 10, 20 up to 90; the other shows units: 0, 1 up to 9. The sum of both numbers (where a combination of 00 and 0 represents 100) can be any number between 1 and 100 with equal probability.

If the sum is 20 or less (20 percent chance), you will receive 9 times the amount put in project B. If the sum is 21 or more (80 percent chance), you will lose the money put in project B.

Your total earnings will be equal to the earnings from project B plus earnings from project A (the latter being equal to 1.2 times the amount in project A). If you have a question, please raise your hand. We will then come to your desk to assist you.

We will now start the computer program for you to make your decisions.

Handout 2 (LP, *Delayed*)

In this part of the experiment you will have to make a number of choices. The table in this handout serves as an illustration of how the choices will look like on the screen. It will always be a choice between the option to determine the outcome of project B today (we call it Option NOW) and the option to let it happen in two days (Option LATER). The probability of success for project B will always be 20 percent for option LATER (this chance is identical to the one you have faced when you were splitting your working money), so you can always choose to stay in the situation as it was when you were making your decision. In contrast, the probability of success in project B will vary in option NOW, as explained below.

MainForm

scherm: 4

Bevestiging

Druk op <bevestiging> als je klaar bent.

	optie LATER	optie NU	
1	succes in project B: kans 20%	succes in project B: kans 0%	later l nu
2	succes in project B: kans 20%	succes in project B: kans 10%	later l nu
3	succes in project B: kans 20%	succes in project B: kans 20%	later l nu
4	succes in project B: kans 20%	succes in project B: kans 30%	later l nu
5	succes in project B: kans 20%	succes in project B: kans 40%	later l nu
6	succes in project B: kans 20%	succes in project B: kans 50%	later l nu
7	succes in project B: kans 20%	succes in project B: kans 60%	later l nu
8	succes in project B: kans 20%	succes in project B: kans 70%	later l nu
9	succes in project B: kans 20%	succes in project B: kans 80%	later l nu
10	succes in project B: kans 20%	succes in project B: kans 90%	later l nu
11	succes in project B: kans 20%	succes in project B: kans 100%	later l nu

Whatever you choose, the amount that you put in project B will remain unchanged and so will the time when the earnings will be transferred to your bank account.

Please note: in order to collect your earnings, you will have to be present for both sessions. There will also be new opportunities to win money during the second session.

One of your choices between NOW and LATER will be randomly selected and implemented (that is to say, really played out with the corresponding probability of success in project B). Make thus your choices carefully.

We will now explain in greater detail the choices you will be making. For this, please look at the table above.

You see that 11 choices have to be made. In each case you have to choose between option NOW and option LATER. As mentioned before, under option NOW you will learn the results of project B during the today's session, whereas under option LATER you will learn it during the session in two days. The table also shows the probabilities of success for project B. This chance is always 20 percent for option LATER but varies for option NOW.

Please remember that one of your choices will be randomly selected to be played out for real.

For an example, look at the second decision problem (in the second row of the table). If you choose for option NOW, project B will succeed with probability 10 percent and whether it does in fact succeed or not will be determined during this session. If you, on the other hand, go for option LATER, the probability of success in project B will be equal to 20 percent and you will learn the outcome of this project during the second session in two days.

The other choices are similar, except for the fact that the probability of success in project B under option NOW increases as you go down the table.

For every choice problem you are asked to choose between options NOW and LATER by clicking on the buttons on the right side of the table (NOW or LATER). If you do not have any preference, such that you cannot decide which option should be selected, please click on "I" (for "Indifferent").

You can thus choose NOW in some of the rows, choose LATER in other rows and have no preference (choose I) in still other rows. You can change your choices and make them in any order you want.

Note that as you go down the rows of the table, the probability of success in project B always increases by 10 percentage points. It can happen that we want to know more precisely about your preference between options NOW and LATER. In such a case, you will see a new table with some more choices of the same sort.

When you are done with your choices, one of them will be randomly selected and played out for real. If you want to know precisely how this will happen, read the following. Otherwise, go to the Summary.
The computer will randomly draw a number between 1 and 100 to determine the chance of success (in percentage points) for project B under option NOW. If you made a choice for this particular percentage, it will be implemented. Otherwise, we will make us of your choices between NOW and LATER for probabilities that are just above and just below the selected number. By doing so we will assume that: you prefer option NOW if in both of these two problems you have picked NOW or if you have picked NOW in one of them and I in the other; you prefer option LATER if in both of these problems you have picked LATER or if you have picked LATER in one of them and I in the other; you are indifferent if you have chosen I in both of these decision problems.

Summary

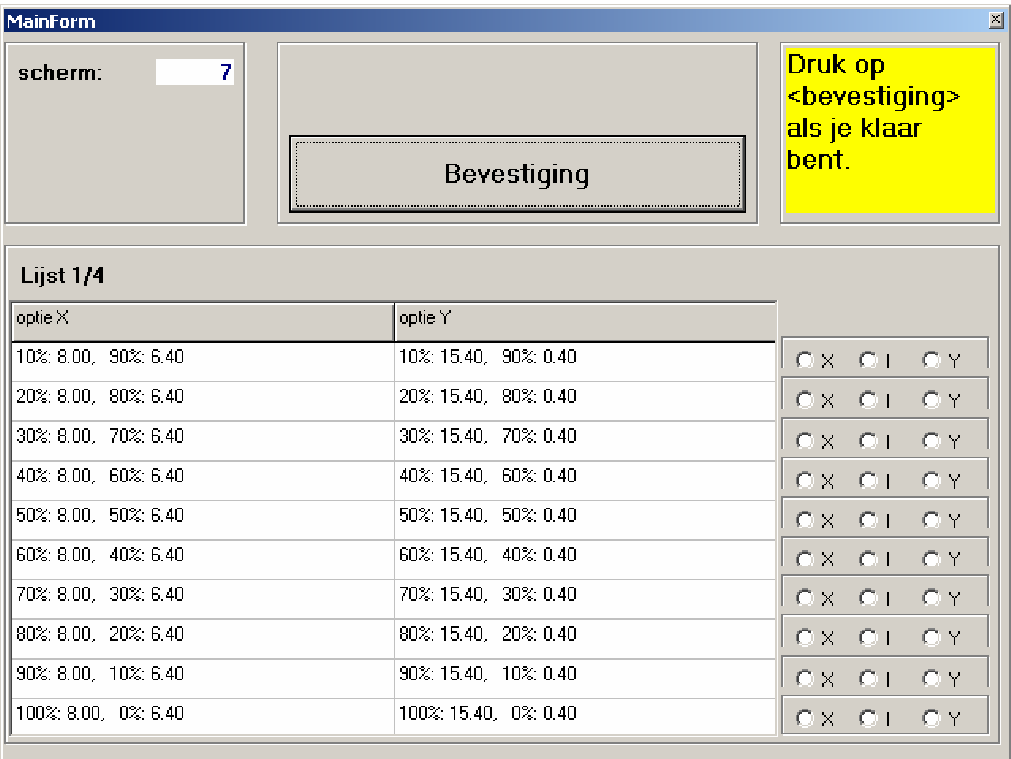
In each row of the table you have to choose whether you prefer option NOW, option LATER or whether you are indifferent (I), taking into account the corresponding time when the result of project B is revealed and the appropriate probability of success.
You can choose NOW for some rows, LATER for other rows and I for still others. You can change your choices and make them in any order you want.
When everyone is ready, the computer will randomly select one of the choices for implementation. In case you do not have a preference for the selected decision problem, one of the options will be chosen randomly.

If you have a question, please raise your hand. We will then come to your table to assist you.
Otherwise, you can start making your choices on the list that will appear on your screen.

Handout 3

In this part of the experiment you will have to make a number of choices. What you have to do is quite similar to the choices between options NOW and LATER that you have been making during the previous session, however this time the options are different. In total you will have to fill out four lists of ten choices between an option **X** and an option **Y**. One of these choices will be randomly selected to be paid out to you.

We will now explain to you the choices you have to make.
For an example, look at the lists in this handout.


MainForm

scherm: 7

Bevestiging

Druk op <bevestiging> als je klaar bent.

Lijst 1/4

optie X	optie Y	
10%: 8.00, 90%: 6.40	10%: 15.40, 90%: 0.40	X I Y
20%: 8.00, 80%: 6.40	20%: 15.40, 80%: 0.40	X I Y
30%: 8.00, 70%: 6.40	30%: 15.40, 70%: 0.40	X I Y
40%: 8.00, 60%: 6.40	40%: 15.40, 60%: 0.40	X I Y
50%: 8.00, 50%: 6.40	50%: 15.40, 50%: 0.40	X I Y
60%: 8.00, 40%: 6.40	60%: 15.40, 40%: 0.40	X I Y
70%: 8.00, 30%: 6.40	70%: 15.40, 30%: 0.40	X I Y
80%: 8.00, 20%: 6.40	80%: 15.40, 20%: 0.40	X I Y
90%: 8.00, 10%: 6.40	90%: 15.40, 10%: 0.40	X I Y
100%: 8.00, 0%: 6.40	100%: 15.40, 0%: 0.40	X I Y

It shows ten decisions. Each decision is a choice between "Option X" and "Option Y". Both options give with some probability a high outcome and with some probability a low outcome. We will explain these options later on.

You will have to choose one of the two options by clicking on the button X or Y on the right. For some decisions you may not care whether you receive Option X or Y, in which case you should click the button labeled "I" for "Indifference".

You will have to fill out four such decision sheets and make ten choices on each of them. But only one of the choices will be used in the end to determine your earnings. Because each decision is equally likely to be selected and played out for real, it is important that you make your decisions carefully.

We will now explain the options on the decision sheet. For an example**,** please look at the first choice in the first row.

If you choose Option X you will get 8.00 euro with probability one in ten (10 percent chance) and 6.40 euro with probability nine in ten (90 percent chance), if this row is selected for real payments. To determine the outcome we will roll a ten-sided dice with numbers from 1 to 10 (0 stands for 10). If the dice shows the number 1 then you will earn 8.00 euro. If the dice shows any other number then you will receive 6.40 euro. Since there are nine numbers other than 1 on the dice, there is a probability of 90 percent (nine in ten) that you receive 6.40 euro and 10 percent (one in ten) that you earn 8.00 euro.

Similarly, option Y yields 15.40 euro with probability 10 percent and 0.40 euro with probability 90 percent.

The other decisions are similar, except that as you move down the table, the chances of the higher payoff for each option increases. In fact, for Decision 10 in the bottom row, no dice roll will be needed since each option pays the highest payoff for sure. So you actually have here a choice between 8.00 and 15.40 euro.

When everybody has made his decisions, we will ask one participant to roll a die four times: first a four-sided die to decide which list (1, 2, 3 or 4) is selected, next a ten-sided die to decide which of the ten choices is selected, then a die to select X or Y for those who are indifferent in this decision problem, and finally a ten-sided die to determine the outcome of options X and Y (only the option that you have selected will apply to you). Note that all dice rolls will apply equally to all participants.

Summary

You will make ten choices on each of four lists. For each decision row you will have to choose whether you prefer Option X or Option Y.

You may for example choose X for some decision rows and Y for other rows, you may also be indifferent between the options X and Y and pick I for still other rows. You may change your decisions and make them in any order.

When you are finished, one decision will be picked as described and your earnings for this choice will be added to your previous earnings.

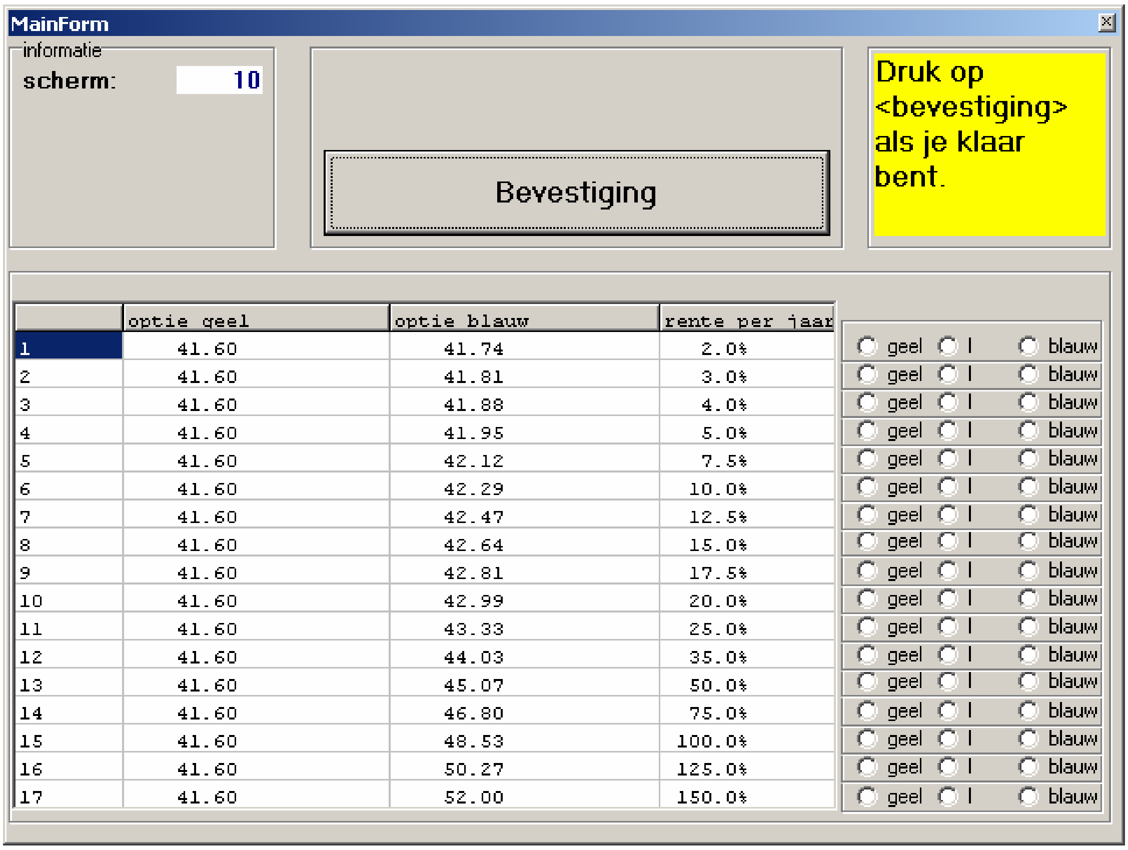
If you have any questions, please raise your hand. We will come to your desk to assist you.

Otherwise, we will start with the choices which you will see on the screen.

Handout 4

In this part of the experiment you will have to make 17 choices between option YELLOW and option BLUE. One of these choices will be randomly selected to be paid out to you.

We will now explain to you the choices you have to make. Please take a look at the table in this handout.



	optie geel	optie blauw	rente per jaar	
1	41.60	41.74	2.0%	geel I blauw
2	41.60	41.81	3.0%	geel I blauw
3	41.60	41.88	4.0%	geel I blauw
4	41.60	41.95	5.0%	geel I blauw
5	41.60	42.12	7.5%	geel I blauw
6	41.60	42.29	10.0%	geel I blauw
7	41.60	42.47	12.5%	geel I blauw
8	41.60	42.64	15.0%	geel I blauw
9	41.60	42.81	17.5%	geel I blauw
10	41.60	42.99	20.0%	geel I blauw
11	41.60	43.33	25.0%	geel I blauw
12	41.60	44.03	35.0%	geel I blauw
13	41.60	45.07	50.0%	geel I blauw
14	41.60	46.80	75.0%	geel I blauw
15	41.60	48.53	100.0%	geel I blauw
16	41.60	50.27	125.0%	geel I blauw
17	41.60	52.00	150.0%	geel I blauw

The table shows seventeen decisions. Each decision is a choice between option YELLOW and option BLUE:

- with option YELLOW your earnings will be transferred tomorrow
- with option BLUE, a higher amount will be transferred in two months time.

You will have to choose one of the two options by clicking button YELLOW or BLUE on the right. For some decisions you may not care whether you receive Option YELLOW or BLUE, in which case you should click the button labeled "I" for "Indifference".

You will have to make seventeen choices but only one of the choices will be used in the end to determine your earnings. Because each decision has an equal chance of being used in the end, it is important that you make each choice carefully.

We will now explain the options on the decision sheet. For an example, please look at the first choice in the first row. Option YELLOW always means that your earnings from the experiment will be transferred to you tomorrow. When you are making your choices, this column thus always shows your earnings from previous parts. In this example this is 41.60 euro. Option BLUE means in this example that 41.74 euros will be transferred to you in two months. Note that this amount is 0.33 percent higher than the amount paid by option YELLOW. This corresponds to a nominal annual rate of 2 percent, as indicated in the fourth column.

The other decisions are similar, except that as you move down the table, the amount that option BLUE pays increases.

When everybody has made his decision, we will ask a participant to roll a die twice: first to select one of the 17 choices and then, for those who selected I (Indifferent) in this row, to select option YELLOW or BLUE. The outcomes of the rolling of the dice will apply to all participants.

Summary

You will make seventeen choices. For each decision row you will have to choose whether you prefer Option YELLOW or Option BLUE.

You may for example choose YELLOW for some decision rows and BLUE for other rows, you may also be indifferent between the options YELLOW and BLUE for still other rows. You may change your decisions and make them in any order. When you are finished, one of the seventeen decision rows will be selected randomly as described before and the option you have chosen in this row will be implemented.

Please raise your hand if you have any questions. We will then come to your desk to assist you. Otherwise, you can start with the choices in the table that will appear on the screens.

Appendix B. Questionnaires

B. 1. Risk propensity scale (Nicholson et al., 2005)
Note: One question about career risk was skipped, since it was considered irrelevant for undergraduate students. Question 06 is based on Dohmen et al. (2005).

Below you find a number of statements, that people use to describe themselves. Read each of them and rank them on a scale from 1 to 5. There are no right or wrong answers. Do not think for too long but choose according to your first impression.

[answer on scale from 1=never to 5=very often]

01. In my adult life I have taken recreational risks (e.g. rock-climbing, scuba diving)
02. In my adult life I have taken health risks (e.g. smoking, poor diet, high alcohol consumption)
03. In my adult life I have taken financial risks (e.g. gambling, risky investments)
04. In my adult life I have taken safety risks (e.g. fast driving, city cycling on a bike with poor brakes, riding a car without a seat belt on)
05. In my adult life I have taken social risks (e.g. standing for election, publicly challenging a rule or decision)

[answer on scale from 1=not at all to 5=very much so]

06. Taken all things together, I am very willing to take risk.

B. 2. Trait anxiety (STAI ; Spielberger et al., 1970)

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers.
Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

[answer on scale from 1="almost never" to 4="almost always"]

07. I feel pleasant
08. I tire quickly
09. I feel like crying
10. I wish I could be as happy as others seem to be
11. I am losing out on things because I can't make up my mind soon enough
12. I feel rested
13. I am "calm, cool and collected"
14. I feel that difficulties are piling up so that I cannot overcome them
15. I worry too much over something that really doesn't matter
16. I am happy
17. I am inclined to take things hard
18. I lack self-confidence

19. I feel secure
20. I try to avoid facing a crisis or difficulty
21. I feel blue
22. I am content
23. Some unimportant thought runs through my mind and bothers me
24. I take disappointments so keenly that I can't put them out of my mind
25. I am a steady person
26. I get in a state of tension or turmoil as I think over my recent concerns and interests

Note: The answers are used to calculate a value between 20 and 80, representing the anxiety trait of the subject [ANXIETY-trait].

B. 3. Sensation seeking (Arnett, 1993)

Below you find a number of statements, that people use to describe themselves. Read each of them and rank them on a scale from 1 to 4, indicating whether or not they describe you correctly. There are no right or wrong answers. Do not think for too long but choose according to your first impression.

[answer on scale from 1="does not describe me at all" to 4="describes me very well"]

27. I can see how it would be interesting to marry someone from a foreign country.
28. When the water is very cold, I prefer not to swim even if it is a hot day.
29. If I have to wait in a long line, I'm usually patient about it.
30. When I listen to music, I like it to be loud.
31. When taking a trip, I think it is best to make as few plans as possible and just take it as it comes
32. I stay away from movies that are said to be frightening or highly suspenseful.
33. I think it's fun and exciting to perform or speak before a group.
34. If I were to go to an amusement park, I would prefer to ride the rollercoaster or other fast rides.
35. I would like to travel to places that are strange and far away.
36. I would never like to gamble with money, even if I could afford it.
37. I would have enjoyed being one of the first explorers of an unknown land.
38. I like a movie where there are a lot of explosions and car chases.
39. I don't like extremely hot and spicy foods.
40. In general, I work better when I'm under pressure.
41. I often like to have the radio or TV on while I'm doing something else, such as reading or cleaning up.
42. It would be interesting to see a car accident happen.
43. I think it's best to order something familiar when eating in a restaurant.
44. I like the feeling of standing next to the edge on a high place and looking down.
45. If it were possible to visit another planet or the moon for free, I would be among the first in line to sign up
46. I can see how it must be exciting to be in a battle during a war.

Appendix C. Declaration of consent

Declaration
I hereby declare my participation in 2 sessions of the experiment on ___ and ___, 2006. I acknowledge that, depending on my choices, I can lose up to 20 euro in the experiment. I am also aware that I will lose this amount if I do not participate in both sessions without a valid reason (e.g. a sick note). I realize that my earnings from the experiment will be transferred to my bank account after the second session and take responsibility for providing the experimenters with wrong bank details.

Signature