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Tempus Fugit:
Time Pressure in Risky Decisions*

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Abstract: We study the effects of time pressure on risky decisions for pure gain prospects, pure loss prospects, and mixed prospects involving both gains and losses. In an experiment we find that risk aversion for gains is robust under time pressure whereas risk seeking for losses turns into risk aversion under time pressure. For mixed prospects, subjects become more loss averse and more gain seeking under time pressure, depending on the framing of the prospects. The results suggest the importance of aspiration levels under time pressure. We discuss the implications of our findings for decision making situations that involve time pressure.

Key words: time pressure, risky decisions, risk aversion, loss aversion, gain seeking, aspiration level
JEL classification: C91, D81

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1. Introduction

Time pressure is common to many economic decisions. Traders make orders in financial markets within seconds after new information becomes available (Busse and Green 2002). Last-minute bidders in auctions learn about common value components and adjust their valuation in an instant (Roth and Ockenfels 2002). Negotiators must often reach agreements before a deadline (Roth et al. 1988, Sutter et al. 2003). This paper studies the effect of time pressure on decision under risk. Risk attitudes are important for economic policy decisions (Barsky et al. 1997, Borghans et al. 2009, Dohmen et al. 2011, Guiso and Paiella 2008), and the effects of time pressure on behavior in risky decisions should be considered by regulators of fast-paced markets. If there is a change in behavior under time pressure, existing behavioral predictions and empirical evidence based on data without time pressure may not be valid in these environments. Self-selection of individuals into occupations and a lack of comparable decision making situations with different degrees of time pressure, complicate the study of time pressure in the real world. We therefore use a laboratory experiment to identify the effect of time pressure on decision making under risk.

The effects of time pressure on decision under risk are also important from a methodological perspective when eliciting risk attitudes. Whereas standard incentivized and non-incentivized methods for eliciting risk attitudes do usually not put the decision makers under time pressure, it is sometimes necessary to do so like in the quickly emerging field of neuro-economics (e.g., Glimcher 2004, Camerer et al. 2005). Because of the technical need to record neural activity in short time windows, subjects are presented stimuli and have to make decisions in only a few seconds (e.g. in Tom et al. 2007, the whole process of presentation and decision took a maximum of 3 seconds; Engelmann et al. 2009, allow 3.5 seconds decision time). If risky decisions are affected by time pressure, the observed patterns of neural activity may also be specific to this condition. If they are not affected or only partially affected, the results can claim wider applicability. More generally, there is no systematic study so far in economics that compares decision under risk with time pressure and without time pressure.

In this paper, we analyze decisions in the gain domain, decisions in the loss domain, and decisions with both gains and losses involved. For gains we observe strong risk aversion; a finding that is very robust under time pressure. For losses we find that subjects become more risk averse under time pressure, turning mild risk seeking into risk aversion. For mixed prospects, the tendency to weigh gains and losses differently can become important. We call such weighting differences *gain-loss attitude*, with loss aversion denoting an overweighting of losses and gain seeking an overweighting of gains. Gain-loss attitude is less robust under time pressure. Both loss aversion and gain seeking can be increased under time pressure depending on simple framing manipulations. In general, we find time pressure to alter choices once we move outside the domain of pure gain prospects.

We also provide half of our subjects with information about the expected value of prospects. For instance, information on average returns is readily available on financial markets, and the impact of this availability on decision making under time pressure seems particularly relevant. We observe that the elicited risk attitudes are not systematically affected by expected value information in pure gain or pure loss decisions, but they are strongly affected for mixed prospects where choices are closer to risk-neutral expected value maximization when the information is available. This holds for decisions with and without time pressure. Interestingly there are no interaction effects of time pressure and the availability of information. Our result suggests that subjects use information helping them to eliminate the influence of economically irrelevant gain-loss framing on their decisions (Slovic 1972, Hilton 2003).

Despite its relevance time pressure in risky decision has received very little attention in the economics literature.[1] Bollard et al. (2007) study the effect of time pressure in an experiment where subjects can buy prospects with different variance and expected payoff in the gain domain. They find more variance aversion for time pressure. Given that subjects had to pay for the prospects, however, all their decisions involve gains and losses, and the increased variance aversion could be explained by the finding of stronger loss aversion under time pressure. There is a psychological literature on time pressure in risky decision (Ben-Zur and Breznitz 1981, Payne et al. 1993, Payne et al. 1996, Maule et al. 2000). These studies focus on information processing and identify two strategies to cope with time pressure. First, behavior becomes more heuristic. Second, subjects exert more cognitive effort. These findings are consistent with evidence on decision-making cost in economics (Wilcox 1993, Camerer and Hogarth 1999, Moffatt 2005). Ben-Zur and Breznitz (1981) consider risk attitudes for mixed prospects involving both gains and losses. They find more risk aversion under time pressure, and our results suggest that this is due to increased loss aversion.

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[1] Its impact has been studied in a few other economic contexts such as search behavior (Ibanez et al. 2009), bargaining (Sutter et al. 2003), and in the beauty-contest game (Kocher and Sutter 2006). Reutskaja et al. (2011) investigate search dynamics from choice sets of different size under time pressure using an eye-tracking device.

Our study is the first to consider risk attitude separately for gains, for losses and for mixed gambles and the first to vary the availability of information both without time pressure and under time pressure. We provide evidence suggesting that risk attitude for losses and gain-loss attitude may be less robust with regard to external circumstances than risk attitude for gains. The generality of risk seeking for losses has been questioned by studies using repetition and financial incentives (Myagkov and Plott 1997), and our results show that time pressure creates yet another environment in which risk aversion for losses may prevail. Under time pressure, gain-loss attitude is strongly affected by economically irrelevant framing effects and loss aversion is not necessarily a valid assumption if gains become more attractive because they give the impression to agents that they can break even.

Different theories of decision making under risk predict different effects of time pressure. Under expected utility, time pressure should have no effects, with the potential exception of increased noise because of errors (Schmidt and Neugebauer 2007). Prospect theory assumes psychophysical effects in the weighting of probabilities and the weighting of gains versus losses. Such weighting effects would reasonably be expected to change under time pressure, but no clear direction is implied by the original theory. An expected utility model with an aspiration level has recently been formalized (Payne 2005, Diecidue and van de Ven 2008). This model can explain similar deviations from expected utility as prospect theory does by allowing utility to increase discontinuously at the aspiration level. The model explicitly assumes that the aspiration level effect derives from a heuristic focus on the likelihood of breaking even (or the total probability to surpass the aspiration level). It therefore predicts that deviations from expected utility become stronger if decisions are made under time pressure. Our results suggest that aspiration-based models may be a useful alternative to prospect theory to model non-expected utility in situations with time pressure. Behavior becomes more heuristic and the probability of breaking even can lead to reversals of typical loss aversion patterns.

The remainder of the paper is organized as follows. The next section introduces the experimental design and the time pressure conditions. In Section 3 we discuss our measures of risk attitude. Section 4 presents the experimental results, and Section 5 discusses the results and concludes the paper.

2. Experimental Design

2.1. Treatments and Procedures

Our experiment employs a 2×2 between-subject factorial design. The two factors we vary are the degree of *time pressure* and the availability of information about the *expected values* of the risky prospects. The four treatments are summarized in Table 1.

In all four treatments, subjects made choices between risky prospects in three separate experimental parts. Part I consisted of binary choices between pure gain prospects that were individually time constrained. Part II consisted of a choice list of seven choices adapted from Holt and Laury (2002). The whole list had to be completed within a time limit. The third part consisted of two subparts: in Part IIIA choices involving both gains and losses were made, and the choices were individually time constrained. In Part IIIB, subjects made individually time-constrained choices between pure gain prospects with a smallest payoff of €20 to cover possible losses from Part IIIA. When making their choices in Part IIIA subjects did not know how much money they could win in Part IIIB. The order of the three parts was fixed.

Table 1: Overview of the Treatments

	No time pressure	Time pressure
No EV information	NTP-NEV N = 42	TP-NEV N= 41
EV information	NTP-EV N = 45	TP-EV N = 48

EV = expected value; N = number of observations (experimental participants).

At the end of the experiment one part was randomly selected to determine a participant's income with equal probability. If either Part I or Part II was selected, one decision within this part was selected with equal probability to be paid out for real.[2] If Part III was selected, then one randomly selected decision from Part IIIA with possible losses *and* one randomly selected decision from Part IIIB were played for real. The decision in Part IIIB was selected

[2] In individual decision experiments, this random lottery system is almost exclusively used for financial incentives (Myagkov and Plott 1997, Holt and Laury 2002, Harrison et al. 2002). Its equivalence to a single and payoff relevant decision task has been empirically tested and confirmed (Starmer and Sugden 1991, Hey and Lee 2005).

independently of the Part IIIA decision. The random selection of the payoff-relevant task was done independently for each subject. The structure of payments in Part III was chosen to avoid giving experimental participants a clear reference point when making decisions in the loss domain in Part IIIA. Hence, losses were more likely to be experienced as real losses at the time of decision making. The sequence of events in the experiment is summarized in Figure 1.

Figure 1: Structure of the Experiment

Part I: Pure gain prospects; separate choices.

Part II: Pure gain prospects; Holt and Laury choice list; seven choices on one screen.

Part IIIA: Pure loss, pure gain and mixed prospects; separate choices; no information about the endowment at this point available.

Part IIIB: Pure gain prospects paying at least €20; separate choices.

Determination of payoffs: one part randomly selected; one decision randomly selected within this part and played for real according to the subject's choice (if Part III was selected, one decision from sub-part A and one decision from sub-part B was played according to the subject's choice).

All parts of the experiment were computerized using the experimental software z-Tree (Fischbacher 2007). All randomizations were conducted by throwing a die individually at the subjects' desks.

Figure 2 shows how the prospects were presented to the subjects on the screen. Subjects always chose between two prospects A and B represented by the second and third row in Figure 2. All prospects had a maximum of two possible outcomes. The first row of the figure shows the faces of a twenty-sided die. The payoffs of the prospects depended on the outcome of a throw of the die. Each face of the die corresponds to a .05 probability. In the example, prospect A therefore pays €20 with probability .5 and zero with probability .5. Prospect B pays €10 for sure. The procedure was explained in detail to all subjects (the original instructions are provided in the appendix), and all rules of the experiment were common knowledge among participants.

Figure 2: Presentation of Prospect Choices

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
A	€20										€0									
B	€10																			

2.2. Time Pressure and Expected Value Manipulation

We manipulated decision time and availability of expected value information. In the treatments without time pressure, we constrained the decisions by introducing a maximum decision time that was very large and then measured actual decision times. Decisions in these treatments were practically unconstrained but we could use identical wording in all instructions by providing some threshold in the treatments without time pressure. Decisions in Part I and Part III were presented and constrained individually. Decisions in Part II had to be made on one screen and were constrained simultaneously, that is, all seven decisions of the choice list had to be made within the time limit. In the time pressure treatments, we restricted the decision times such that there was significant time pressure but subjects would still have sufficient time to make meaningful decisions at the computers.[3] All subjects within a treatment faced identical time constraints because we use a between-subject design. Table 2 summarizes the maximum and the actual decision times for each part of the experiment.

For each decision problem subjects had to click a button to make their choice between options A and B, and then, had to click an 'OK'-button to confirm their choice within the time limit. The clock was clearly visible at the top of the screen. An example screenshot is given in the appendix. If a subject failed to submit and confirm a choice before time runs out, this decision would pay the minimum payoff possible in either of the two prospects, should it be selected randomly for real pay. In decisions involving losses this would be the maximum loss. If a subject failed to submit all seven decision in Part II within the time limit, she would earn zero for each possibly selected decisions in this part of the experiment. Between two decision screens, a waiting screen occurred for 2 seconds in all treatments. This ensured that subjects could properly prepare for the next decision problem, especially under time pressure.

[3] We conducted a pilot session with different time limits to test the severity of different limits.

Before each part of the experiment, specific instructions were distributed and read aloud. This gave subjects time to rest between parts.[4]

Table 2: Maximum and Actual Median Decision Times per Decision in Seconds

	No time pressure			Time pressure		
		No EV info	EV info		No EV info	EV info
	Max	Actual	Actual	Max	Actual	Actual
Part I	60	5.64	5.95	4	2.38	2.05
Part II[a]	150	59.5	71	30	29	26
Part IIIA[b]	60	5.87	5.95	4	2.42	2.47

Numbers are average medians in Part I and Part III and medians in Part II; EV info = expected value information.

[a] Part II decision time refers to the total time for seven choices of the Holt and Laury (2002) choice list.

[b] Data for Part IIIB were not used to determine decision times under time pressure. The time limit in this part was identical to the time limit in Part I and Part IIIA.

In the treatments with expected value information, it was provided for each prospect next to the button that had to be clicked for the decision. This location allowed subjects to access the information efficiently (see the screenshot in the appendix). The meaning of an expected value was explained to the subjects in written instructions before the experiment. We did not refer to the information as ‘useful’ or ‘helpful’ and did not make any suggestions regarding whether subjects should actually use the information in their decisions.

2.3. Subjects and Payoffs

One hundred and seventy-six undergraduate students from the University of Amsterdam in the Netherlands participated in eight laboratory sessions and were randomly assigned to treatments. Students were recruited electronically from a pool of approximately 1,200 potential participants and came from different disciplines. Each subject participated only once.

Subjects received a show-up payment of €5 and could earn between €0 and €200 based on their choices and, when applicable, on the random draws. Average earnings were €17.15, and the experiment took between 30 and 50 minutes depending on the treatment.

[4] The working of the computer mouse was essential for subjects to enter decisions rapidly into the computer. We checked the computer mice with each subject before the experiment for proper working.

3. Prospects and Dependent Variables

We analyze the effects of time pressure and expected value information on dependent variables that measure attitudes towards risk under gains and losses, and gain-loss attitude. The prospects used to construct these variables are discussed in the following and summarized in Table 3.

RAG (from Part I) measures **r**isk **a**version for **g**ains by the percentage of safe choices a subject makes in six decisions between pure gain prospects each involving one sure gain. Three decisions involve choices between a prospect and its expected value. The other three decision problems are adapted from prospect choices for which a preference of roughly 50% for each option has been found in the literature (Wakker et al. 2007b). These choices are therefore likely to distinguish well between subjects.

RAG=EV (from Part I) uses only the three choices between prospects and their expected value from RAG. This variable is used to calibrate the average risk attitude for our sample of subjects.

RAGHL (from Part II) measures **r**isk **a**version for **g**ains using a **H**olt and **L**aury (2002) choice list with pure gain prospects. We scaled up their low payoff treatment (2002, p. 1645) by a factor of six and used only choices with probabilities between .2 and .8 including. The variable indicates the percentage of safer choices a subject makes if there was a unique point where the subject switched from the safer to the riskier option as the probability of the larger payoff increased. Subjects who switched twice or switched from risky to safe as the probability of the higher payoff increased were excluded from the analysis.

RAL (from Part IIIA) measures **r**isk **a**version for **l**osses by the percentage of safe choices a subject makes in six decisions between pure loss prospects each involving one sure loss. Three decisions involve choices between a prospect and its expected value. The other three decisions have a lower expected value for the risky option to detect possible risk seeking for losses.

RAL=EV (from Part IIIA) uses only the three choices between prospects and their expected value from RAL to calibrate the average risk attitude for losses for our sample of subjects.

RALMPS (from Part IIIA) measures **r**isk **a**version for **l**osses considering two choices between prospects and **m**ean **p**reserving **s**preads of these prospects. The variable indicates the percentage of a subject's choices of the prospect with lower variance. All prospects involved non-zero losses and had positive variance.

<u>*PLA*</u> (from Part IIIA) measures **a**voidance of prospects with a **p**rominent **l**oss by the percentage of a subject's choices of a pure gain prospect over a mixed prospect with higher expected value (and variance) in three decision problems. We call the loss in these decision problems prominent because gain-loss differences are more prominent here compared to pure loss decisions in RAL, and there is only one loss outcome but three gain outcomes in each decision problem.

<u>*PGS*</u> (from Part IIIA) measures **s**eeking of prospects with a **p**rominent **g**ain by the percentage of a subject's choices of a mixed prospect over a pure loss prospect with higher expected value (and lower variance) in three decision problems. There is only one gain outcome but three loss outcomes in each decision problem.

<u>*ENDOW*</u> (from Part IIIB) measures the percentage of a subject's safe choices in six decisions between prospects and their expected values used to endow subjects with at least €20 for the part involving losses.

For each variable we have slightly different sample sizes because different numbers of subjects violated the time constraint in different parts of the experiment. More precisely, subjects who violated the time constraint in at least one of the decision problems used to construct a variable were excluded from the analysis of this variable.

Table 3: Dependent Variables and Prospects

Variable	Short Description	Choices		Expected values
RAG	Percentage of safe choices	(€20, .5) vs. €10	RAG=EV (first three choices)	€10 vs. €10
		(€52, .25) vs. €13		€13 vs. €13
		(€15, .8) vs. €12		€12 vs. €12
		(€18, .95) vs. €14		€17.10 vs. €14
		(€32, .5) vs. €13		€18 vs. €13
		(€200, .05) vs. €11		€10 vs. €11
RAGHL	Percentage of safe choices if there was a unique switching point toward the riskier prospect	(€12, .2; €9.60, .8) vs. (€23.10, .2; €0.60, .8)		€10.08 vs. €5.01
		(€12, .3; €9.60, .7) vs. (€23.10, .3; €0.60, .7)		€10.32 vs. €7.35
		(€12, .4; €9.60, .6) vs. (€23.10, .4; €0.60, .6)		€10.56 vs. €9.60
		(€12, .5; €9.60, .5) vs. (€23.10, .5; €0.60, .5)		€10.80 vs. €11.85
		(€12, .6; €9.60, .4) vs. (€23.10, .6; €0.60, .4)		€11.04 vs. €14.10
		(€12, .7; €9.60, .3) vs. (€23.10, .7; €0.60, .3)		€11.28 vs. €16.35
		(€12, .8; €9.60, .2) vs. (€23.10, .8; €0.60, .2)		€11.52 vs. €18.60
RAL	Percentage of safe choices	(– €20, .5) vs. – €10	RAL=EV (first three choices)	– €10 vs. – €10
		(– €15, .8) vs. – €12		– €12 vs. – €12
		(– €20, .1) vs. – €2		– €2 vs. – €2
		(– €20, .8) vs. – €15		– €16 vs. – €15
		(– €10, .95) vs. – €9		– €9.5 vs. – €9
		(– €19, .85) vs. – €13		– €16.15 vs. – €13
RALMPS	Percentage of choices with lower variance	(– €18, .5; – €10, .5) vs. (– €15, .5; – €13, .5)		– €14 vs. – €14
		(– €9, .5; – €1, .5) vs. (– €6, .5; – €4, .5)		– €5 vs. – €5
PLA	Percentage of pure gain prospects chosen	(€4, .35; €2, .65) vs. (– €6, .25; €8, .75)		€2.70 vs. €4.50
		(€7, .25; €2, .75) vs. (– €4, .2; €7, .8)		€3.25 vs. €4.80
		(€11, .85; €15, .15) vs. (– €1, .1; €15, .9)		€11.60 vs. €13.40
PGS	Percentage of mixed prospects chosen	(– €14, .15; – €11, .85) vs. (– €17, .85; €8, .15)		– €11.45 vs. – €13.25
		(– €14, .4; – €5, .6) vs. (– €14, .8; €4, .2)		– €8.60 vs. – €10.40
		(– €6, .45; – €3, .55) vs. (– €19, .35; €2, .65)		– €4.35 vs. – €5.35
ENDOW	Percentage of safe choices	(€20, .5; €24, .5) vs. €22		€22 vs. €22
		(€20, .6; €25, .4) vs. €22		€22 vs. €22
		(€20, .75; €28, .25) vs. €22		€22 vs. €22
		(€20, .8; €30, .2) vs. €22		€22 vs. €22
		(€20, .9; €40, .1) vs. €22		€22 vs. €22
		(€20, .95; €60, .05) vs. €22		€22 vs. €22

4. Experimental Results

4.1. Time Pressure Manipulation

Table 2 in Section 2.2 shows that median decision times under time pressure were approximately half the size of median decision times under no time pressure. We tested for each decision problem and under both expected value information conditions the null hypothesis that decision times are equal under both decision time conditions, using Mann-Whitney tests. Equality of decision times was rejected for all choice problems. The smallest z-value was z=3.171 (p=0.002),[5] indicating that decision times have been much shorter under time pressure. We lose between four and eight observations per variable in Part I and Part III because of violations of time limits in the separate binary choices. Hence, the time constraints in these decisions have been substantial but not prohibitive. We lose twenty observations in the choice list in Part II; a fact suggesting that decision makers appeared to be seriously constrained with the 30 seconds time limit in Part II.[6]

In a post-experimental questionnaire subjects indicated their stress level and the perceived difficulty of the experiment on a five-point Likert scale. Subjects in the time pressure treatments felt more stressed during the experiment (Mann-Whitney test, z=5.520, p<0.001) and considered it a more difficult experiment than subjects in the unconstrained treatments (Mann-Whitney test, z=2.230, p=0.026).

The correlation between our risk measures and decision times was practically zero for all variables in the treatments *without* time pressure. That is, there were not certain types of subjects in terms of their risk attitudes that were more constrained than others; for instance, more risk averse subjects did not deliberate longer before making a decision. Our choice for a between-subject design is, hence, corroborated by the data.

Note also that in the treatments without time pressure, decisions times for gains in Part I and for losses and mixed prospects in Part IIIA do not differ (Mann Whitney tests, z<1.093, ns). This suggests that pure gain, pure loss and mixed decisions created a similar level of difficulty for the decision makers.

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[5] All tests in this paper are two-sided tests, and the abbreviation *ns* denotes non-significance.

[6] Another ten subjects were eliminated because they switched more than once in the choice list, nine of them under time pressure. Yet, in comparison to other experiments using the same elicitation method the percentage of consistent choice lists submitted by the subjects is high, despite the time pressure.

4.2. Time Pressure and Risk Attitude

An overview of the means and standard deviations of all variables in our four treatments is given in the appendix. Here, we first consider results for pure gain and pure loss decisions, and then consider results for decisions involving mixed prospects. For each variable in Table 3 we run linear regressions of the general form

$$mra_i = \alpha + \beta_1 \, TP_i + \beta_2 \, EV_i + \beta_3 \, (TP_i \times EV_i) + \beta_4 \, FEMALE_i + \varepsilon_i \, , \qquad (1)$$

where mra_i is the measure of risk attitude for subject i that is considered in the regression (always in percentages), TP_i is a dummy variable that equals 1 if subject i was in the time pressure condition, EV_i is a dummy variable that equals 1 if the subject was given expected value information, and the interaction term $TP_i \times EV_i$ equals 1 if the subject experiences time pressure and received expected value information. FEMALE controls for the subjects' gender and ε_i is the error term.[7]

4.2.1. Pure Gain and Pure Loss Decisions

The linear regressions in Table 4 show that risk attitude for pure gains is not affected by time pressure. The variables RAG, RAGHL and ENDOW involve different payoff ranges and time constraints, and they are measured in different parts of the experiment. There is no direct effect of time pressure on either of these variables. Expected value information does not affect these variables, nor does its interaction with time pressure.

Result 1: Risk attitude for gains is robust under time pressure and it does not respond to the availability of expected value information.

For losses, however, subjects become comparably more risk averse under time pressure (Table 5). For both variables RAL and RALMPS, the percentage of safe choices under time pressure increases. No significant effect is found for expected value information or for its interaction with time pressure.

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[7] We report linear regression results here in order to simplify the interpretation and the comparison between variables in terms of percentage of safe choices. Ordered probit regressions on the *number* of safe choices for each variable give qualitatively the same results for all reported regressions. Results are available on request.

Table 4: Linear Regression Results for Pure Gains

OLS	RAG	RAG	RAGHL	RAGHL	ENDOW	ENDOW
Time pressure	–0.011 (0.035)	–0.001 (0.051)	0.010 (0.038)	–0.054 (0.055)	–0.026 (0.039)	–0.032 (0.057)
Expected value information	0.069 (0.035)	0.079 (0.05)	0.025 (0.037)	–0.024 (0.048)	0.011 (0.039)	0.006 (0.055)
Time pressure × expected value		–0.019 (0.071)		0.121 (0.075)		0.011 (0.079)
Female	**0.121**** **(0.037)**	**0.120**** **(0.038)**	0.059 (0.039)	0.062 (0.039)	**0.122**** **(0.042)**	**0.122**** **(0.042)**
# observations	172	172	146	146	170	170

Standard errors in parenthesis; ×: interaction; * significant at 5% level, ** significant at 1% level.

Table 5: Linear Regression Results for Pure Losses

OLS	RAL	RAL	RALMPS	RALMPS
Time pressure	**0.078*** **(0.039)**	**0.110*** **(0.056)**	**0.143*** **(0.057)**	**0.203*** **(0.082)**
Expected value information	0.000 (0.039)	0.031 (0.054)	0.046 (0.057)	0.103 (0.08)
Time pressure × expected value		–0.061 (0.077)		–0.114 (0.113)
Female	**0.084*** **(0.041)**	**0.083*** **(0.041)**	0.109 (0.06)	0.106 (0.06)
# observations	171	171	173	173

Standard errors in parenthesis; ×: interaction; * significant at 5% level,
** significant at 1% level.

The effect of time pressure for loss prospects is larger for the mean preserving spreads (RALMPS) than for RAL. This is consistent with the fact that RAL contained three decisions that were designed to detect risk seeking for losses. As will be discussed next, there was on average only mild risk seeking for losses in the baseline treatment; that is, without time pressure many subjects chose the safer options already.

Result 2: With losses, time pressure leads to more risk averse choices. The availability of expected value information does not affect behavior in either of the treatment conditions.

To show the effect of time pressure on average risk attitudes for gains and losses under both time pressure conditions we consider the variables RAG=EV and RAL=EV, pooling the data from both expected value information treatments. These variables involve only choices between prospects and their expected values and the average risk attitude can be determined by testing whether subjects chose on average more than half of the safe options (Table 6).

Table 6: Average Percentage of Safe Choices

	No time pressure	Time pressure	Mann-Whitney-Test
RAG=EV	73.9%	71.7%	z=0.391, ns
	(z=6.669, $p<0.001$)[a]	(z=6.173, $p<0.001$)[a]	
RAL=EV	46.7%	60.1%	z= 2.677, p=0.007
	(z=0.696, ns)[a]	(z=4.130, $p<0.001$)[a]	

[a] Wilcoxon signed-rank test for the average percentage of safe choices being equal to 50%.

In the baseline condition with no time pressure, our data show the common pattern of ‘partial reflection’ (see Wakker et al. 2007a, for an extensive review of empirical findings). There is strong risk aversion for gains, but mild and insignificant risk seeking for losses. Under time pressure, we obtain risk aversion for both gains and losses, i.e. risk seeking for losses without time pressure turns into risk aversion for losses under time pressure. We observe that under time pressure, subjects have strong preferences for safer options for both gains and losses, clearly rejecting the conjecture that choices were more random under time pressure.[8]

[8] Risk aversion for gains is quite strong for our variable RAG=EV, and it is conceivable that no treatment effect for risk attitude is observed because risk aversion was high without time pressure already. However, the above regressions also employ the variables RAG and RAGHL to detect changes in risk attitude. These variables

Result 3: With time pressure, choices are risk averse, on average, in the gain domain and in the loss domain.

4.2.2. Decisions Involving Gains and Losses

The variables PLA and PGS study gain-loss attitude. PLA measures the percentage of choices of a pure gain prospect over a mixed prospect with higher expected value. These decisions always involve one prominent loss, and apart from risk aversion also loss aversion can lead subjects to choose the pure gain prospect. PGS measures the percentage of choices of a mixed prospect over a pure loss prospect with higher expected value. These decisions always involve one prominent gain. Loss aversion would lead to fewer choices of the mixed prospect while gain seeking, which is overweighting of gains relative to losses, may lead subjects to choose the mixed prospect. The linear regressions in Table 7 show that subjects avoid more mixed gambles in PLA and take more mixed gambles in PGS under time pressure.

Result 4: In mixed gambles, decision makers are more likely to avoid the prominent loss and seek the prominent gain under time pressure.

We also observe an effect of expected value information on both PLA and PGS. If expected values are provided, subjects choose the higher expected value prospect more often, leading to less aversion to the prominent loss and less seeking of the prominent gain. We did not observe an effect of expected value information for the pure gain or pure loss decisions, suggesting that gain-loss attitude is affected by expected value information and plays an important role in PLA and PGS choices. The effect of expected value information occurs under both time pressure conditions and there are no significant interactions between time pressure and expected value information.

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include decisions between prospects of unequal expected value, and the mean percentage of safe choices without time pressure was 60% for RAG and 64% for RAGHL (pooling the data from both expected value information conditions). These preferences are not extreme, and they are comparable to the mean percentage of safe choices of 58% without time pressure for the variable RAL for which we detected increased risk aversion for losses under time pressure.

Result 5: In mixed gambles, the availability of expected value information leads to decisions that are closer to risk neutrality than without expected value information. This effect occurs without and with time pressure.

Table 7: Linear Regression Results for Mixed Prospects

OLS	PLA	PLA	PGS	PGS
Time pressure	**0.170**** **(0.055)**	0.115 (0.08)	**0.253**** **(0.043)**	**0.186**** **(0.062)**
Expected value information	**–0.12*** **(0.056)**	**–0.173*** **(0.078)**	**–0.125**** **(0.043)**	**–0.188**** **(0.06)**
Time pressure × expected value		0.106 (0.11)		0.129 (0.086)
Female	**0.130*** **(0.059)**	**0.133*** **(0.059)**	–0.006 (0.046)	–0.003 (0.046)
# observations	172	172	168	168

Standard errors in parenthesis; ×: interaction; * significant at 5% level,
** significant at 1% level.

A simultaneous increase in loss aversion and gain seeking under time pressure cannot be explained by a change in gain-loss attitude as typically modeled under prospect theory. An increase in loss aversion implies that losses receive more weight relative to gains under time pressure than without time pressure. An increase in gain seeking implies the opposite effect. However, aspiration level-based expected utility theory (Diecidue and van de Ven 2008) is consistent with such an effect. The theory predicts that people consider the total probability of surpassing the aspiration level, leading to deviations from expected utility. In the current setting, the aspiration level would naturally be the zero outcome. Consequently, in the PLA decisions, the overall probability of a gain is lower for the mixed gamble, leading to loss aversion; and in the PGS decisions, the overall probability of a gain is higher for the mixed gamble, leading to gain seeking. We find that PLA and PGS are strongly positively correlated on the individual level (Spearman's $\rho=.32$, $p<0.001$). That is, subjects who avoid the prominent-loss mixed prospect in PLA are also more likely to seek the prominent-gain mixed prospect in PGS. This observation corroborates the view that gain-loss attitude is driven by the interaction of framing and a subject's susceptibility to aspiration levels.[9]

4.2.3. Gender and Risk Attitude

There has been much interest in gender differences in risk attitude (Barsky et al. 1997, Booij and van de Kuilen 2009, Borghans et al. 2009, Croson and Gneezy 2009, Dohmen et al. 2011, Fehr-Duda et al. 2006, Schubert et al. 1999). We control for gender in our regressions and find, in line with the exiting literature, that females are more risk averse both under gains and under losses. There were no significant interactions between gender and time pressure or gender and expected value information.[10]

5. Conclusion

Decisions under uncertainty that are made in auctions, managerial settings, or financial markets often involve serious decision time constraints. Similarly, neuro-economic studies involving risky decisions let subjects make decisions under a strict timing schema. In contrast, most experimental measurements of risk attitudes provide subjects with ample decision time, and in fact urge subjects to consider their choices carefully. We study risky decisions under time pressure for gains, losses, and mixed prospects. Our results show that time pressure affects choices under risk, but only in situation with loss prospects or mixed prospects. In such settings, behavior becomes more heuristic, and the findings support the view that aspiration levels become important. In the gain domain, the patterns of decision making seem very robust, even under severe time pressure.

In particular, we find more risk aversion for losses, more loss aversion, and more gain seeking under time pressure. Our results show that typical non-expected utility patterns as modeled by prospect theory may not provide an appropriate description of choice behavior if time pressure becomes important. We have shown that recently developed models of

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[9] A similar effect has been found in Issac and James (2000) and James (2007) in comparisons between risk attitude elicitation procedures. In the two studies the subjects who are most risk averse under one elicitation procedure are most risk seeking under the other procedure, suggesting that differences in elicited risk attitudes depend on differences in the susceptibility towards the specific framing of the procedure.

[10] Regression results are available on request.

expected utility with an aspiration level (Diecidue and van de Ven 2008) may be a useful alternative in such situations.

Our results provide reasserting evidence for the generalizability of risk attitude results from the laboratory to naturally occurring environments that exhibit time pressure in decision making, as long as the gain domain is concerned. If losses and mixed outcomes are involved, results with existing elicitation methods seem to be only partially valid in such environments. Obviously, the same remark applies to results from neuro-economic studies.

Our finding that expected value information reduces both loss averse and gain seeking behavior, irrespective of time pressure, suggests that subjects benefit from such decision aids. Surprisingly no effect of expected value information was found for pure gain or pure loss gambles, supporting the view that elicited risk attitudes are robust to the availability of summary statistics. For mixed gables, our results suggest that subjects are aware of their sensitivity to framing and aspiration levels, and try to avoid such effects by falling back on presumably objective measures. Given that in many decision situations outside the lab a wide range of decision aids is available to the decision maker, actual behavior may thus be closer to the risk neutral benchmark than laboratory studies sometimes suggest.

Appendix[11]

A.1. Experimental Instructions

Instructions Part I

In Part I you make choices between two risky options A and B, which pay some amount of money depending on the outcome of a 20-sided die (dobbelsteen). See Example 1.

Example 1:

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th></tr>
<tr><td>A</td><td colspan="10">11€</td><td colspan="10">9€</td></tr>
<tr><td>B</td><td colspan="5">20€</td><td colspan="15">21€</td></tr>
</table>

A 20-sided die will be thrown. Option A pays 11€ if the die shows a 1, 2, 3,…, or 10, and pays 9€ if the die shows an 11, 12, 13,…, or 20. Option B on the other hand pays 20€ if the outcome of the die is 1,2,…, or 5, and pays 21€ if the outcome of the die is 6,7,8,…, or 20. If this choice were selected to be payoff relevant for you, the experimenter would come to your desk and you would throw a 20-sided die. You would receive the payoff depending on the Option you have chosen before and the number shown by the die.

Recognize that each number of the die represents a probability of 5%. The whole die adds up to 100% therefore. In Example 1 this means that Option A offers a chance to win 11€ with probability 50% and to win 9€ with probability 50%. Option B on the other hand offers a 25% chance to win 20€ and 75% chance to win 21€.

Another example:

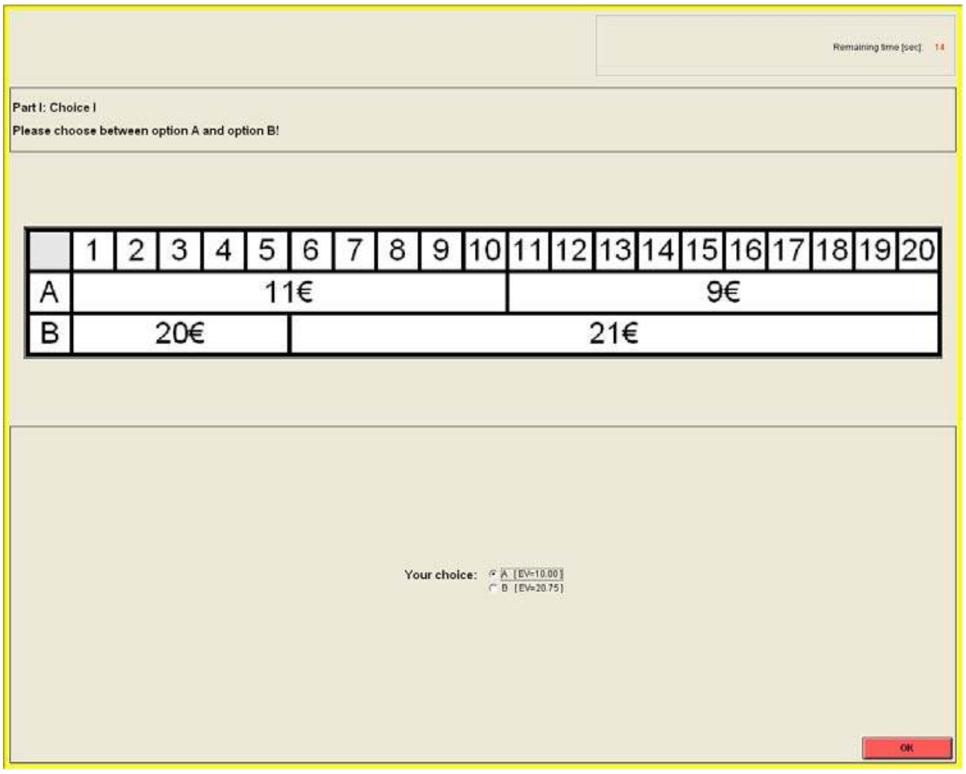
Example 2:

<table>
<tr><th></th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th><th>17</th><th>18</th><th>19</th><th>20</th></tr>
<tr><td>A</td><td colspan="10">11€</td><td colspan="10">9€</td></tr>
<tr><td>B</td><td colspan="20">10€</td></tr>
</table>

Here, Option A is the same as above: if you choose A, and the die shows any number between 1 and 10 including, you receive 11€. If the die shows any number between 11 and 20 including, you receive 9€. If you choose Option B, on the other hand, you receive 10€ for any number the die might show. Option B pays 10€ with probability 100%.

[11] Not necessarily for publication; could be made available online.

A.2. Example Screen Shot



A.3.Means and Standard Deviations of Variables by Treatment

Treatment / Variable	NTP-NEV	TP-NEV	NTP-EV	TP-EV	Mann-Whitney-Tests
RAG	0.56 (0.24)	0.56 (0.27)	0.65 (0.21)	0.63 (0.23)	1<3, z=2.15, p=0.0318
RAGHL	0.65 (0.20)	0.60 (0.29)	0.64 (0.16)	0.70 (0.26)	-
RAL	0.56 (0.27)	0.68 (0.25)	0.60 (0.24)	0.65 (0.25)	1<2, z=2.06, p=0.0396
RALMPS	0.44 (0.39)	0.65 (0.36)	0.56 (0.37)	0.64 (0.38)	1<2, z=2.445, p=0.0145
PLA	0.47 (0.38)	0.59 (0.33)	0.31 (0.35)	0.53 (0.39)	3<4, z=2.605, p=0.0092 1<3, z=1.991, p=0.0464
PGS	0.28 (0.28)	0.47 (0.30)	0.10 (0.18)	0.41 (0.32)	1<2, z=2.723, p=0.0005 3<4, z=4.867, p=0.0000 1<3, z=3.413, p=0.0006
ENDOW	0.20 (0.27)	0.18 (0.22)	0.22 (0.29)	0.20 (0.26)	-

Standard deviations in parenthesis.

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