

Is There One Unifying Concept of Utility?

An Experimental Comparison of Utility under Risk and Utility over Time

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Abstract

This paper explores whether there is one unifying concept of utility, as commonly assumed in applied and empirical economics, or whether utility is context-specific, as typically assumed in economic theory. We present a new method to measure the utility for gains, the utility for losses, and loss aversion both for risk and for time. Utility under risk was significantly more curved than utility over time. Loss aversion under risk was more pronounced than loss aversion over time and the two were not correlated. This suggests that loss aversion, while important in both decision contexts, is volatile.

Key Words: Decision under risk, intertemporal choice, utility, prospect theory, discounting, loss aversion.

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1. Introduction

The nature of utility is one of the most controversial issues in economics. The leading economists of the late 19th century took utility as a cardinal index of goodness that could be measured through introspection and could be applied to all economic problems (Jevons 1911 [1879], Walras 1926 [1874], Menger 1871, Edgeworth 1881, Marshall 1890). This notion of one unifying concept of cardinal utility was challenged by Pareto (1906), who showed that to explain market phenomena only ordinal utility was needed. The banishing of cardinal utility, initiated by Pareto, was furthered by the works of Johnson (1913), Slutsky (1915), and Hicks and Allen (1934) who aimed to purge economics of any introspective elements and to base it entirely on observable choice. This ordinal revolution coincided with the behaviorist revolution in psychology, which likewise aimed to rid psychology of introspection and base it on observable data only. It culminated in Samuelson's (1938) revealed preference paradigm that has dominated mainstream economics since. Detailed surveys of the history of utility are in Stigler (1950a, 1950b), Edwards (1954), Lewin (1996), and Abdellaoui, Barrios, and Wakker (2007).

The notion of cardinal utility re-emerged when von Neumann and Morgenstern (1944) derived cardinal utility from a set of plausible axioms on risky choice. Meanwhile cardinal utilities turned out to be necessary also for intertemporal evaluations (Samuelson 1937) and utilitarian welfare evaluations (Harsanyi 1955). The consensus within economics became that cardinal utility is relevant, but that it has no meaning outside the domain to which it applies (Arrow 1951, Luce and Raiffa 1957, Fishburn 1989). Thus cardinal utility for risk need not be equivalent to cardinal intertemporal utility.

Recently, there has been a reconsideration of the nature of utility. This reconsideration was fostered by the developments in non-expected utility theory, in

particular the introduction of prospect theory. Under prospect theory risk attitude is not only modeled through the utility function, which opens the possibility that the utility function captures people's attitudes towards outcomes and is also applicable to decisions that do not involve risk (Wakker 1994). Simultaneously, the discovery by behavioral economists and psychologists of inconsistencies in choice has challenged economists' reliance on studying revealed preferences. If choices can be inconsistent then they do not necessarily reflect people's "true" preferences.

While the nature of utility has been extensively debated in economic theory, in applied economics transferability of utility has generally been taken for granted and utilities measured within one decision context are routinely applied in other decision contexts as well. For instance, in health economics, measurements of utility under risk are widely used to value intertemporal health profiles and in welfare evaluations. In empirical economics transferability of utility is also commonly assumed. Andersen et al. (2008) and Takeuchi (2010), for example, used utility measured under risk to compute people's discount rates from intertemporal choices.

Perhaps surprisingly, the question whether cardinal utilities measured in different contexts are equal has hardly been addressed. The main reason is that no methods existed to measure utility outside the context of risk. A few studies compared utility under risk with choiceless utility measured through introspection (Abdellaoui, Barrios, and Wakker 2007, Stalmeier and Bezembinder 1999) but these are, obviously, not based on revealed preference. This paper provides a comparison between utility under risk and intertemporal utility that is entirely based on observed choice behavior. We present a new method to measure intertemporal utility. The key insight underlying our method is that only one time weight needs to be known to measure intertemporal utility. This insight substantially simplifies the measurement of

utility. We compared risk and time because these are important areas of economic application. It is important to know, both for applied and for empirical economics, whether utility under risk and intertemporal utility are exchangeable.¹

We measured utility both for gains and for losses. We also measured loss aversion. We are the first to establish the link between intertemporal utility for gains and intertemporal utility for losses and, consequently, the first to quantify loss aversion in intertemporal choice. The comparison between loss aversion under risk and loss aversion over time provides insight whether there is a common psychological concept underlying loss aversion in different decision contexts. Gaechter, Johnson, and Herrmann (2007) compared loss aversion in a WTP-WTA task with loss aversion in a risky decision task and observed that they were correlated. To measure loss aversion they had to make several simplifying assumptions, including linearity of utility. These simplifying assumptions are avoided in this paper.

We performed two experiments, one involving hypothetical payoffs and one involving real payoffs for gains. The conclusions were not affected by the use of real incentives. Utility under risk was significantly different from utility over time. For gains, utility under risk was concave and intertemporal utility was linear. For losses, utility was either convex or linear under risk but concave over time. A large majority of subjects was loss averse both under risk and over time. The degree of loss aversion was, however, significantly stronger under risk than over time. Loss aversion under risk and loss aversion over time were not correlated suggesting that loss aversion, while important in both contexts, is volatile across contexts.

¹ Andreoni and Sprenger (2010) and Coble and Lusk (2010) also compared intertemporal utility and utility under risk and found that they were significantly different. Their analysis assumed, however, both expected utility and constant rate discounting, assumptions that are commonly violated and are known to cause biases. We avoid such simplifying assumptions.

The remainder of the paper is organized as follows. Section 2 gives background. Section 3 describes our method to measure utility under risk and utility over time. Section 4 describes the design of the first experiment that we performed and Section 5 that of the second. Section 6 and 7 describe the results of the experiments and Section 8 discusses the results. Section 9 concludes.

2. Background

Because we distinguish between gains and losses we use theories that accommodate reference-dependence of preferences. For decision under risk we use prospect theory (Tversky and Kahneman 1992), the most important descriptive theory of decision under risk today. For intertemporal choice we use a generalization of Loewenstein and Prelec's (1992) hyperbolic discounting model, the most comprehensive model of time preference available.

Throughout outcomes are monetary and more money is preferred to less. Outcomes are defined as gains and losses relative to a reference point. We assume that the reference point is 0. Gains are outcomes larger than 0 and losses are outcomes less than 0.

2.1. Decision under risk

In this paper we only consider prospects involving at most two distinct outcomes. For such prospects original (Kahneman and Tversky 1979) and cumulative (Tversky and Kahneman 1992) prospect theory are identical. Let $(x,p;y)$ denote the prospect that gives money amount x with probability p and y with probability $1-p$. A prospect is *riskless* if either $x = y$ or $p = 1$ or $p = 0$. Otherwise the prospect is *risky*. We assume that there exists a preference relation \succsim over prospects. As usual, strict

preference and indifference are denoted $>$ and \sim , respectively. Without loss of generality we assume that prospects are *rank-ordered*, i.e. for gains [losses] the notation $(x,p;y)$ implies that $x \geq y$ [$x \leq y$].

Under prospect theory, preferences over prospects are represented by a real-valued *utility function* U^r defined over money amounts, where the superscript r indicates that the utility function applies to risk and serves to distinguish it from the intertemporal utility function introduced later, and by two probability weighting functions w^+ for gains and w^- for losses. The utility function is strictly increasing, satisfies $U^r(0) = 0$, and is a ratio scale meaning that we can freely choose the unit of utility. The probability weighting functions are strictly increasing and satisfy $w^i(0) = 0$ and $w^i(1) = 1$, $i = +, -$.

The evaluation of a prospect $(x,p;y)$ is equal to

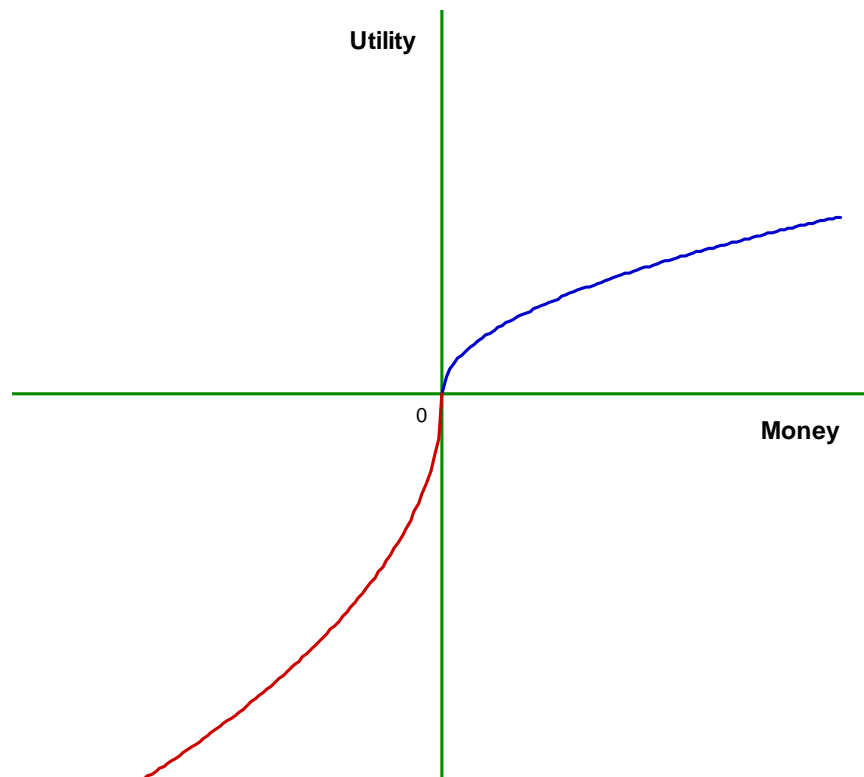
$$\pi_1 U^r(x) + \pi_2 U^r(y). \quad (1)$$

where $\pi_1 = w^+(p)$ and $\pi_2 = w^-(1-p)$ if the prospect is *mixed* and involves both a gain x and a loss y , and $\pi_1 = w^i(p)$ and $\pi_2 = 1 - w^i(p)$, $i = +, -$, if the prospect either involves no losses or it involves no gains.

In this paper we focus on prospect theory's utility function. Tversky and Kahneman (1992) assumed that the utility function was concave for gains and convex for losses. Such an S-shaped function has been displayed in Figure 1. Empirical evidence confirms concavity of utility for gains (Tversky and Kahneman 1992, Gonzalez and Wu 1999, Abdellaoui, Bleichrodt, and Paraschiv 2007, Booij and van de Kuilen 2009). For losses the evidence is mixed. While most studies found slight convexity (Tversky and Kahneman 1992, Abdellaoui 2000, Schunk and Betsch 2006, Abdellaoui, Bleichrodt, and Paraschiv 2007), concave utility for losses has also been

observed (Abdellaoui, Bleichrodt, and l'Haridon 2008, Bruhin, Fehr-Duda, and Epper 2010). In general, the utility for losses is closer to linear than the utility for gains.

Figure 1: The Utility for Gains and Losses under Prospect Theory



Prospect theory also assumes that the utility function is steeper for losses than for gains, reflecting loss aversion. Many studies have observed qualitative evidence for loss aversion. Quantifications of loss aversion are less ubiquitous. To measure loss aversion, utility must be measured on its entire domain, i.e. the utility for gains and losses must be measured simultaneously. Abdellaoui, Bleichrodt, and Paraschiv (2007) and Abdellaoui, Bleichrodt, and l'Haridon (2008) proposed methods to achieve this. An additional complication for the measurement of loss aversion is that there exists no agreed-upon definition of loss aversion in the literature. Abdellaoui et al.

(2007) concluded that the most satisfactory definitions are those by Kahneman and Tversky (1979) and Köbberling and Wakker (2005). In this paper we adopt the definition by Köbberling and Wakker (2005), but, as we will explain later, our findings are also valid under the definition of Kahneman and Tversky (1979). Köbberling and Wakker (2005) defined loss aversion as the kink at the reference

point. This corresponds to a definition of loss aversion as $\frac{U'_{\uparrow}(0)}{U'_{\downarrow}(0)}$ where $U'_{\uparrow}(0)$ stands

for the left derivative of utility at the reference point and $U'_{\downarrow}(0)$ for the right derivative. A similar definition was suggested by Benartzi and Thaler (1995).

2.2. Decision over time

Let $(x,t;y)$ denote the *temporal prospect* that pays x at time point t and y now. The present is denoted by $t = 0$. We assume that there exists a preference relation \succsim over the set of temporal prospects. Under Loewenstein and Prelec's (1992) hyperbolic discounting model preferences over temporal prospects can be represented by an intertemporal utility function U^t and a discount function φ . The utility function is assumed to have a similar shape as the utility function in prospect theory, concave for gains, convex for losses, and steeper for losses than for gains (see Figure 1).

The discount function is a ratio scale with $\varphi(0) = 1$. Its specification is immaterial for our analyses and we impose no restriction on it.² Loewenstein and Prelec (1992) assume that the discount function does not depend on the sign of the outcomes. The differential discounting of gains and losses (Benzion, Rapoport, and Yagil 1989) is explained through the utility function. Abdellaoui, Attema, and Bleichrodt (2010) observed, however, that the discount functions for gains and for

² In Loewenstein and Prelec's (1992) model $\varphi(t) = (1+\alpha t)^{-\beta/\alpha}$, $\alpha, \beta > 0$.

losses differed even after correction for differences in utility curvature. Hence, we will allow discounting to be different for gains and for losses and we will denote the discount function for gains by ϕ^+ and the discount function for losses by ϕ^- .

The evaluation of a temporal prospect $(x,t;y)$ is then equal to

$$U^t(y) + \phi^i(t)U^t(x), i = +, -. \quad (2)$$

We will refer in what follows to Eq.(2) as Loewenstein and Prelec's model even though it is more general. Hardly any evidence exists on the shape of the intertemporal utility function. Abdellaoui, Attema, and Bleichrodt (2010) measured the utility for gains and the utility for losses separately using a parameter-free method and found that utility was concave for gains and close to linear for losses.

3. Measurement Method

Our measurement method is based on the method introduced in Abdellaoui, Bleichrodt, and l'Haridon (2008) who applied it to decision under risk. There are a few important differences, however, which we explain below.

We assume that the utility U^j , $j = r,t$, that we observe is composed of a loss aversion coefficient λ^j and a basic utility function u^j :

$$\begin{cases} u^j(x) & \text{if } x \geq 0 \\ \lambda^j u^j(x) & \text{if } x < 0 \end{cases}, j = r,t \quad (3)$$

The basic utility function may be interpreted as the normative or economic component of utility. The loss aversion parameter captures psychological factors, namely the differential treatment of gains and losses. Equation (3) was also assumed by Köbberling and Wakker (2005). A similar separation between observable or psychological and basic or economic utility was made by Sugden (2003) and by Köszegi and Rabin (2006).

We start by measuring utility on the domain of gains. To measure utility under risk, we selected an arbitrary probability p_g and asked subjects a series of questions in which they had to state the amount for sure G^r , the *certainty equivalent*, that they considered equivalent to a risky prospect $(x, p_g; y)$, $x \geq y \geq 0$. The stimuli x and y varied across the questions but p_g was held constant. Using Eq.(1) the indifference $G^r \sim (x, p_g; y)$ implies that

$$G^r = u^{r-1}(\pi^+(u^r(x) - u^r(y)) + u^r(y)), \quad (4)$$

where $\pi^+ = w^+(p_g)$.

To measure intertemporal utility, we chose a common delay t_g and asked subjects a series of questions in which they had to state the amount G^t now, known as the *present equivalent*, that they considered equivalent to a temporal prospect $(x, t_g; y)$, $x \geq y \geq 0$. As in the risky questions, t_g was held constant throughout, but x and y varied across questions. Using Eq.(2) the elicited indifference $G^t \sim (x, t_g; y)$ implies

$$G^t = u^{t-1}(\tau^+ u^t(x) + u^t(y)), \quad (5)$$

where $\tau^+ = \varphi^+(t)$.

If we adopt parametric specifications for the basic utility functions u^r and u^t then Eqs. (4) and (5) can easily be estimated using nonlinear least squares. We adopted the exponential specifications:

$$u^j(x) = \begin{cases} \frac{1 - e^{-\mu^j x}}{\mu^j} & \text{if } x \geq 0 \\ -\frac{e^{\nu^j x} - 1}{\nu^j} & \text{if } x < 0 \end{cases} \quad j = r, t. \quad (6)$$

The exponential utility function is concave [convex] for gains [losses] if $\mu > 0$ [$\nu > 0$], linear if $\mu = \nu = 0$ and convex [concave] if $\mu < 0$ [$\nu < 0$]. Under Eq. (6) both the utility for gains and the utility for losses have derivative 1 at 0 and, thus, the basic utility

functions are differentiable at 0. Thus, Köbberling and Wakker's (2005) definition of loss aversion can be computed under exponential utility.

Exponential utility has been widely used in economics and it generally fits experimental data on utility measurement well (e.g. Abdellaoui et al. 2007). We did not use the power specification, which is also commonly used, because the basic utility functions are not differentiable at 0 under the power specification unless the powers for gains and losses happen to be identical. We did not want to commit a priori to identical powers and, hence, identical utility curvature, for gains and losses and therefore chose exponential utility. The exponential specification also has the desirable feature that if $\lambda \geq 1$ then we have not only loss aversion in the sense of Köbberling and Wakker (2005), but also loss aversion in the sense of Kahneman and Tversky (1979).

The measurement of utility on the domain of losses is similar to that for gains. For risk we selected probability p_ℓ and elicited the certainty equivalents L^\uparrow of a series of prospects $(x, p_\ell; y)$, $x \leq y \leq 0$. We then obtain an expression for L^\uparrow similar to Eq.(4) but with $\pi^- = w^-(p_\ell)$ instead of π^+ . For time we chose $t_\ell = t_g$ and elicited the present equivalents L^\dagger of a series of temporal prospects $(x, t_\ell; y)$, $x \leq y \leq 0$. This gives an expression for L^\dagger similar to Eq.(5) but with $\tau^- = \varphi^-(t)$ instead of τ^+ .

3.1. Loss aversion

The final step in our method is to connect utility on the gain domain with utility on the loss domain. This step permits the quantification of loss aversion. The connection can be realized through one single question. For decision under risk we

selected a gain G_*^r from the domain of gains and asked subjects to state the loss L_*^r for which $(G_*^r, p_g; L_*^r) \sim 0$. By Eqs.(1) and (3),

$$\pi^+ u^r(G_*^r) + \lambda^r \pi^- u^r(L_*^r) = u^r(0) = 0. \quad (7)$$

Because π^+ , $u^r(G_*^r)$, π^- , and $u^r(L_*^r)$ are known from the estimations of the utility for gains and the utility for losses, the value of λ^r follows immediately.

To determine loss aversion for decision over time, we chose a gain G_*^t and asked for the loss L_*^t for which $(G_*^t, t_g; L_*^t) \sim 0$. By Eqs. (2) and (3),

$$\tau^+ u^t(G_*^t) + \lambda^t u^t(L_*^t) = u^t(0) = 0. \quad (8)$$

The values of τ^+ , $u^t(G_*^t)$, τ^- , and $u^t(L_*^t)$ are known and, consequently, λ^t follows. Of course, we could also fix L_*^t and ask for the gain G_*^t that established indifference between $(L_*^t, t_\ell; G_*^t)$ and 0. In the experiments reported below we used both ways to measure λ^t .

4. First Experiment: Rotterdam

4.1. Subjects

Subjects in the Rotterdam experiment were 68 (29 female) students from Erasmus University with various academic backgrounds. Subjects were paid a flat fee of €10 for their participation. The experimental questions involved hypothetical payoffs. The issue of incentives is discussed in Section 8. The mean duration of the experiment was 26 minutes. Before the actual experiment, the experimental design was tested and fine-tuned in several pilot sessions.

4.2. Procedure

The experiment was computer-run in small groups of 2 to 4 subjects with one interviewer present. The subjects were seated in small cubicles. They could not see the screens of the other subjects and were not allowed to communicate with each other.

Whether the experiment started with the risk or with the time questions was randomly determined. The two parts were not interspersed, however. If we started with the risk questions then all risk questions were administered first and subsequently all time questions. Each experimental session started with 6 practice questions: two questions involving gains, two questions involving losses, and two mixed questions involving both gains and losses. If the experiment started with the risk questions then the practice questions were risk questions. If the experiment started with the time questions then the practice questions were time questions.

All indifferences were elicited through a series of binary choices. The binary choices were part of an iterative process that zeroed in on subjects' indifference values. The stimuli in the first iteration of the risky questions were such that the prospects had equal expected value. In the time questions, the stimuli in the first choice ensured that the undiscounted values of the temporal prospects under consideration were equal. For the questions involving only gains or only losses there were 5 iterations. For the mixed questions there were 6 iterations. The first choice of each iterative process was always repeated to control for response errors. In case subjects made a different choice in the repeated choice the iterative process for that particular question was started anew. We used a choice-based procedure because empirical evidence suggests that choices lead to fewer inconsistencies than matching where subjects are directly asked for their indifference values (Bostic, Herrnstein, and

Luce 1990). Appendix A gives examples of the presentation of the risk and time questions.

4.3. Stimuli

Tables B1 and B2 in the appendix show the risky and temporal prospects used to measure utility under risk and over time. We used 8 questions to measure utility both for risk and for time and both for gains and for losses. Substantial amounts of money (up to €1000) were used to detect curvature of utility. For small amounts of money utility is close to linear. The probabilities p_g and p_ℓ were both set equal to $\frac{1}{2}$.

In the intertemporal profiles the delays t_g and t_ℓ were both set equal to 1 year.

We asked three questions to measure loss aversion in decision under risk. These three questions yielded three values of λ^r , which, under prospect theory and Eq. (3), should be equal. We also obtained three measurements of λ^t . Under Loewenstein and Prelec's model and Eq. (3) these three values should be equal.

We started with the 8 gain questions, then the 8 loss questions, and finally the 3 mixed questions. The pilot sessions showed that interspersing the gain, loss, and mixed questions tended to confuse subjects and led to more response errors. Within the gain, loss, and mixed questions the order of the questions was random.

Apart from repeating the first iteration of each question, we included 14 additional consistency questions. Both for risk and for time we repeated the third iteration of 3 randomly selected gain questions, of 3 randomly selected loss questions and of 1 randomly selected mixed question.

5. Second Experiment: Paris

The experiment in Paris was in many respects similar to the one in Rotterdam. The main reason to perform the Paris experiment was to include an incentivized task. We also made several other changes to test the robustness of our findings. These changes are outlined below.

5.1. Subjects

Subjects in the Paris experiment were 52 undergraduate students in management at Paris Descartes University (35 female). Subjects were paid a flat fee of €10. In addition, three subjects were randomly selected to play one of their choices in the gain domain for real. In case the question to be played out for real was a risk question, it was played out on the spot. In case a time question was selected and the subject had opted for the amount now, the money was paid at the end of the experimental session. In case a subject had chosen the delayed option, they had to leave a permanent address (typically their parents' address) and a "sure" email address. Subjects were told that they would be contacted 15 days before the future payment was due.³ The Paris experiment involved more questions than the Rotterdam experiment and lasted for 45 minutes on average.

5.2. Procedure

The procedure was similar to the one in Rotterdam except for the following. Data were collected in personal interview sessions. The data were entered in the computer by the interviewer in an attempt to further reduce the impact of errors.

³ Benhabib et al. (2010) and Coble and Lusk (2010) used the same payment system.

Because the Rotterdam experiment showed no order effects, the Paris experiment always started with the time questions. Each experimental session started with 9 practice questions: three questions involving gains, three questions involving losses, and three mixed questions. Because the experiment started with the time questions, the practice questions were also time questions.

In the Paris experiment the iteration process continued until the change in Euros between successive stimulus values was less than 2 Euros. Hence, the number of iterations varied across subjects. We did not replicate the first choice of the iteration process as we had learnt from the Rotterdam experiment that few people reversed their choice in this question and the Paris experiment was already rather long.

Appendix A gives examples of the way the risk and time questions were displayed in the Paris experiment.

5.3. *Stimuli*

Tables B3 and B4 in the appendix show the risky and the temporal prospects used to measure utility under risk and over time. For risk we used 6 questions to measure utility both for gains and for losses. The probabilities p_g and p_ℓ were set equal to $\frac{1}{4}$. We also measured $w^+(\frac{1}{2})$, $w^+(\frac{3}{4})$, and $w^-(\frac{1}{2})$, weights used in the elicitation of loss aversion. For time we used 7 questions to measure utility both for gains and for losses. In the intertemporal profiles the delays t_g and t_ℓ were both set equal to 6 months.

We used four questions to measure loss aversion under risk. In two questions we used probability $\frac{1}{4}$, in the other two questions probability $\frac{1}{2}$. These questions intended to test prospect theory. Under prospect theory and Eq.(3), the estimates of

loss aversion should be equal and should not depend on the probabilities used in the mixed prospects.

We also used four questions to measure loss aversion in intertemporal choice. We asked two questions in which the loss was delayed and the gain was obtained immediately and two questions in which the loss was incurred immediately and the gain was delayed. The aim was to explore whether these changes had an effect on the measured loss aversion coefficients. Loewenstein and Prelec's (1992) model predicts the absence of such an effect.

Both for time and for risk, we started with the gain questions, followed by the loss questions, and finally the mixed questions. Within the gain, loss, and mixed questions the order of the questions was random.

We included 16 consistency questions. We repeated both for risk and for time the third iteration of 3 randomly selected gain questions, of 3 randomly selected loss questions and of 2 randomly selected mixed questions.

6. Main Results

6.1. Consistency

6.1.1. Rotterdam

We removed three subjects from the experimental analyses. One of these subjects did not understand the tasks. The other two subjects were classified as outliers because their answers differed by more than three standard deviations from the mean responses. The reason to exclude them was to prevent that their responses would drive the estimation results. This left 65 subjects in the final analyses.

Replication rates compared favorably with the inconsistency rates of up to 33% that have been observed in other experiments (Stott 2006). The replication of

the first choice led to the same choice in 91% of the risk questions and in 96.5% of the time questions. The difference in reliability between risk and time was significant (paired t-test, $p = 0.00$). The replication rate for gains than losses did not differ significantly.

The replication of the third choice led to the same choice in 88% of the cases. The lower replication rate for the third choice could be expected given that the stimuli were closer to the indifference values. The replication rate was significantly higher for time than for risk (91% versus 83%, paired t-test, $p = 0.00$) and for gains than for losses (91% versus 84%, paired t-test, $p = 0.00$).

6.1.2. Paris

Two subjects were removed from the final analyses. One subject did not understand the tasks and the other was an outlier whose responses differed by more than three standard deviations from the mean responses. This left 50 subjects in the final analyses.

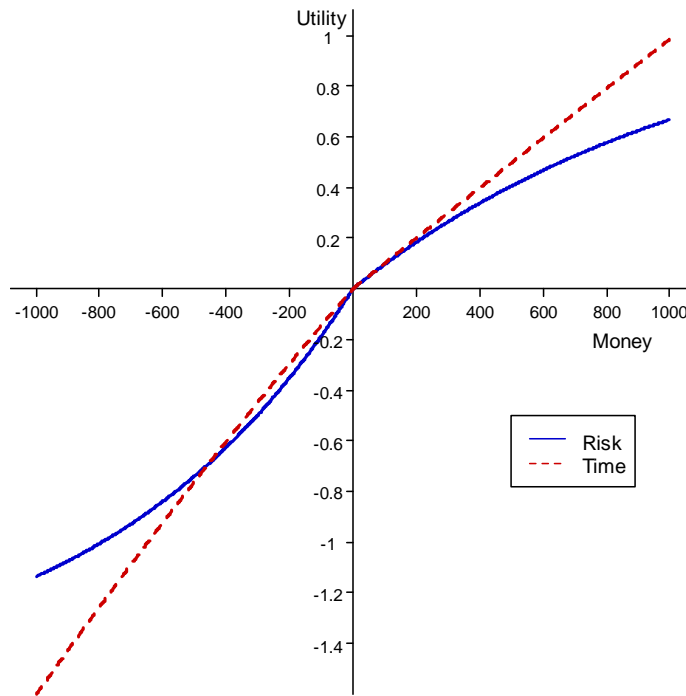
The replication of the third iteration led to the same choice in 97% of the cases. There was no significant difference between risk and time (96% versus 97.5%, paired t-test, $p = 0.23$) nor between gains and losses (96.5% versus 94.4%, paired t-test $p = 0.28$). The last finding is noteworthy as we used real incentives for gains but not for losses. Reliability was significantly higher in the Paris experiment than in the Rotterdam experiment. This held both for risk, for time, for gains, and for losses ($p = 0.00$ in all cases). A reason could be that preferences were elicited through personal interview sessions in the Paris experiment whereas we used small group sessions in the Rotterdam experiment.

6.2 Utility

6.2.1 Rotterdam

Figure 2 shows utility under risk and utility over time based on the pooled data in the Rotterdam experiment. The figure also displays the estimated exponential coefficients. Utility under risk and utility over time were clearly different. For risk, utility has the S-shape predicted by prospect theory. It is concave for gains and convex for losses. Both the utility for gains and the utility for losses differed significantly from linearity (t-test, $p < 0.01$ in both cases).

**Figure 2: Utility under Risk and over Time
Pooled Data Rotterdam**



Utility over time was much closer to linearity and we found no support for Loewenstein and Prelec's (1992) conjecture that the intertemporal utility function is S-shaped. For gains, we could not reject the hypothesis that utility was linear (t-test, p

= 0.71). For losses, utility was concave and the exponential coefficient differed significantly from 0 ($p < 0.01$). Both the utility for gains and for losses differed significantly between risk and time (paired t-test, $p < 0.01$ in both cases).

We obtained significant evidence for loss aversion both for risk and for time. For risk, the mean of the three loss aversion coefficients that we estimated was equal to 1.99. For time, this mean was lower and equal to 1.45. Loss aversion was significantly different between risk and for time (paired t-test, $p = 0.02$).

We also estimated utility under risk and utility over time for each subject separately. These results were largely similar to the results based on the pooled responses. Utility under risk and utility over time differed significantly both for gains and for losses (paired t-test $p = 0.00$ in both tests). Utility under risk was concave for gains and convex for losses. Sixty-two percent of the subjects had concave utility for gains (exponent > 0) and this proportion was significantly higher than the 38% who had convex utility (binomial test, $p = 0.04$). Sixty-nine percent of the subjects had convex utility for losses and this proportion was significantly higher than the 31% concave subjects ($p = 0.001$).

For time, utility was linear for gains and concave for losses. The proportion (43%) of subjects who had concave utility for gains did not differ significantly from the proportion of subjects who had convex utility. For losses, 65% of the subjects had concave utility and this proportion was significantly higher than the proportion of convex subjects ($p = 0.012$).

There was significant loss aversion both for risk and for time. In contrast with the pooled data, we could not reject the hypothesis that loss aversion was the same for risk and for time (paired t-test, $p = 0.32$). On the other hand, there was no significant correlation between the loss aversion coefficients under risk and those over time

(correlation = -0.04 , $p = 0.77$). Loss aversion varied considerably across subjects. The interquartile ranges (IQR) were [1.12, 1.84] for risk and [1.16, 1.56] for time.

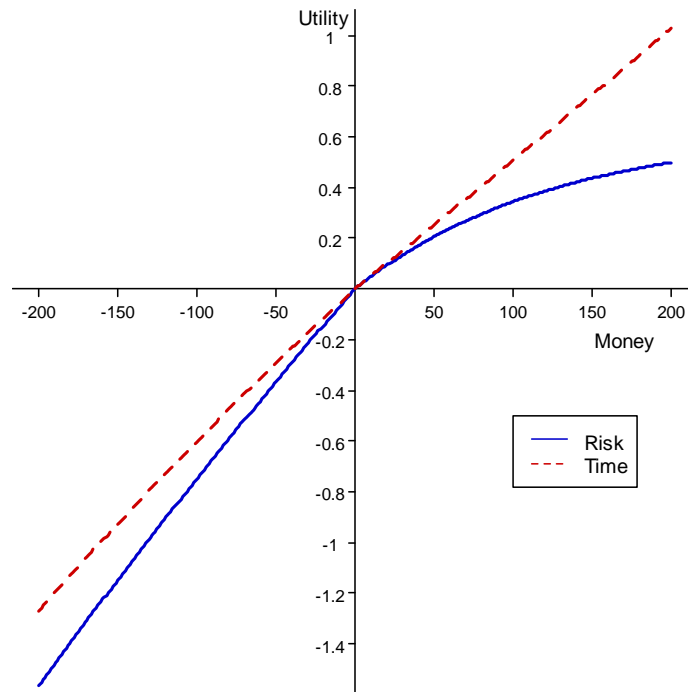
Our tests of prospect theory and Eq.(3) yielded mixed results. We could reject the hypothesis that the three loss aversion coefficients that we elicited were equal based on the pooled data (ANOVA, $p = 0.042$), but not based on the individual subject data (ANOVA, $p = 0.19$). For time, the data supported Loewenstein and Prelec's (1992) model and Eq.(3). The three elicited loss aversion coefficients did not differ significantly neither for the pooled data (ANOVA, $p = 0.98$) nor for the individual subject data (ANOVA, $p = 0.37$).

6.2.2. Paris

Figure 3 shows the utility under risk and over time based on the pooled data in the Paris experiment. Utility under risk and utility over time also differed in the Paris experiment. In contrast with the Rotterdam experiment, we did not observe prospect theory's S-shaped utility function for risk. The utility for gains was significantly concave ($p < 0.01$), but for losses utility was linear. For time, utility was similar to what we observed in the Rotterdam experiment: linear for gains and significantly concave for losses ($p < 0.01$). The utility for gains differed significantly between risk and time ($p < 0.01$). For losses, on the other hand, we could not reject the hypothesis that utility under risk and utility over time were the same ($p = 0.64$). The difference in the utility for losses between risk and time, reflected in Figure 3, was due to a difference in loss aversion. We observed significant loss aversion both for risk and for time ($p < 0.01$ in both cases), but loss aversion was significantly stronger for risk than for time ($p = 0.02$). The mean loss aversion coefficient for risk was equal to 1.44, for

time it was 1.15. Both for risk and for time we observed significantly less loss aversion than in the Rotterdam experiment ($p < 0.01$ in both cases).

**Figure 3: Utility under Risk and over Time
Pooled Data Paris**



The individual data led to similar conclusions. Utility under risk and utility over time differed significantly. Utility under risk was concave for gains and linear for losses. For gains, the proportion of concave subjects (86%) was significantly higher than the proportion of convex subjects, for losses these proportions did not differ significantly ($p = 0.32$). Utility over time was linear for gains and concave for losses. For gains, the proportion of convex subjects (66%) was significantly higher than the proportion of concave subjects ($p = 0.02$), for losses we found no significant difference ($p = 0.23$). Loss aversion was significant both for risk and for time, but it was significantly higher for risk than for time ($p < 0.01$). For risk we observed

substantially more loss aversion in the individual subject data. The median of the individual loss aversion coefficients was 2.45, much larger than the coefficient of 1.44 we estimated based on the pooled data. The difference was due to individual heterogeneity in loss aversion. The IQR of the loss aversion coefficients for risk was [1.67, 4.46]. For time there was much less heterogeneity: the IQR was [0.98, 1.32] and loss aversion for the individual subject data was similar to loss aversion based on the pooled data. In contrast with the concept of a common psychological intuition underlying loss aversion, the correlation between loss aversion for risk and loss aversion over time was low and insignificant (Pearson correlation = 0.08, $p = 0.60$).

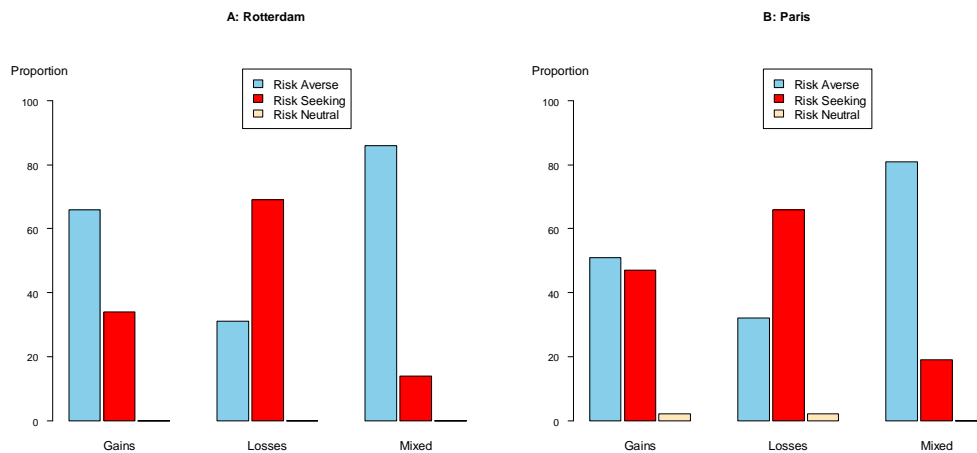
We elicited four loss aversion coefficients both for risk and for time. For risk we observed that the elicited loss aversion coefficients depended on the probability used in the mixed prospects. Loss aversion was significantly higher for gain probability $\frac{3}{4}$ than for gain probability $\frac{1}{2}$. This held both for the pooled data and for the individual subject data ($p < 0.01$ in both cases) and it is inconsistent with prospect theory with utility as in Eq.(3). For time, we found that the loss aversion coefficients depended on the delay of the loss. Loss aversion was significantly higher in the questions in which the gain was received immediately and the loss with a delay of 6 months than in the questions in which the loss was incurred immediately and the gain was received in 6 months ($p = 0.04$ for the pooled data and $p < 0.01$ for the individual subject data). The dependence of loss aversion on the delay of the loss are inconsistent with Loewenstein and Prelec's (1992) model with utility as in Eq.(3).

7. Auxiliary Analyses

7.1 Risk aversion

Figure 3 shows the proportions of risk averse, risk seeking, and risk neutral responses, where risk aversion [seeking, neutrality] is defined as the certainty equivalent of a prospect being smaller than [larger than, equal to] its expected value. In Rotterdam the modal preference was risk aversion for gains and risk seeking for losses. Risk aversion was most pronounced in the mixed questions.

Figure 3: Proportions of risk averse, risk seeking, and risk neutral responses



In the Paris experiment, we observed more risk seeking for gains. For losses and in the mixed questions the pattern was very close to the one observed in Rotterdam.

The larger proportion of risk seeking choices was due to the questions involving probability $\frac{1}{4}$. When we only compare the questions involving the same probability ($\frac{1}{2}$) we did observe more risk aversion in the Paris experiment than in the Rotterdam experiment in agreement with the common findings that people become

more risk averse in the presence of real incentives (Camerer and Hogarth 1999, Holt and Laury 2002).

For probability $\frac{1}{4}$ a majority of choices was actually risk seeking in the Paris experiment. This was not caused by convexity of utility as utility was clearly and significantly concave in the Paris experiment and over 80% of the Parisian subjects had concave utility for gains. The coexistence of concave utility and risk seeking behavior is impossible under expected utility. Our data show that under prospect theory risk seeking and concave utility can coexist.

7.2. Impatience

Figure 4: Proportions of impatient, patient, and timing neutral responses

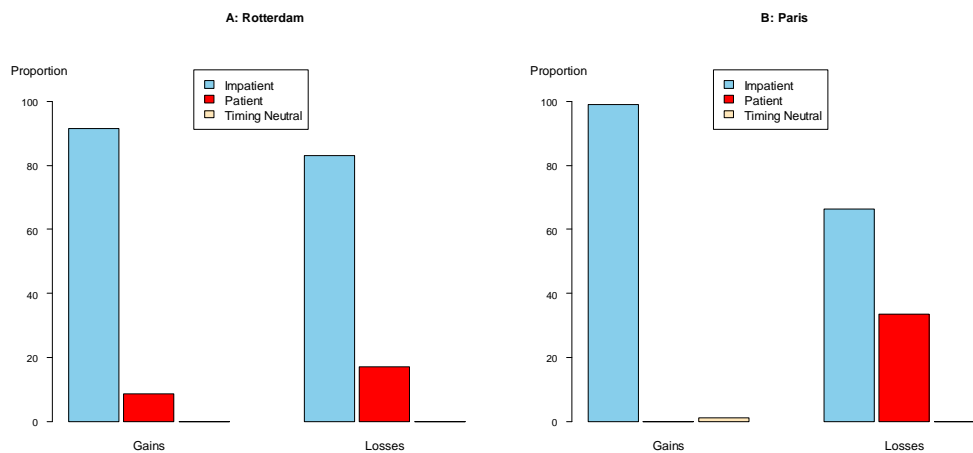


Figure 4 shows the proportions of impatient, patient, and timing neutral responses in the two experiments. Both in Rotterdam and in Paris impatience was the most common response pattern. A minority of subjects did not want to delay losses and this tendency was stronger in the Paris experiment than in the Rotterdam experiment. Negative discounting for unfavorable outcomes is not uncommon in the literature.

Other studies that observed evidence of it include Yates and Watts (1975), Loewenstein (1987), and Benzion, Rapoport, and Yagil (1989) for losses and van der Pol and Cairns (2000) for aversive health outcomes.

7.3. Attitude towards risk and towards time

Our data allowed us to explore the relationship between risk aversion and impatience. Are risk averse people more or less patient? The literature on this question is mixed. Anderhub et al. (2001) and Eckel, Johnson, and Montmarquette (2005) found that risk averse people were less patient, Booij and van Praag (2009) on the other hand found that risk averse people were more patient and Chabris et al. (2008) and Cohen, Tallon, and Vergnaud (2010) found no relation between risk aversion and discounting. All of these studies made simplifying assumptions that may have affected their conclusions and that are avoided in this paper.

To measure risk aversion we computed for each subject and for gains, losses and mixed questions the medians of $(EV-CE)/\sigma$, where EV denotes the prospect's expected value, CE its certainty equivalent and σ is the standard deviation of the prospect involved. A larger value of this index corresponds to more risk aversion. For temporal prospects we computed the medians of $(|UV|-|PV|)/\sigma$, where UV is the value corresponding to no discounting, PV denotes the actual present value given, and σ is the standard deviation of the temporal prospect involved. Both for gains and for losses a larger value of this index corresponds to more impatience. For mixed temporal prospects we used $(PV-UV)/\sigma$ for temporal prospects in which the loss was delayed and $(UV-PV)/\sigma$ for prospects in which the gain was delayed. Larger values of these indices correspond to more impatience.

In the Rotterdam experiment we found a small and marginally significant tendency for people who are risk averse to be more patient as well. This held both for gains (correlation = -0.23 , $p = 0.06$) and for mixed prospects (correlation = -0.23 , $p = 0.05$), but not for losses (correlation = -0.15 , $p = 0.23$). In the Paris experiment we observed no correlation between risk aversion and impatience for any of the outcomes.

7.4. Probability Weighting and Time Discounting

Our estimation method also yielded estimates probability weighting and discounting. Table 1 summarizes the findings based on the pooled data. The results based on the individual subject data were similar. In Rotterdam no significant probability weighting was observed. In Paris, the data were consistent with inverse S probability weighting (overweighting of small probabilities and underweighting of large probabilities) for gains and with underweighting of probabilities for losses. Probability weighting for gains was significantly different from probability weighting for losses in the Paris experiment ($p = 0.00$).

Table 1: Probability Weighting and Discounting Based on the Pooled Data

	Rotterdam		Paris	
	Gain	Loss	Gain	Loss
Probability weight	$w^+(\frac{1}{2}) = 0.49$	$w^-(\frac{1}{2}) = 0.50$	$w^+(\frac{1}{4}) = 0.38$ $w^+(\frac{1}{2}) = 0.48$ $w^+(\frac{3}{4}) = 0.71$	$w^-(\frac{1}{4}) = 0.21$ $w^-(\frac{1}{2}) = 0.37$
Discount rate 1 year delay	16.7%	14.5%	54.0%	19.0%

Both for gains and for losses we observed significant discounting. The difference in discounting between gains and losses was not significant in the Rotterdam experiment ($p = 0.47$), but it was in the Paris experiment ($p < 0.01$).

8. Discussion

Utility under risk and utility over time were significantly different in all but one of the tests that we performed. The one exception was the utility for losses in the Paris experiment. Our findings suggest that utility under risk and utility over time are context-specific and they caution against transferring utility across contexts, as is common in applied and empirical economics.

Our evidence on the shape of utility for risk was mixed. In the Rotterdam experiment we could confirm prospect theory's hypothesis that utility under risk is S-shaped, concave for gains and convex for losses. In the Paris experiment, on the other hand, utility under risk was concave for gains but linear for losses. The finding that curvature of utility is less pronounced for losses than for gains is common in the literature and our evidence is in line with this.

We obtained less support for Loewenstein and Prelec's (1992) conjecture that the intertemporal utility function is also S-shaped. In both experiments, the intertemporal utility for gains was linear and the utility for losses was slightly concave. Linearity of intertemporal utility is commonly assumed in measurements of discounting. Our results suggest that this assumption does not introduce much distortion. Abdellaoui, Attema and Bleichrodt (2010), the only study in the literature that measured intertemporal utility for gains and losses without making a priori parametric assumptions about its functional shape, also observed that intertemporal utility was close to linear. Andersen et al. (2008) argued that not accounting for utility curvature distorts measured discount rates. They measured utility in the context of risk, however, and assumed expected utility. Our results suggest that their implicit assumption that utility under risk can be used in intertemporal choice is questionable.

The widely documented violations of expected utility cast further doubt on their findings.

We found that loss aversion affects both decision under risk and decision over time. It was significantly stronger in decision under risk than in decision over time, however. No significant correlation between loss aversion in decision under risk and decision over time was observed. Gaechter, Johnson, and Herrmann (2007) observed that loss aversion in a WTP-WTA task and in a risky decision task were strongly correlated. These conflicting findings indicate that the nature of loss aversion is still unclear and requires more evidence.

Several caveats are in order when interpreting our results. We assumed that prospect theory and Loewenstein and Prelec's (1992) discounting model held in combination with a decomposition of utility in a term reflecting attitudes towards outcomes and a term reflecting loss aversion (see Eq. 3). Our evidence on assumptions was mixed. In the Rotterdam experiment they were generally supported. In the Paris experiment, which varied more experimental parameters, loss aversion depended on the experimental stimuli (probabilities and delay of the loss). This dependence is inconsistent with prospect and Loewenstein and Prelec's (1992) model. Our findings are only based on a limited number of tests, however, and in Abdellaoui, Bleichrodt, and l'Haridon (2008) we observed no evidence that loss aversion under risk depended on the probabilities involved. Future research should further explore the relationship between loss aversion and experimental stimuli.

Loewenstein and Prelec's (1992) model assumes separability of time points. This is a strong assumption that has been challenged empirically (Prelec and Loewenstein 1991, Wathieu 1997, Dolan and Kahneman 2008). The lower loss aversion in intertemporal choice could, for instance, be expected to some degree if

time separability were violated. In decision under risk there is no compensation for a loss, you either incur a loss or receive a gain. In decision over time on the other hand the loss and the gain are obtained jointly and the loss is at least partly offset by the gain. Similarly, violations of separability may contribute to the difference between intertemporal utility and utility under risk.

On the other hand, the observed linearity of intertemporal utility cannot be explained by subjects always choosing the option yielding the highest joint payments. Their responses were not in agreement with such a response strategy. Moreover, Abdellaoui, Attema, and Bleichrodt (2010) who used an experimental design that was not vulnerable to the heuristic that subjects simply added money amounts, obtained comparable linearity of utility.

Money is a fungible reward. Consequently, most experimental studies, including this one, do not directly measure people's time preference for consumption (Cubitt and Read 2007). Recent experimental research observed, however, that discount rates for money and consumption are correlated and that people do not reschedule money, suggesting that money can be used as a proxy for consumption (Reuben, Sapienza, and Zingales 2010, Benhabib, Bisin, and Schotter 2010).

In the Rotterdam experiment we used hypothetical questions, whereas in the Paris experiments the questions for gains were incentivized. The issue of hypothetical versus real payoffs has been widely debated in the literature. The main conclusion appears to be that while real incentives tend to produce less noisy data and more risk aversion, qualitative patterns do not depend on whether incentives are used. Our main conclusions did not depend on the type of incentives used. The shapes of utility were comparable and the conclusion that utility under risk and utility over time were significantly different held both for real and for hypothetical choices. The only case in

which incentives appeared to matter was the discounting of gains. The observed discount rate was much higher in the incentivized Paris experiment than in the hypothetical Rotterdam experiment. It could be that subjects considered future real payoffs risky and that this has increased their discount rates. Anderson and Stafford (2009) also observed that the introduction of risk tends to increase discount rates. Halevy (2008) and Baucells and Heukamp (2010) show theoretically why uncertainty increases discount rates.

Our data may be interpreted as evidence that real incentives tend to reduce error. Reliability rates, though good in both experiments, were significantly higher in the Paris experiment than in the Rotterdam experiment. On the other hand, the higher reliability held both for gains, which were incentivized, and for losses, for which the questions were hypothetical. Another explanation for the higher reliability in the Paris experiment is that we used personal interviews in the Paris experiment and group sessions in the Rotterdam experiment. Real incentives also appeared to increase risk aversion. For probability $\frac{1}{2}$, the probability used in the Rotterdam experiment, we indeed observed substantially more risk aversion in the Paris experiment.

9. Conclusion

Utility is context-specific. Utility under risk was significantly more curved than utility over time. We could mostly confirm the hypothesis of Tversky and Kahneman (1992) that utility under risk is S-shaped, concave for gains and convex for losses. Utility for losses was closer to linear than utility for gains. Utility in Loewenstein and Prelec's (1992) discounting model was, however, not S-shaped, but close to linear. Our findings question the transferability of utility, often assumed in applied and empirical economics. We observed significant loss aversion, both for risk

and for time. Loss aversion under risk was significantly stronger than loss aversion over time and the two were not correlated. These findings suggest that loss aversion is important in choice behavior but that it is volatile.

Appendix A: Presentations of Choices

Figure A1: Presentation of the risky choices in the Rotterdam experiment



Figure A2: Presentation of the intertemporal choices in the Rotterdam experiment

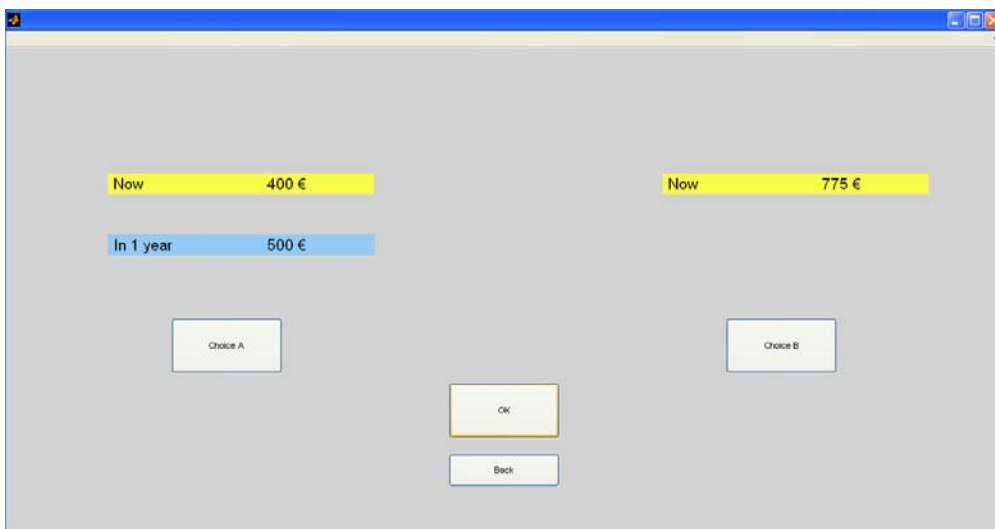


Figure A3: Presentation of the risky choices in the Paris experiment

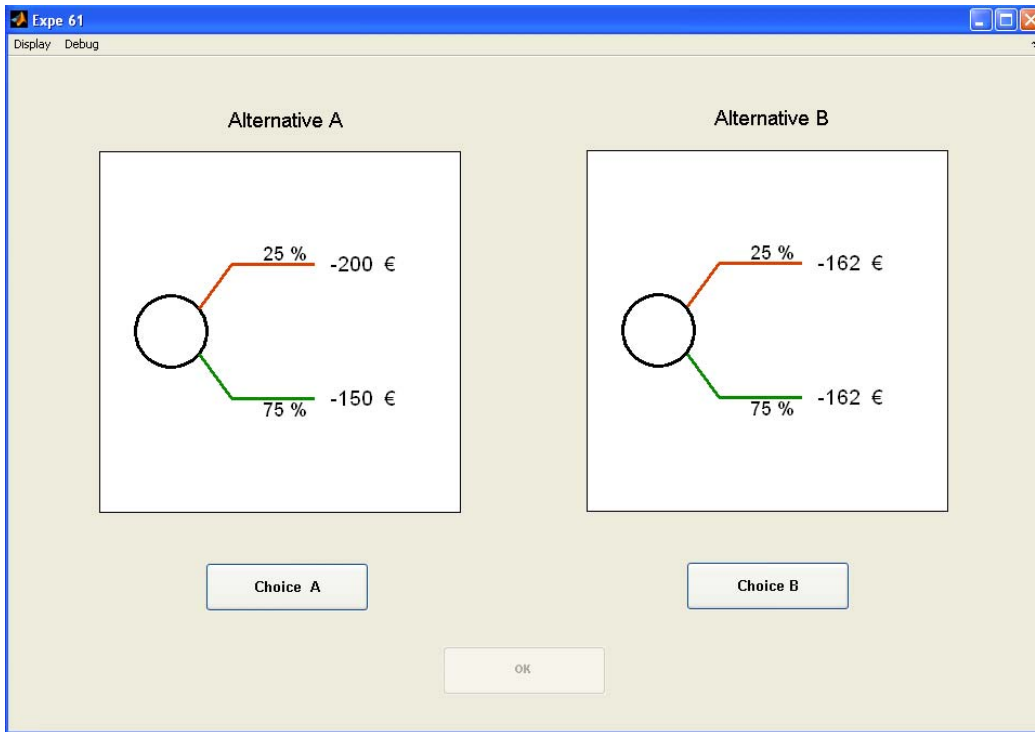
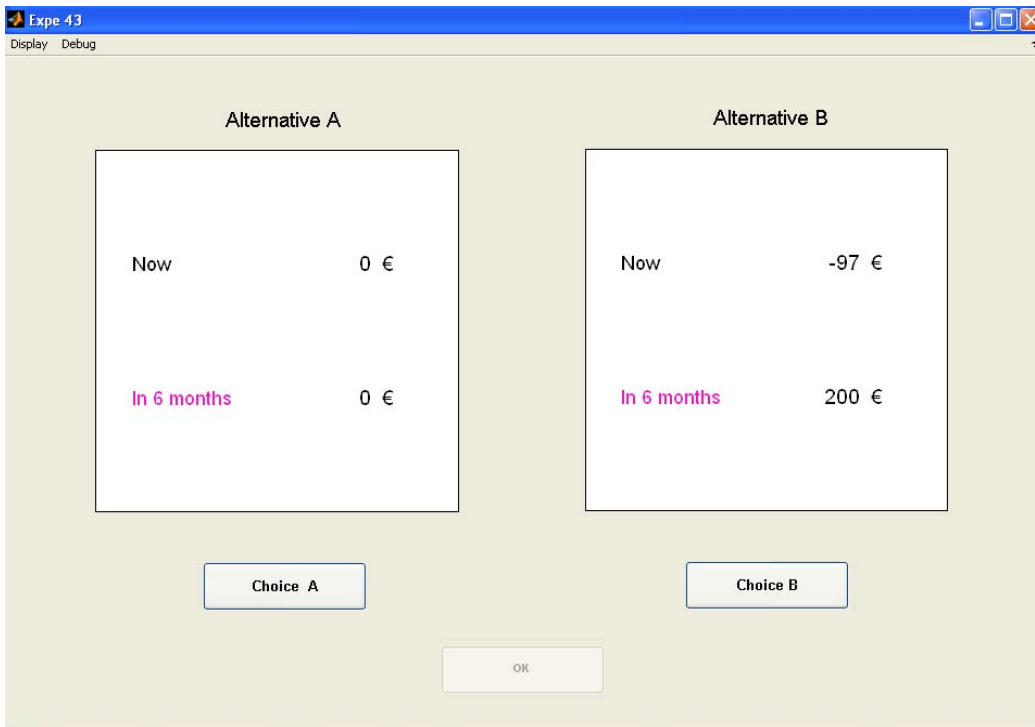


Figure A4: Presentation of the intertemporal choices in the Paris experiment



Appendix B: Experimental Data

Table B1: Results of the Rotterdam Experiment. Risk.

	Prospect	Median	IQR	Mean
Gain prospects	$(400, \frac{1}{2}; 0)$	193.50	[143.50,193.50]	169.27
	$(600, \frac{1}{2}; 0)$	290.50	[196.50,309.00]	264.06
	$(600, \frac{1}{2}; 200)$	393.50	[356.00,406.00]	374.85
	$(800, \frac{1}{2}; 200)$	471.50	[391.75,509.00]	449.63
	$(800, \frac{1}{2}; 400)$	593.50	[568.50,606.00]	586.00
	$(1000, \frac{1}{2}; 400)$	690.50	[610.75,709.00]	652.50
	$(1000, \frac{1}{2}; 600)$	793.50	[743.50,806.00]	778.50
	$(1000, \frac{1}{2}; 800)$	903.00	[896.50,909.00]	898.15
Loss prospects	$(-400, \frac{1}{2}; 0)$	-193.50	[-206.00,-165.38]	-184.08
	$(-600, \frac{1}{2}; 0)$	-290.50	[-313.63,-271.50]	-283.68
	$(-400, \frac{1}{2}; -200)$	-393.50	[-406.00,-343.50]	-371.96
	$(-800, \frac{1}{2}; -200)$	-393.50	[-434.00,-331.00]	-388.20
	$(-800, \frac{1}{2}; -400)$	-593.50	[-606.00,-531.00]	-567.15
	$(-1000, \frac{1}{2}; -400)$	-690.50	[-709.00,-615.50]	-659.15
	$(-1000, \frac{1}{2}; -600)$	-793.50	[-806.00,-756.00]	-779.65
	$(-1000, \frac{1}{2}; -800)$	-896.50	[-903.00,-882.50]	-889.62
Mixed prospects	$(G_{*1}^r, \frac{1}{2}; -L_{*1}^r)$	-99.00	[-179.25,-60.25]	-124.05
	$(G_{*2}^r, \frac{1}{2}; -L_{*2}^r)$	-178.50	[-285.00, -97.13]	-214.91
	$(G_{*3}^r, \frac{1}{2}; -L_{*3}^r)$	-272.50	[-361.63,-106.25]	-257.32

Table B2: Results of the Rotterdam Experiment. Time.

	Prospect	Median	IQR	Mean
Gain prospects	$(200, 1y.; 0)$	181.00	[156.00,193.50]	166.38
	$(300, 1y.; 0)$	271.50	[215.50,290.50]	251.08
	$(300, 1y.; 100)$	371.50	[329.38,390.50]	354.84
	$(400, 1y.; 100)$	462.50	[437.50,487.50]	448.27
	$(400, 1y.; 200)$	562.50	[512.50,587.50]	547.50
	$(500, 1y.; 200)$	652.50	[621.50,684.00]	639.29
	$(500, 1y.; 300)$	721.50	[690.50,784.00]	725.35
	$(500, 1y.; 400)$	852.50	[790.50,884.00]	832.58
Loss prospects	$(-200, 1y.; 0)$	-181.00	[-193.50,-156.00]	-179.08
	$(-300, 1y.; 0)$	-271.50	[-290.50,-234.00]	-262.89
	$(-300, 1y.; -100)$	-371.50	[-390.50,-329.38]	-354.82
	$(-400, 1y.; -100)$	-462.50	[-487.50,-431.25]	-444.42
	$(-400, 1y.; -200)$	-537.50	[-587.50,-512.50]	-524.81
	$(-500, 1y.; -200)$	-652.50	[-684.00,-590.50]	-628.22
	$(-500, 1y.; -300)$	-721.50	[-784.00,-690.50]	-725.85
	$(-500, 1y.; -400)$	-821.50	[-884.00,-790.50]	-802.77
Mixed prospects	$(-L_{*1}^t, \frac{1}{2}; G_{*1}^t)$	-149.50	[-172.00,-116.88]	-141.11
	$(-L_{*2}^t, \frac{1}{2}; G_{*2}^t)$	-224.00	[-266.50, -175.38]	-214.91
	$(-L_{*3}^t, \frac{1}{2}; G_{*3}^t)$	-324.50	[-365.00,-271.88]	-306.77

Table B3: Results of the Paris Experiment. Risk.

	Prospect	Median	IQR	Mean
Gain prospects	$(100, \frac{1}{4}; 0)$	25.00	[20.00,38.00]	27.98
	$(200, \frac{1}{4}; 50)$	81.00	[75.00,96.00]	84.22
	$(200, \frac{1}{4}; 100)$	129.00	[125.00,136.00]	128.98
	$(50, \frac{1}{4}; 0)$	17.00	[12.00,20.00]	16.82
	$(150, \frac{1}{4}; 100)$	118.00	[114.00,121.00]	118.86
	$(200, \frac{1}{4}; 150)$	167.00	[164.00,170.00]	166.88
	$(200, \frac{1}{4}; 0)$	39.00	[32.00,50.00]	46.44
	$(200, \frac{1}{2}; 0)$	67.00	[50.00,83.00]	67.40
Loss prospects	$(200, \frac{3}{4}; 0)$	106.00	[79.00-129.00]	106.08
	$(-100, \frac{1}{4}; 0)$	-20.00	[-29.00,-17.00]	-22.66
	$(-200, \frac{1}{4}; -50)$	-78.00	[-88.00,-68.00]	-78.72
	$(-200, \frac{1}{4}; -100)$	-121.00	[-128.00,-116.00]	-122.30
	$(-50, \frac{1}{4}; 0)$	-10.00	[-12.00,-10.00]	-11.02
	$(-150, \frac{1}{4}; -100)$	-112.00	[-116.00,-110.00]	-113.12
	$(-200, \frac{1}{4}; -150)$	-162.00	[-166.00,-160.00]	-163.08
	$(-200, \frac{1}{4}; 0)$	-47.50	[-61.00,-32.00]	-48.28
Mixed prospects	$(-200, \frac{1}{2}; 0)$	-77.00	[-92.00,-62.00]	-78.24
	$(200, \frac{1}{2}; -L_{*1}^r)$	-77.00	[-107.00,-51.00]	-87.84
	$(50, \frac{1}{2}; -L_{*2}^r)$	-26.00	[-36.00,-20.00]	-29.46
	$(200, \frac{3}{4}; -L_{*3}^r)$	-126.00	[-180.00,-83.00]	-137.62
	$(50, \frac{3}{4}; -L_{*4}^r)$	-33.50	[-58.00,-26.00]	-42.04

Table B4: Results of the Paris Experiment. Time.

	Prospect	Median	IQR	Mean
Gain prospects	$(100, 6m.; 0)$	78.00	[74.00,85.00]	77.24
	$(75, 6m.; 25)$	82.00	[76.00,87.00]	81.52
	$(150, 6m.; 0)$	120.00	[109.00,135.00]	119.66
	$(50, 6m.; 0)$	38.00	[34.00,42.00]	37.12
	$(100, 6m.; 50)$	130.00	[120.00,140.00]	129.14
	$(150, 6m.; 50)$	172.00	[159.00,181.00]	168.80
	$(200, 6m.; 0)$	163.00	[149.00,177.00]	159.42
Loss prospects	$(-100, 6m.; 0)$	-93.50	[-101.00,-87.00]	-93.10
	$(-75, 6m.; -25)$	-91.00	[-101.00,-87.00]	-92.58
	$(-150, 6m.; 0)$	-143.00	[-151.00,-130.00]	-138.70
	$(-50, 6m.; 0)$	-49.00	[-51.00,-44.00]	-48.46
	$(-100, 6m.; -50)$	-142.00	[-151.00,-135.00]	-141.42
	$(-150, 6m.; -50)$	-185.00	[-201.00,-170.00]	-183.50
Mixed prospects	$(-200, 6m.; 0)$	-179.00	[-201.00,-170.00]	-182.60
	$(-L_{*1}^t, 6m.; 200)$	-77.00	[-107.00,-51.00]	-87.84
	$(-L_{*2}^t, 6m.; 50)$	-26.00	[-36.00,-20.00]	-29.46
	$(200, 6m.; -L_{*3}^t)$	-126.00	[-180.00,-83.00]	-137.62
	$(50, 6m.; -L_{*4}^t)$	-33.50	[-58.00,-26.00]	-42.04

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