Dynamic choice, independence and emotions

Hopfensitz, A.; van Winden, F.

DOI
10.1007/s11238-007-9058-y
Publication date
2008
Document Version
Final published version
Published in
Theory and Decision

Theory and Decision (2008) 64:249–300
DOI 10.1007/s11238-007-9058-y

ASTRID HOPFENSITZ and FRANS VAN WINDEN

DYNAMIC CHOICE, INDEPENDENCE AND EMOTIONS

ABSTRACT. From the viewpoint of the independence axiom of expected utility theory, an interesting empirical dynamic choice problem involves the presence of a "global risk," that is, a chance of losing everything whichever safe or risky option is chosen. In this experimental study, participants have to allocate real money between a safe and a risky project. Treatment variable is the particular decision stage at which a global risk is resolved: (i) before the investment decision; (ii) after the investment decision, but before the resolution of the decision risk; (iii) after the resolution of the decision risk. The baseline treatment is without global risk. Our goal is to investigate the isolation effect and the principle of timing independence under the different timing options of the global risk. In addition, we examine the role played by anticipated and experienced emotions in the choice problem. Main findings are a violation of the isolation effect, and support for the principle of timing independence. Although behavior across the different global risk cases shows similarities, we observe clear differences in people's affective responses. This may be responsible for the conflicting results observed in earlier experiments. Dependent on the timing of the global risk different combinations of anticipated and experienced emotions influence decision making.

KEY WORDS: anxiety, background risk, emotions, global-risk, investment, laboratory experiment, regret

JEL CLASSIFICATION: A12, C91, D81

1. INTRODUCTION

Real life situations of decision making under uncertainty, like investment, often involve compound lotteries with multiple options and a significant timing element. In contrast, most economic experiments that study such behavior in the lab are

limited to simple, static, and binary lotteries. From the viewpoint of the independence axiom of expected utility theory, an interesting dynamic choice problem concerns the presence of an independent "global risk," that is, a chance of losing everything whichever safe or risky option is chosen.[1]

Ample experimental evidence exists showing a behavioral shift towards risk seeking if a common probability is factored into the lotteries of a binary choice problem—the common ratio effect (Allais, 1953; Camerer, 1995). Interestingly, there is also some evidence suggesting that this shift does not occur in case of compound lotteries where the common component of the risk of losing is presented separately (Kahneman and Tversky, 1979; Cubitt et al., 1998). This has been explained by the *isolation effect*, according to which people ignore (transparent) common components of alternatives. In the experiments examining the isolation effect an individual has to commit to a choice to be made conditional on a prior act of nature (the resolution of the global risk). Cubitt et al. (1998) compare this precommitment choice problem with the case where the resolution of the global risk is preceding the choice. They find a significant difference in behavior between these two cases, violating the dynamic choice principle of *timing independence*. However, this does not exhaust the possibilities for the timing of a global risk. Bosman and van Winden (2005) experimentally investigate investment if the resolution of the global risk takes place after (instead of before) the resolution of the risky option. Surprisingly, they find that people invest *less* than in the absence of a global risk, which violates the isolation effect.

Due to the theoretical significance of the independence axiom, it is important to check the robustness of these findings and the underlying determinants. Regarding the latter, one interesting factor pointed at in various theoretical analyses, but typically not accounted for in economic experiments, concerns the impact of affect (see Pope, 1995; Loewenstein et al., 2001). In a number of theories of risky choice, the anticipation of future feelings is assumed to influence the behavior of the decision makers, such as regret (Bell, 1982; Loomes

and Sugden, 1982), disappointment (Bell, 1985; Loomes and Sugden, 1986), and anxiety (Wu, 1999; Caplin and Leahy, 2001). It is an empirical question whether indeed emotions are anticipated and taken into account and, if so, whether the anticipation is correct (Zeelenberg, 1999). More particularly, it is important to know *which* emotions are anticipated. In addition to anticipated emotions also experienced emotions can influence decision making under risk. Feelings are frequently claimed to influence investors (see e.g., Krugman, 2001; Sacco et al., 2003 on the emotional impact of global terrorism on investment). Good and bad moods appear to influence risk behavior in laboratories (Isen, 2001; see also Kirchsteiger et al., 2006) and in the real world (Kliger and Levy, 2003). Furthermore, induced anxiety appears to increase individuals' preferences for low-risk/low-reward options (Raghunathan and Pham, 1999). If indeed the anticipation of emotional states is not perfect, actually experienced emotions may influence behavior in a way that is not foreseen by the decision maker, facilitating time inconsistencies. To get to know these effects, a thorough analysis of both anticipated and experienced emotions related to decision making under risk and uncertainty is needed.

The purpose of this experimental study is to investigate (1) the isolation effect and timing independence under all possible timing options of a global risk, and (2) the role played by anticipated and experienced emotions in the related choice problems. Our main findings are a violation of the isolation effect, which differs from the one observed by Bosman and van Winden (2005), and support for the principle of timing independence. Although behavior across the different global risk cases shows similarities, we observe clear differences in people's affective responses which may be responsible for the conflicting results observed in earlier experiments. Dependent on the situation, different *combinations* of anticipated and experienced emotions appear to influence decision-making.

The paper is organized as follows. Section 2 presents the experimental design and procedures. Section 3 shows our findings concerning investment behavior, affective responses,

and the relation between the two. Section 4 addresses some differences between our findings and earlier evidence using the results of additional experiments. Section 5 concludes.

2. EXPERIMENTAL DESIGN AND PROCEDURES

2.1. *Experimental design*

Our baseline treatment concerns the following choice problem. Each participant in the experiment is endowed with an amount of money z that he/she has to allocate (once and for real) to two options, one of which is safe while the other is risky. The amount allocated to the safe option is returned with certainty, yielding neither gains nor losses. The risky option returns 2.5 times the amount invested with probability $p = 1/2$, and returns nothing with probability $(1 - p) = 1/2$. In the sequel, the probability p will be called the *decision risk*, while only the money that is allocated to the risky option (x) will be called *investment*.[2]

This Baseline treatment will be compared with several other treatments where we add a variously timed *global risk*, that is, a chance ($q = 1/3$) that the participant faces a zero return from *both* options whatever the investment decision was (implying zero earnings from the experiment). Three possibilities exist with respect to the timing of the resolution of the global risk (for the decision trees, see Fig. 1):

(1) GR-Pre: the global risk is resolved before the investment decision. If the risk materializes, the participant loses the endowment and gets no further chance of gaining money.
(2) GR-Inter: the resolution of the global risk occurs after the investment decision but before the resolution of the decision risk (p). If the risk materializes, the participant loses the endowment allocated to the two options, without learning the outcome of the decision risk.
(3) GR-Post: the global risk is resolved after the investment decision and the resolution of the decision risk. If the risk materializes, all the returns from both the safe option and the risky option are lost.

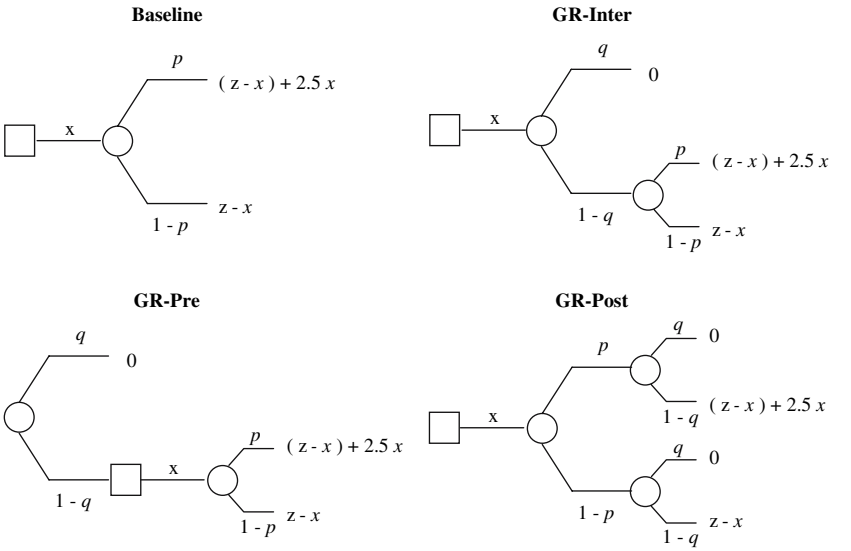

Figure 1. Decision trees for Baseline, GR-Inter, GR-Pre, and GR-Post.

According to classical expected utility theory (EU), the existence of a global risk should not influence investment. Theories including a probability weighting function, e.g., rank-dependent utility theory (RDU) and cumulative prospect theory (CPT) (Quiggin, 1982; Tversky and Kahneman, 1992), can predict changes in behavior under global risk. In these theories the common risk does not cancel out and using an inverse-S shaped probability weighting function, we should observe more investment under global risk. This being the case if the reference point is taken as either zero or z. Both RDU and CPT would predict no difference between GR-Inter and GR-Post. In case of GR-Pre, according to CPT (e.g., for a loss aversion parameter of $\lambda = 2$) we might expect less investment compared to Baseline if a "lucky draw" will shift the reference point from zero to z. If we allow for different probability weighting functions, dependent on the affective strength of the situation (Rottenstreich and Hsee, 2001), we might expect more investment for the more affect-rich situation. Finally dependent on the chosen utility function, RDU and CPT can predict intermediate investment while classical

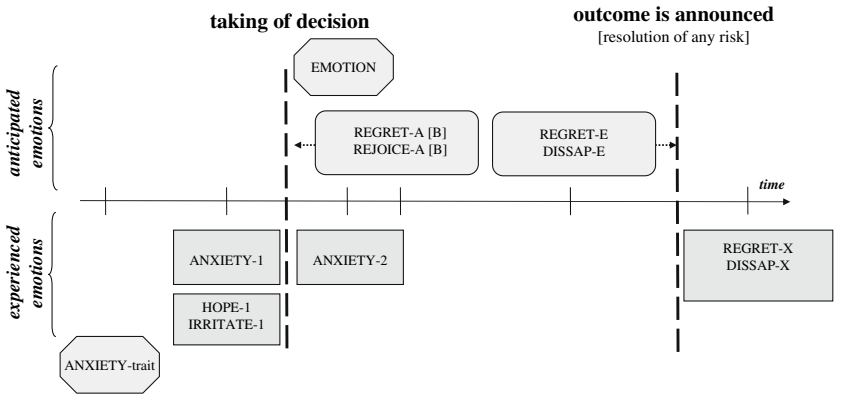

Figure 2. Time-line of emotion measures and their respective point of reference.

EU (of wealth) predicts full investment. For a more detailed discussion of the application of these theories to our investment situation, see the formal discussion in Bosman and van Winden (2005).

As mentioned in the introduction, the existing experimental evidence is puzzling. While some results are in line with EU, showing no effect, other results have shown that, under certain conditions, global risk can lead to more investment (Kahneman and Tversky, 1979), less investment (Bosman and van Winden, 2005) or leave investment unchanged (Cubitt et al., 1998). Our conjecture is, that different affective reactions might be held responsible for this.

To investigate the occurrence and influence of emotions during the experiment both experienced and anticipated emotions are measured, using self-reports.[3] The role of the following emotions is investigated: anxiety, regret, rejoicing, disappointment, hope, irritation, surprise, sadness, and happiness. We further measure anxiety as a trait because of its hypothesized importance in case of uncertainty. For an overview of the kind and timing of these measures, see Table I and Fig. 2, respectively.

To gauge anxiety we use the well known Spielberger state/trait-anxiety inventory, abbreviated as STAI (Spielberger et al., 1970). It is considered to be an "excellent measure of both types [state and trait] of anxiety" (Kline, 1993) and is widely

TABLE I

Emotion measures used in the experiment

A. Anxiety (see Appendix A.1.1)

Variable	Moment of measure	Comments
ANXIETY-trait	Before start of experiment	General disposition to anxiety
ANXIETY-1	Before decision was made	Experienced anxiety prior to decision
ANXIETY-2	After decision was made	Experienced anxiety after decision

B. Regret, rejoicing and disappointment (see Appendix A.2)

B.1. Anticipated regret and rejoicing

Variable	Moment of measure	Comments
REGRET-A	After decision was made	Regret as motivation for project A
REGRET-B	After decision was made	Regret as motivation for project B
REJOICE-A	After decision was made	Rejoicing as motivation for project A
REJOICE-B	After decision was made	Rejoicing as motivation for project B

B.2. Relative measures of regret (rejoicing) and disappointment

Variable	Moment of measure	Comments
REGRET-R	After decision was made	REGRET-A - REGRET-B
REJOICE-R	After decision was made	REJOICE-B - REJOICE-A
REGRET-E	After decision was made	Estimation of regret
DISAPP-E	After decision was made	Estimation of disappointment
REGRET-X	After outcome was known	Experienced regret after outcome
DISAPP-X	After outcome was known.	Experienced disappointment after outcome

TABLE I
Continued

C. General emotions (see Appendix A.3.2)		
Variable	Moment of measure	Comments
EMOTION	After decision was made	Importance of emotions for decision
HOPE-1 IRRITATE-1	Before decision was made	Experienced hope (irritation) before the decision

used. A general score is computed from the detailed answers to a series of questions (see Appendix A.1.1), which represents either the general disposition for anxiety (trait scale) or the anxiety experienced at the moment when the questionnaire is filled out (state scale). In the experiment, trait anxiety (ANXIETY-trait) is measured before participants get into the lab, while state anxiety is measured immediately before (ANXIETY-1) and after (ANXIETY-2) the investment decision.

Based on the existing psychological evidence a negative influence of (anticipated) state anxiety on risk taking is predicted. Furthermore, as people with a stronger disposition for anxiety are more likely to experience and to anticipate this emotion, greater risk aversion is expected from participants with a higher anxiety trait score.

Regret, rejoicing, and disappointment are measured in three different ways (for details, see Appendix A.2). First, we ask for the regret and rejoicing participants anticipated when making their investment decision[4] (represented by the variables REGRET-A [B] and REJOICE-A [B] and the relative measures REGRET-R = REGRET-A - REGRET-B, and REJOICE-R = REJOICE-B - REJOICE-A).[5] Where the A [B] indicates that these emotions might lead to more investment in option A [B]. Then, participants are asked to imagine a hypothetical scenario where they lose their invested money because of a negative outcome of the risky project. Participants have to indicate their estimated level of regret

(REGRET-E) and disappointment (DISAPP-E) using an indirect measure adopted from Zeelenberg et al. (1998). The items of this measure have been found to be significantly correlated with the two emotions. Because of the quick succession of the two questions regarding regret, this indirect measure is chosen, to minimize the chance that participants try to be consistent in their answers. Finally, experienced regret (REGRET-X) and disappointment (DISAPP-X) are measured when the outcome of both risks is known. These allow us to investigate how well people forecast their future emotional state (Loewenstein and Schkade, 1999).

Before the investment decision is taken, we also measure the experience of some other emotions (see Appendix A.3), in particular hope and irritation because of their specific relevance for the situation at hand (HOPE-1, IRRITATE-1). Although the valence of these experienced emotions is different, we expect both of them to have a positive effect on investment. However if irritation is not of the aggressive type, but related to anxiety it would rather follow the latter's action tendency of promoting risk aversion; (see Leith and Baumeister, 1996; MacLeod and Byrne, 1996).

Because participants take only one decision, we will analyze the role of emotions in the different treatments from an inter-individual (between-subjects) perspective. Although a within-subjects design is attractive to examine treatment effects, in this case we prefer a between-subjects design to avoid any confounding effects of the decision problem[6] and spillover effects of experienced emotions.

2.2. *Experimental procedures*

Upon entering the reception room, participants were handed the ANXIETY-trait questionnaire, which they filled out in quiet. When everybody had finished, the participants were requested to randomly draw a seat number for the laboratory and to put a sticker with that number on the (nameless) questionnaire before handing it in and entering the lab. In

the analysis responses to the questionnaire could be linked to data obtained in the lab (only) through the seat number. In this way, anonymity was maintained. In the lab, each participant received an envelope with 15 euro in coins and bills as working money for the experiment. Participants were told that if they would lose some of their money in the experiment they would have to pay back the amount of the loss after the session (keeping the rest), while earnings in excess of their working money would be paid out to them on top of the 15 euro. After checking the content of their envelope, participants received the instructions, which were handed out and read aloud by the experimenter (for a translation, see Appendix B.2). In the instructions participants were informed that they would have to allocate their working money to two projects, one of which had a certain return (no gains, no losses), while the other had a probability of $p = 1/2$ to return 2.5 times the amount invested and a probability of $(1 - p) = 1/2$ to return nothing. Furthermore, they were told that they would have to determine the outcome of the risky project themselves, by rolling a dice under supervision. In the treatments with the global risk (GR-Pre, GR-Inter, and GR-Post) they were additionally informed that they were to face a risk of $q = 1/3$ to lose all their money from the experiment (see Appendix B.1.2). The resolution of this global risk would again be determined by themselves, by rolling another dice under supervision. After an opportunity for raising questions, participants went individually through the computerized questions of the experiment.

The first set of questions concerned the intensity with which they experienced the emotions of anxiety (ANXIETY-1), hope (HOPE-1), and irritation (IRRITATE-1), at that very moment. Subsequently, they were asked to fill in the amounts of money they would like to allocate to the projects A and

B (the fraction invested in project B will be labeled INVESTMENT). The amounts could be any multiple of 50 eurocent and had to add up to 15 euro. In the treatment GR-Pre this was preceded by the dice roll resolving the global risk.[7] After the investment decision, participants were asked to record the anxiety they experienced now that they had made their investment decision, but before knowing the outcome of the still to be resolved risk(s) (ANXIETY-2). This was followed by the question whether they had taken their future emotions into account when they made their decision (EMOTION) and, more specifically, to which extent the anticipation of regret and rejoicing influenced their decision (REGRET-A[B], REJOICE-A[B]). Next, they were asked to estimate the extent to which they would experience regret and disappointment in case they lost their money in the risky project (REGRET-E, DISAPP-E). Finally, participants were requested to confirm their decision, with an option to alter it if they wanted.[8]

The experimenters went then through the lab to have the private decision risk resolved by the dice roll and to record the result. In the treatment GR-Inter this was preceded by the dice roll resolving the global risk, while in GR-Post this happened after the resolution of the decision risk. Note, however, that in GR-Inter the decision risk was *not* resolved for those who lost everything. The experiment ended with a debriefing questionnaire including the question whether the participant experienced regret (REGRET-X) about the decision taken or disappointment (DISAPP-X) about the outcome. Participants were then paid out in private. If earnings were less than their working money they were required to pay back the difference.

The experiment took about one hour. All sessions took place in the CREED-laboratory of the University of Amsterdam. Participants were recruited from various fields of study, and in total 192 students participated in the experiment. They received 2.50 euro as show-up fee, and on average their total earnings were 16.80 euro (approximately $ 20.20).

3. BEHAVIORAL RESULTS

3.1. *Compound independence and the isolation effect*

An important implication of the independence axiom of rational choice theory, when applied to two-stage lotteries, is *compound independence*. This axiom states that: the two-stage lottery A yielding with probability α a ticket for lottery X and with probability $1-\alpha$ a ticket for lottery Z, is preferred to the two-stage lottery B, which is the same as A with Y instead of X, if and only if the one-stage lottery X is preferred to the one-stage lottery Y (i.e., $A=(X,\alpha;Z,(1-\alpha)) \succcurlyeq B=(Y,\alpha;Z,(1-\alpha))$ if and only if $X \succcurlyeq Y$; see Segal (1990)). Kahneman and Tversky (1979) found experimental support for this axiom, using a two-stage choice problem similar to our treatment GR-Inter (with the resolution of the global risk resolved after the decision is made, but before the resolution of the decision risk). For explanation, they suggested the existence of an editing phase in decision making where (transparent) common components of alternatives are cancelled - the *isolation effect*. Several other experimental studies reported corroborating evidence for this effect (Tversky and Kahneman, 1981, 1986; Conlisk, 1989; Bernasconi, 1994). Because these studies either used hypothetical payoffs or a random lottery incentive system, one may be sceptical concerning the evidence.[9] However Cubitt et al. (1998), using monetary incentives in a carefully designed experiment, arrived at the same conclusion, that is, that the isolation effect holds.

In all these experimental studies people are confronted with a two-stage choice problem similar to GR-Inter, but they are restricted to a binary choice (for either the safe or the risky option). Our design differs in this respect, by allowing participants to allocate their money to the two projects in whatever proportion they like, which resembles more the adjustment of a portfolio of assets. Therefore, we focus first on the treatments Baseline and GR-Inter, to investigate the robustness of the isolation effect. For the decision trees of the respective choice problems we refer to Fig. 1.

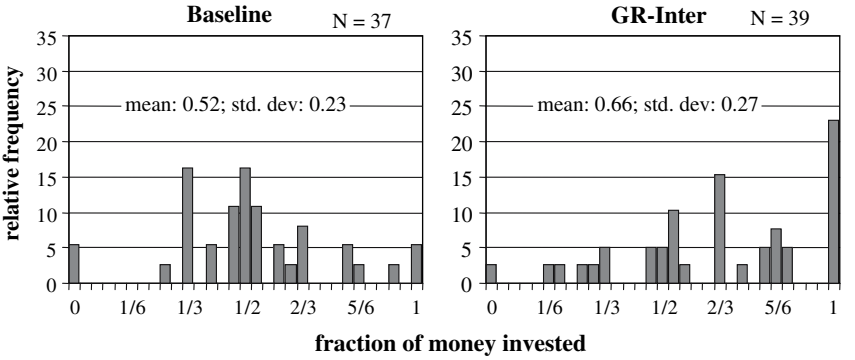

Figure 3. INVESTMENT in Baseline and GR-Inter.

3.1.1. *Investment: GR-Inter vs. Baseline*

Figure 3 presents the distributions of the investment choices. The distributions are clearly different. Whereas Baseline shows a mode at half of the money being invested, the mode in GR-Inter is at full investment. Furthermore, mean investment is 27% higher in GR-Inter (0.662 vs. 0.521), and substantially more participants invest all their money in that treatment (23% vs. 5%). Tests[10] corroborate that the distributions are different, with investment being higher in GR-Inter (Mann–Whitney, $p = 0.011$; Kolmogorov–Smirnov, $p = 0.012$).[11]

Thus, even though we took great care in making the global risk very transparent (see Appendix B), we find evidence against compound independence and the isolation effect.

Result 1. *In GR-Inter investment is higher and more extreme than in Baseline, violating compound independence. In contrast to other studies we find no support for the isolation effect.*

Although these results cannot be explained by EU, they can be explained by RDU and CPT (excluding the isolation effect). Whether these theories can also explain the results of the remaining treatments, GR-Pre and GR-Post, we will see below. We first examine the role of emotions in Baseline and GR-Inter.

3.1.2. *The role of emotions*

The question we want to address here is whether the investment level is related to emotional disposition and anticipated and experienced emotions when the decision was made. To that purpose, we employ a (Tobit) regression model with INVESTMENT as the dependent variable, and as independent variables: trait anxiety (ANXIETY-trait), anticipated rejoicing (REJOICE-R),[12] experienced anxiety (ANXIETY-1), hope (HOPE-1), and irritation (IRRITATE-1).[13] Based on the evidence referred to above, we hypothesize a negative impact of trait/state anxiety and a positive impact of rejoicing, while no specific effect is predicted for hope. The effect of irritation is expected to be positive, unless it is a correlate of anxiety, in which case the predicted effect is negative.

As Table II shows, very similar regression results are obtained for the two treatments. More specifically, none of the estimated coefficients is different across treatments (F-test, $p > 0.299$). Joint estimation, using a treatment dummy for GR-Inter, shows that GR-Inter furthers investment (dummy coefficient: $+0.130$, $p = 0.024$). Our hypotheses concerning the impact of emotions are partially confirmed. Interestingly, hope shows a positive effect. Although perhaps intuitive, note that a relationship between risk attitude and hopefulness could not be confirmed by Chew and Ho (1994), while no clear action tendency seems related to the emotion of hope in psychology (Lazarus, 1999). As predicted, anticipation of more relative rejoicing leads to higher investment. Substituting REGRET-R for REJOICE-R leads to an opposite and weaker effect (coefficient: -0.066, $p = 0.026$). Trait and state anxiety do not show a significant impact on investment. The two variables are strongly correlated (Spearman: 0.558, $p = 0.000$). However, even if one of them is left out no significance is obtained. This is surprising in light of the psychological evidence that anxiety influences risk taking. We will return to this issue below. Interestingly, irritation is correlated with state anxiety (Spearman: 0.244, $p = 0.034$) and shows a negative impact on investment.

TABLE II

Censored tobit regressions of investment on emotions

Baseline			
	Number of obs		37
	LR $\chi^2(5)$		22.89
	Prob $> \chi^2$		0.000
	Cox Snell R^2		0.461
INVESTMENT t1	*Coef.*	Std. Err.	$p > \|t\|$
ANXIETY-trait	−0.004	0.005	0.433
ANXIETY-1	0.003	0.005	0.532
HOPE-1	0.249	0.057	0.000
IRRITATE-1	−0.100	0.052	0.062
REJOICE-R	0.108	0.031	0.001
Intercept	−0.075	0.257	0.773
2 obs. left-censored; 2 obs. right-censored			
GR-Inter	Number of obs		39
	LR $\chi^2(5)$		20.46
	Prob $> \chi^2$		0.001
	Cox Snell R^2		0.408
INVESTMENT t1	*Coef.*	Std. Err.	$p > \|t\|$
ANXIETY-trait	−0.003	0.007	0.728
ANXIETY-1	0.000	0.005	0.952
HOPE-1	0.169	0.067	0.016
IRRITATE-1	−0.121	0.050	0.022
REJOICE-R	0.126	0.038	0.002
Intercept	0.431	0.313	0.178
1 obs. left-censored; 9 obs. right-censored			

Thus, except for the level shift in investment, it appears that emotions impact investment in a very similar way in Baseline and GR-Inter. One of the reasons why investment is higher in GR-Inter is that experienced hope, which has the strongest influence in our regression model, is higher in GR-Inter.[14] Anticipated rejoicing does not differ and irritation differs marginally.[15] An indicator of higher arousal in GR-Inter concerns experienced anxiety when corrected for

TABLE III
Averages of experienced and estimated emotions (std. dev. in parentheses)

	Baseline	GR-Pre	GR-Inter	GR-Post
ANXIETY-trait	35.43	34.42	35.10	37.24
	(8.26)	(8.84)	(7.18)	(7.72)
ANXIETY-1	35.76	40.13	40.49	38.14
	(7.29)	(10.08)	(11.94)	(8.48)
ANXIETY-difference	0.32	5.71	5.39	0.91
	(7.40)	(9.55)	(10.28)	(9.14)
HOPE-1	2.95	3.35	3.28	3.02
	(0.57)	(0.64)	(0.65)	(0.64)
IRRITATE-1	1.46	1.40	1.85	1.57
	(0.65)	(0.64)	(0.93)	(0.80)
REGRET-A	2.65	2.70	2.80	2.75
	(1.17)	(1.18)	(1.15)	(1.11)
REJOICE-A	2.47	1.97	2.30	2.29
	(1.18)	(1.01)	(1.08)	(0.95)
REGRET-B	2.18	2.00	2.35	2.58
	(1.13)	(1.08)	(1.14)	(0.93)
REJOICE-B	2.88	3.03	2.75	3.17
	(1.11)	(1.01)	(1.21)	(0.82)
REGRET-E	6.16	5.42	5.69	5.98
	(2.15)	(2.28)	(2.18)	(2.05)
DISAPP-E	6.86	6.77	7.18	7.02
	(2.17)	(2.15)	(1.73)	(1.92)
REGRET-X	1.57	1.42	1.51	1.36
	(0.80)	(0.71)	(0.76)	(0.53)
DISAPP-X	1.92	2.13	2.49	2.40
	(1.16)	(1.18)	(1.27)	(1.19)

trait anxiety (i.e., ANXIETY-1-ANXIETY-trait) which is higher in GR-Inter.[16] There is some psychological evidence concerning lotteries (albeit with hypothetical payoffs) suggesting that arousal is related to risk seeking (Mano, 1994; Leith

TABLE IV
Correlations of emotions

A. (Spearman) correlation coefficients of investment with:

	REGRET-A				REJOICE-A			
Baseline	−0.554	p	=	0.021	−0.377	p	=	0.136
GR-Pre	−0.432	p	=	0.008	−0.304	p	=	0.068
GR-Inter	−0.528	p	=	0.017	−0.707	p	=	0.001
GR-Post	−0.249	p	=	0.241	−0.277	p	=	0.190
	REGRET-B				REJOICE-B			
Baseline	−0.235	p	=	0.364	0.134	p	=	0.609
GR-Pre	−0.303	p	=	0.068	0.440	p	=	0.006
GR-Inter	0.222	p	=	0.347	0.383	p	=	0.096
GR-Post	0.070	p	=	0.744	0.530	p	=	0.008

B. (Spearman) correlation coefficients of estimated and experienced:

	Disappointment				Regret			
Baseline	0.200	p	=	0.457	0.660	p	=	0.005
GR-Pre	−0.031	p	=	0.885	0.410	p	=	0.042
GR-Inter	0.252	p	=	0.430	0.537	p	=	0.072
GR-Post	0.349	p	=	0.324	0.618	p	=	0.057

and Baumeister, 1996). If so, then this would help explain the upward shift in investment in GR-Inter.

The next result summarizes our findings.

Result 2. *From a multiple (Tobit) regression model it appears that emotions have a clear and similar impact on investment in Baseline and GR-Inter. The experience of hope and anticipated rejoicing further investment. Anticipated regret and anticipated rejoicing are correlated, with the former having an opposite and weaker effect on investment. Neither trait anxiety nor state anxiety impact investment. However, the experience of irritation, which positively correlates with state anxiety, has a negative influence. The higher intensity of hope and arousal observed in GR-Inter helps explain the higher level of investment in this treatment.*

3.2. *Timing independence*

According to Cubitt et al. (1998) the principle of *timing independence* requires that "an agent, if required to precommit to an action to be taken conditional on a prior act of nature, precommits to the action which would be chosen if the moment of choice was delayed until after that act of nature." If this principle of rational choice theory holds, people confronted with choice problems similar to GR-Inter and GR-Pre (see the decision trees in Fig. 1) should show identical investment behavior. However, in their experimental study Cubitt et al. (1998) find that the principle is violated, even though no significant difference is observed between (in our terminology) Baseline and GR-Inter and between Baseline and GR-Pre, respectively.[17] The violation is due to the combined effect of more risk seeking when the global risk is resolved after the investment decision and less risk seeking when it is resolved before this decision is taken, compared to the baseline without global risk. Our treatments Baseline, GR-Inter, and GR-Pre are equivalent in terms of decision trees, except that we do not restrict decision making to a binary choice. Therefore, we want to see whether the principle of timing independence is also violated in our case.

3.2.1. *Investment: GR-Inter vs. GR-Pre*

As announced in the instructions to the participants (see Appendix B.2), in treatment GR-Pre the global risk was resolved before the investment decision. Those who could continue were, on the face of it, presented with the same decision problem as participants in Baseline. The others, for whom the global risk draw was unfavorable, were asked to answer the questions hypothetically, with no money to be earned. Fig. 4 presents the distribution of investment in GR-Pre (for those that could continue because of a lucky draw).[18]

The distribution seems similar to GR-Inter and indeed, statistically, no difference in investment is found (Mann–Whitney, $p = 0.247$; Kolmogorov–Smirnov, $p = 0.312$). Thus, contrary

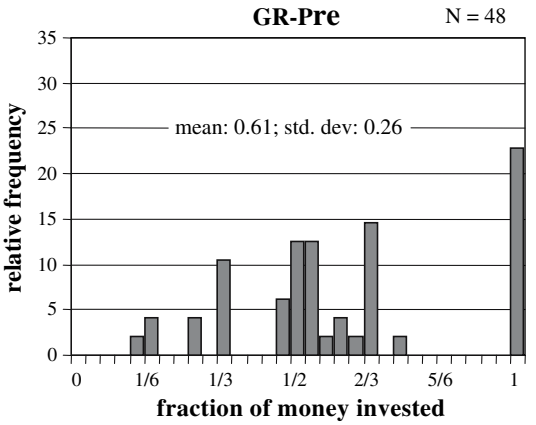

Figure 4. INVESTMENT in GR-Pre.

to Cubitt et al. (1998), we find no evidence of a violation of timing independence. In line with the results obtained by these authors, we also find no difference in investment between GR-Pre and Baseline (Mann–Whitney, $p = 0.117$; Kolmogorov–Smirnov, $p = 0.454$).

Result 3. *Investment in GR-Pre is similar to GR-Inter and to Baseline. Contrary to Cubitt et al. (1998), no violation of timing independence is observed.*

Because RDU and CPT can also explain these outcomes, they survive as explanatory theories of our results so far. Note with respect to CPT that one has to assume here that no significant shift in reference point has occurred in GR-Pre (from 0 to z), because this should have induced less investment, according to this theory.

We want to point out some (qualitative) aspects differentiating the three treatments, which adds a caveat to Result 3. This concerns the shape of the investment distributions. The frequency of full investment in GR-Pre (23%), is identical to GR-Inter (23%) but remarkably higher than the frequency in Baseline (5%; Pearson χ^2, $p < 0.029$). Moreover, in GR-Pre as well as in GR-Inter full investment is also the mode. Another concern relates to the role of emotions to which we turn next.

3.2.2. *The role of emotions*

Remarkably, the (Tobit) regression model of investment, which was successfully employed for Baseline and GR-Inter, fails to reach significance for GR-Pre ($\chi^2 = 0.152$; see Table V in Appendix C). Only anticipated rejoicing appears to have a (positive) effect on investment, but weaker than in the previous two treatments (coefficient REJOICE-R: +0.080, $p = 0.024$). Thus, even though, equality of the investment distributions cannot be rejected, from an emotion point of view these treatments nevertheless appear to be different. Three other differences show up when we take a closer look at the remaining emotion variables of the model: anxiety, hope, and irritation. First, while little variation is observed in trait-anxiety,[19] more anxiety is experienced in GR-Pre than in Baseline, as was found for GR-Inter.[20] Apparently, global risk elicits greater anxiety, independent of whether its resolution just happened or is about to take place soon. A similar difference is observed for hope, with more hope being experienced in both global risk treatments.[21] As discussed for GR-Inter, higher arousal may have positively influenced investment in GR-Pre. These additional findings in turn suggest that, compared to Baseline, the global risk treatments are more alike in this respect.

Result 4. *GR-Pre cannot be explained with the regression model that is successfully employed for Baseline and GR-Inter, showing that emotions are not a mere correlate of investment. Only anticipated rejoicing shows again a positive (but weaker) effect on investment.*

While GR-Pre and GR-Inter resemble each other in some emotional respects, they differ in others. This restricts our confidence in statistical results ignoring emotions. Factors influencing emotional intensity (like vividness or closeness) that have not been controlled for in experimental studies so far may have affected the results. This sets an important agenda for future research.

Another unexpected finding concerns predictions from the mood maintenance hypothesis (see e.g., Isen and Simmonds, 1978). According to this hypothesis people may become more risk averse when they are happy, in order not to risk loosing their good mood (which has a positive hedonic value). In case of GR-Pre this would suggest that people being happy after surviving the global risk would invest less. Incidentally, this might help explain the violation of timing independence observed by Cubitt et al. (1998), because they indeed find that investment is less when the global risk is resolved before making the choice between the safe and the risky option. Unfortunately, they do not have the required data on affect to test this. Surprisingly, we do not find that people with a lucky draw in GR-Pre are happier.[22] Moreover, happiness is not correlated with investment (Spearman, 0.172, $p = 0.244$).[23]

3.3. *Adding GR-Post*

Our main findings so far are a violation of the isolation effect (with more investment in GR-Inter than in Baseline), support for timing independence (GR-Pre vs. GR-Inter), and evidence that, affectively, people do not experience the various (global risk) treatments in the same way. Furthermore, RDU and CPT survived as explanatory theories. We will now check the robustness of these findings by adding the results of our remaining treatment GR-Post (for its decision tree, see Fig. 1).

Before we do so, we first extend Cubitt et al.'s definition of timing independence to include the new timing of the global risk: an agent, if required to precommit to an action to be taken conditional on a prior act of nature, precommits to the action which would be chosen if the moment of choice was delayed until after that act of nature *or if the act of nature were to be delayed till after the outcome of the action.*

Furthermore, note that from the perspective of RDU and CPT investment in GR-Post should be the same as in GR-Inter. This suggests that we should also observe higher investment in GR-Post, compared to Baseline.[24] On the other hand, Bosman and van Winden (2005) found lower investment

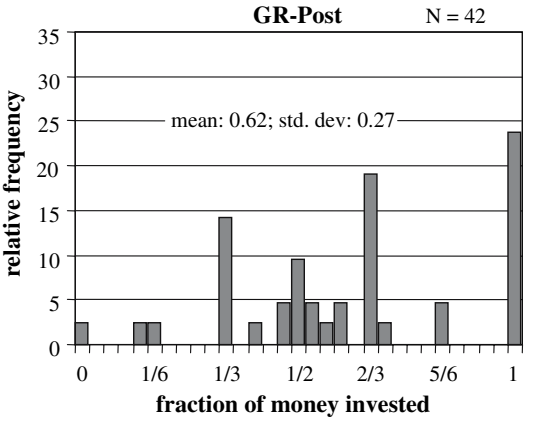

Figure 5. INVESTMENT in GR-Post.

in their treatment where the global risk was resolved after the resolution of the decision risk, a result that flies in the face of both RDU and CPT. Because our design seems to differ only in the use of more extensive measures of emotions and in using euros instead of guilders, a similar outcome is expected for GR-Post.

3.3.1. *Investment across treatments*

Figure 5 presents the distribution of investment in GR-Post. Surprisingly, in our case, investment is clearly not smaller when compared to Baseline (see Fig. 3). Although mean investment is even higher in GR-Post (0.62 vs. 0.52), statistically, we find only some weak evidence of a difference with Baseline, and no evidence of a difference with GR-Inter and GR-Pre (see Tables VIII and IX in Appendix C for the statistics, concerning all treatments). Thus, also with this treatment included, we find no violation of timing independence.

Result 5. *Including GR-Post, we find no evidence of a difference in the distribution of investment between the global risk treatments GR-Pre, GR-Inter and GR-Post, supporting timing independence. However, as observed for GR-Pre (Result 3), there is also no (clear) evidence of a difference between Baseline and GR-Post in contrast with what is observed for GR-Inter (Result*

1). It appears that GR-Pre and GR-Post are distribution-wise in between Baseline and GR-Inter.

Although, statistically, we observe only a difference between Baseline and GR-Inter, remarkably, in all treatments involving global risk we see a very similar proportion of full investment (circa 23%), which is higher than in Baseline (Pearson χ^2, $p < 0.029$).[25] If we restrict our attention to participants that invested only part of their working money (i.e., INVESTMENT <1) we still observe some tendency towards larger investment in GR-Inter (Mann–Whitney, $p = 0.122$; Kolmogorov–Smirnov, $p = 0.140$), and no difference between Baseline and the remaining global risk treatments. The higher observed means in these treatments are mainly due to differences in participants choosing full instead of intermediate investment.

Next, we will again turn to the role of emotions to examine how people affectively experience the timing of the global risk, which can help improve our understanding of the behavioral results.

3.3.2. *Comparing the role of emotions*

It turns out that our Tobit model of investment — successful in explaining investment in Baseline and GR-Inter, but not in GR-Pre — is also not significant for GR-Post ($\chi^2 = 0.269$; see Appendix C). The only coefficient showing (weak) significance relates to experienced *irritation*, and has a *positive* sign (coefficient: +0.130, $p = 0.078$).[26] Also, only in this treatment there is no clear effect of anticipated rejoicing as measured by REJOICE-R ($p = 0.119$). We will return to this below.

For a better understanding of the differences across treatments, we compare the role played by emotions in the various treatments (see Tables III and IV).

One of our hypothesis is that the presence of global risk will lead to higher experienced *anxiety*, compared to Baseline. While little variation is observed in trait anxiety,[27] experienced anxiety is indeed higher in GR-Pre, and GR-Inter

(see Table III). Controlling for trait-anxiety by looking at ANXIETY-difference (= ANXIETY-1 - ANXIETY-trait), more anxiety is experienced in GR-Pre (Mann–Whitney, $p < 0.028$) and GR-Inter (Mann–Whitney, $p < 0.134$, compared to Baseline and GR-Post). Somewhat surprisingly, this does not apply to GR-Post, where the resolution of the threat to lose all income is to take place at the very end of the experiment. This suggests that anxiety is particularly elicited if the global risk is either just experienced or is to be experienced in the near(er) future. A similar outcome is obtained for *hope*. The experience of hope is higher in GR-Pre (Mann–Whitney, $p < 0.016$) and GR-Inter (Mann–Whitney, $p < 0.075$), compared to Baseline and GR-Post. This suggests that even though behavior may seem similar in the presence of global risk, treatments are affectively appraised as being different. Whereas GR-Pre and GR-Inter clearly differ regarding the prospect of the global risk, they elicit hope and anxiety to a very similar degree. In remarkable contrast, GR-Post appears to differ from GR-Inter in this respect, even though the former seems only a slight variation of the latter (which is neglected by RDU and CPT).

An interesting further difference between the treatments is found with respect to the emotions *regret*, *rejoicing*, and *disappointment*.

Since in GR-Inter global risk is resolved before the decision risk, subjects will not learn in 1/3 of the cases if they made the "right" decision or not. Thus, on average, the anticipation of regret and rejoicing may be expected to be less related to investment in GR-Inter than in GR-Post. Anticipation of regret (rejoicing) was measured through questions about the importance of avoiding (seeking) regret (rejoicing) when making the investment decision. For example, regarding project A participants were requested to indicate to what extent the following statements were applicable to them (similar questions for project B; see Appendix A):

1. I did not put more money in B, because I did not want to feel really bad when project B returns nothing (loses). [REGRET-A]
2. I did not put less money in A, because I will feel really good if project B returns nothing (loses). [REJOICE-A].

From the answers we can see whether participants took the possibility into account of (not) having to experience regret (rejoicing). Our first observation is that the average scores for these questions are not different across treatments.[28] In all treatments, people report to have thought to an equal degree about regret and rejoicing. However, not in all treatments these answers are similarly related to their investment decisions. Correlation coefficients show that the focus of regret and rejoicing differed (see Table IV). For all treatments we observe that REGRET-A is stronger correlated with investment than REGRET-B. Thus, insofar as regret is concerned people always seem to focus more on the safe project. Regarding rejoicing, though, there are variations across treatments. In both Baseline and GR-Inter, REJOICE-A is stronger correlated with investment than REJOICE-B, suggesting that in these treatments the focus is more on the safe project when it comes to rejoicing. This is in contrast with both GR-Pre and GR-Post where rejoicing is mostly related to investment in project B. Furthermore, note that in Baseline only REGRET-A is correlated with investment, whereas in all treatments with global risk (also) some correlation with REJOICE-B is observed.

We further find that regret is mostly correlated with investment in treatments where these emotions can be prominent at the very end of the experiment. This singles out GR-Post, because here it is the emotion of disappointment (about the resolution of the global risk) that is prominent at the end. The "peak-end" rule of memory may play a role here (see Kahneman et al., 1993; Schreiber and Kahneman, 2000; Kahneman, 2000). This rule refers to the finding that strongest intensity and final experience define the memory of the utility of a situation. If this effect does not only exist for the cre-

ation of memory, but also for the anticipation of utility, this might explain our findings. Comparing the situations of GR-Inter and GR-Post, through the timing of the global risk, the former would generate more anxiety and hope and a stronger focus on regret and rejoicing than the latter. Which is what we observe. Although GR-Inter and GR-Post are equivalent in RDU and CPT, affectively they are experienced as being different.

Responses to the question (posed after the investment decision) how one would feel if the invested money would be lost with the resolution of the decision risk show that *estimated regret* and *disappointment* for this scenario (REGRET-E and DISAPP-E) do not differ across treatments (Table III). Estimated regret is in all treatments correlated with actually *experienced* regret if the invested money was indeed lost.[29] Because the loss of invested money should be less related to disappointment, it is not surprising that in all treatments we find no correlation of estimated and experienced disappointment (see Table IV: B).[30] Interestingly, in all cases experienced regret is overestimated.[31]

The next result summarizes our findings concerning GR-Post.

Result 6. *As holds for GR-Pre, investment in GR-Post cannot be explained with the regression model that helps explain behavior in Baseline and GR-Inter. At the individual emotion level, anticipated rejoicing is again found to be positively correlated with investment, but in this case only if restricted to the rejoicing anticipated from taking risk (REJOICE-B). Furthermore, experienced irritation appears to be positively related to investment, in contrast with Baseline and GR-Inter (negative correlation) and GR-Pre (no correlation). The experienced amount of hope and anxiety is more like in Baseline than in GR-Pre and GR-Inter where the resolution of the global risk precedes the resolution of the decision risk.*

The findings of this section can be summarized as follows.

SUMMARY

- While compound independence cannot be rejected in GR-Post, the isolation effect is violated in GR-Inter.
- Timing independence cannot be rejected.
- Full investment seems higher in the presence of global risk.
- The same affect model helps explain investment in Baseline and GR-Inter, showing similar coefficients for anticipated rejoicing (+), experienced hope (+), and experienced irritation (-).
- Affect functions differently in GR-Pre and GR-Post. Only anticipated rejoicing is (positively) correlated with investment in both. In addition, experienced irritation is found to be correlated with investment in GR-Post, but with a positive sign.
- On average, across treatments, participants are similarly motivated by anticipated regret and rejoicing, but the relation with investment differs. Another indicator showing that, affectively, treatments are appraised as being different is that the experience of hope and anxiety is of higher intensity in GR-Pre and GR-Inter where a global risk (arguably the more dramatic risk) is present but resolved before the resolution of the decision risk.
- Estimated regret from a bad outcome of the decision risk does not differ across treatments. The regret that is actually experienced is overestimated.

4. DISCUSSION AND FURTHER EVIDENCE

Our results are surprisingly different from the findings of the two most related studies: Cubitt et al., 1998 and Bosman and van Winden (2005). In contrast with the former study, we find evidence against the isolation effect, but not against the principle of timing independence. Furthermore, we do not find that people invest less in GR-Post, compared to Baseline, which contrasts with the latter study. How to explain

these behavioral differences? Because of our multiple findings that (anticipated and experienced) emotions play a role in the investment decision, we conjecture that factors influencing emotional intensity (like vividness or closeness), which have not been controlled for in these studies, may have affected the results. To substantiate this claim we will focus on the difference between our findings and those of Bosman and van Winden (in the sequel, indicated as BvW), concerning GR-Post. Two potentially important issues will be addressed: the influence of emotion measures and the amount of money that is at stake.[32]

As acknowledged in the psychological literature (e.g., Lerner and Keltner, 2001), emotion measures may influence affect, and thereby behavior, by inducing people to focus on their emotional experience. Because only in our study emotion measures were applied before the investment decision was made,[33] this may partly explain the different results. For example, it may be that the Spielberger questionnaires used to measure (trait and state) anxiety have contributed to the anxiety and irritation that participants experienced. If so, this could explain why we observe less investment in Baseline and more in GR-Post than Bosman and van Winden.[34] To check out this potential effect, we replicated Baseline and GR-Post, omitting the self-report measures in the lab prior to the taking of the decision. These new treatments will be labeled Baseline-without and GR-Post-without.

The second issue to be examined concerns the amount of working money (stake size). In all our treatments we endowed the participants with 15 euro as working money, to be allocated to the two projects in multiples of 50 eurocent. This was based on the 30 guilders used by Bosman and van Winden (2005) in their global risk experiment (similar to our GR-Post) — where participants had to allocate the money in multiples of one guilder — and an exchange rate of approximately 2 to 1. However, we have the impression that people may have perceived the 15 euro as being of less value, and perhaps more like 15 guilders.[35] Therefore, we also replicated Baseline and GR-Post using an endowment of 30 euro (to be allocated in

multiples of 1 euro). These two new treatments will be labeled Baseline-high and GR-Post-high.[36]

4.1. *Further evidence on investment behavior*

Investment behavior in the additional treatments is shown in Fig. 6. We focus first on Baseline-without and GR-Post-without. There are indications of a distributional shift in the direction of BvW: a shift towards higher investment in Baseline-without and towards lower investment in GR-Post-without, with modal investment coinciding now at 2/3 and a less pronounced difference in the frequency of full investment. As in BvW, adding the global risk seems to negatively affect investment, albeit that the difference is not significant in this case (Mann–Whitney, $p = 0.530$).[37] Thus, the additional emotion measures applied immediately before the investment decision seem (partly) responsible for the divergence in findings.

One finding of BvW is still missing, which is the inverted-U shaped investment distribution (over the interval [1/3, 1]) in case of the global risk. Interestingly, this phenomenon shows up if we turn to the treatments with the higher stake: Baseline-high and GR-Post-high. In GR-Post-high there is crowding out of investment in the open interval (1/3, 1), with a remarkable downward shift in modal investment (from 1 to 1/3), generating a clear U-shaped investment distribution.[38] With the exception of the mode in Baseline-high being at 1/3 instead of 2/3, the results of the *high* treatments look very similar to the ones obtained by BvW.

Observation 1. *The measurement of emotions immediately before the investment decision, together with a different amount of money being at stake, seems responsible for our finding that in contrast to BvW investment in GR-Post is not significantly lower than in Baseline.*

4.2. *Further evidence on the role of emotions*

The Tobit model of investment that is successful in explaining investment in Baseline and GR-Inter, but not in GR-

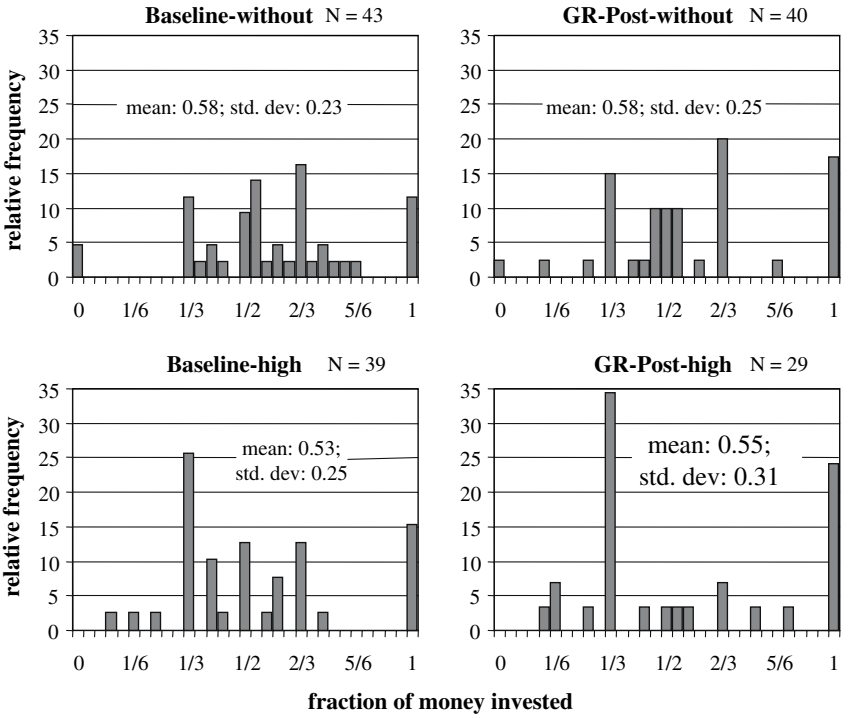

Figure 6. INVESTMENT in Baseline-without, GR-Post-without and Baseline-high, GR-Post-high

Pre and GR-Post, is again helpful for the new treatments Baseline-high and GR-Post-high where also experienced emotions were measured before the investment decision (see Appendix C). In the former, the coefficients of experienced hope and anticipated rejoicing are again significant and of very similar magnitude as in Baseline. The main difference is experienced irritation, the coefficient of which is no longer (weakly) significant. Interestingly, in contrast with GR-Post, the model is significant for GR-Post-high. It shows a larger and significant coefficient for anticipated rejoicing. While the coefficient of experienced irritation is again positive and has kept almost exactly the same size, its significance has dropped to the 20% level. Apparently, the larger stake in these treatments diminishes the role of irritation.

Because we do not find clear statistical evidence of a difference in the investment distributions of the respective high and lower stake treatments, we further mention the regression results of grouping the observations from the lower and higher stakes treatments, labeled Baseline-grouped and GR-Post-grouped. Both models are highly significant (prob $> \chi^2 = 0.000$). Regarding Baseline-grouped we find similar coefficients as before for experienced hope and anticipated rejoicing (hope: 0.220, $p = 0.000$; REJOICE-R: 0.097, $p = 0.000$), while the coefficient of experienced irritation is again insignificant (as in Baseline-high). For GR-Post-grouped we find that the coefficient of anticipated rejoicing is closer to the one obtained in Gr-Post-high (REJOICE-R: 0.127, $p = 0.000$), while the coefficient of experienced irritation is as before, but is now clearly significant (irritation: 0.133, $p = 0.018$).[39]

Surprisingly, so far we have not found any direct evidence of an effect of (trait and state) anxiety. Neither for trait-anxiety nor for state-anxiety differences between the treatments are found (Kruskal–Wallis, $p > 0.202$).[40] Only for Baseline-grouped (now including Baseline-without) we find a (weakly) significant negative correlation between trait-anxiety and investment if, in addition, investment is categorized into low, middle, and high investment (Spearman, -0.171, $p = 0.064$). Another piece of evidence, this time concerning state-anxiety, is obtained from a linear regression with the finally confirmed (and some-times changed) investment level as dependent variable and, as independent variables, INVESTMENT and ANXIETY-2 (anxiety experienced after the investment decision, but before confirmation). Using the data of Baseline-grouped and GR-Post-grouped, with in both cases six participants who changed their decision, we find for the former as well as the latter a negative effect of ANXIETY-2.[41] Interestingly, the effect of state-anxiety vanishes completely if ANXIETY-1, instead of ANXIETY-2, is used.

Result 7. *The Tobit investment model is helpful also for explaining investment in the additional treatments (Baseline-high and GR-Post-high) and if treatments are grouped together (Baseline-*

grouped and GR-Post-grouped). The coefficients of anticipated rejoicing, experienced hope, and experienced irritation are quite similar in Baseline, Baseline-high and Baseline-grouped, as well as in GR-Post, GR-Post-high and GR-Post-grouped. The only exception concerns irritation in the baseline treatments (which loses the weak significance it had in Baseline). Finally, using grouped observations we also find some weak evidence of a negative effect of trait and state anxiety on investment.

5. CONCLUSION

In this paper we presented a comprehensive study aimed at investigating decisions under all the possible timing options of a global risk that can not be influenced by the decision maker. In contrast with earlier studies neither an isolation effect nor a violation of timing independence was observed. Regarding the latter, no statistical difference in behavior was found when comparing the effect of a global risk being resolved before the decision has to be made with situations where the decision maker has to decide without yet knowing the outcome of the global risk. Even though behavior is more or less the same across our global risk treatments, variations in the affective responses across treatments were found. It was argued that these differences may very well explain the conflicting results from earlier experiments.

ACKNOWLEDGEMENTS

We would like to thank Jos Theelen for his excellent programming help. We further gratefully acknowledge comments by participants of seminars at Georgia State University and the University of Amsterdam, and by participants at the ISRE conference in Bari, the IAREP conference in Paris, the FUR XII conference at LUISS in Rome, and the ESA meeting in Osaka.

APPENDIX

A. EMOTION MEASURES (TRANSLATED FROM DUTCH)

A.1. *State trait anxiety inventory (Spielberger et al., 1970)*

A.1.1. *STAI-trait*

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *generally* feel. There are no right or wrong answers.

Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	Almost never			Almost always
01. I feel pleasant	(1)	(2)	(3)	(4)
02. I tire quickly	(1)	(2)	(3)	(4)
03. I feel like crying	(1)	(2)	(3)	(4)
04. I wish I could be as happy as others seem to be	(1)	(2)	(3)	(4)
05. I am losing out on things because I can't make up my mind soon enough	(1)	(2)	(3)	(4)
06. I feel rested	(1)	(2)	(3)	(4)
07. I am "calm, cool and collected"	(1)	(2)	(3)	(4)
08. I feel that difficulties are piling up so that I cannot overcome them	(1)	(2)	(3)	(4)
09. I worry too much over something that really doesn't matter	(1)	(2)	(3)	(4)
10. I am happy	(1)	(2)	(3)	(4)
11. I am inclined to take things hard	(1)	(2)	(3)	(4)
12. I lack self-confidence	(1)	(2)	(3)	(4)

13. I feel secure	(1)	(2)	(3)	(4)
14. I try to avoid facing a crisis or difficulty	(1)	(2)	(3)	(4)
15. I feel blue	(1)	(2)	(3)	(4)
16. I am content	(1)	(2)	(3)	(4)
17. Some unimportant thought runs through my mind and bothers me	(1)	(2)	(3)	(4)
18. I take disappointments so keenly that I can't put them out of my mind	(1)	(2)	(3)	(4)
19. I am a steady person	(1)	(2)	(3)	(4)
20. I get in a state of tension or turmoil as I think over my recent concerns and interests	(1)	(2)	(3)	(4)

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

A.1.1. *STAI-state*

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *feel* right now, that is, *at this moment*.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Almost never			Almost always
01. I feel calm	(1)	(2)	(3)	(4)
02. I feel secure	(1)	(2)	(3)	(4)
03. I am tense	(1)	(2)	(3)	(4)
04. I am regretful	(1)	(2)	(3)	(4)
05. I feel at ease	(1)	(2)	(3)	(4)
06. I feel upset	(1)	(2)	(3)	(4)
07. I am presently worrying over possible misfortunes	(1)	(2)	(3)	(4)

08. I feel rested	(1)	(2)	(3)	(4)
09. I feel anxious	(1)	(2)	(3)	(4)
10. I feel comfortable	(1)	(2)	(3)	(4)
11. I feel self-confident	(1)	(2)	(3)	(4)
12. I feel nervous	(1)	(2)	(3)	(4)
13. I am jittery	(1)	(2)	(3)	(4)
14. I feel 'high strung'	(1)	(2)	(3)	(4)
15. I am relaxed	(1)	(2)	(3)	(4)
16. I feel content	(1)	(2)	(3)	(4)
17. I am worried	(1)	(2)	(3)	(4)
18. I feel over-excited and 'rattled'	(1)	(2)	(3)	(4)
19. I feel joyful	(1)	(2)	(3)	(4)
20. I feel pleasant	(1)	(2)	(3)	(4)

Note: The answers are used to calculate a value between 20 and 80, representing the anxiety state at that moment in time. [ANXIETY-1][ANXIETY-2]
In the experiment the validated Dutch translation of the STAI was used (van der Ploeg et al., 1980).

A.2. *Regret*

A.2.1. *Anticipated regret and rejoicing*

To which extent are the following remarks for your decision applicable?

	Not at all			Very much so
1. For project A: I did not put more money in A, because I did not want to feel really bad when project B ends well (wins). *regret as motivation for project B* [REGRET-B]	(1)	(2)	(3)	(4)
2. For project A: I did not put less money in A, because I will feel really good if project B returns nothing (loses). *rejoicing as motivation for project A*[REJOICE-A]	(1)	(2)	(3)	(4)

3. For project B: I did not put less money in B, because I will feel really good if project B ends well (wins). *rejoicing as motivation for project B* [REJOICE-B]	(1)	(2)	(3)	(4)
4. For project B: I did not put more money in B, because I did not want to feel really bad when project B returns nothing (loses). *regret as motivation for project A* [REGRET-A]	(1)	(2)	(3)	(4)

Note: Comments in italics and brackets were not included in the questionnaire and refer to the descriptions made in the text. To account for relative importance of regret and rejoicing we define:

$$\text{REGRET-R} = \text{REGRET-A} - \text{REGRET-B}$$
$$\text{REJOICE-R} = \text{REJOICE-B} - \text{REJOICE-A}$$

A.2.2. *Estimated regret and disappointment*

We ask you now to think about the money that you invested in project B (no matter how much it was). Imagine that you roll the white dice and that you get a 5. Which means that you lost the money that you had invested in project B. How do you feel then?

	Not at all			Very much so
1. Feel powerless?	(1)	(2)	(3)	(4)
2. Feel that you should have known better?	(1)	(2)	(3)	(4)
3. Feel the tendency to kick myself?	(1)	(2)	(3)	(4)
4. Feel the tendency to get away from the situation?	(1)	(2)	(3)	(4)
5. Want to undo the event?	(1)	(2)	(3)	(4)
6. Want to do nothing?	(1)	(2)	(3)	(4)

Note: Items 2, 3, and 5 measured [REGRET-E], the remaining items measured [DISAPP-E] (Zeelenberg et al., 1998).

A.2.3. *Experienced regret*

Please answer the following questions:

	Not at all			Very much so
1. Are you disappointed by the outcome?	(1)	(2)	(3)	(4)
2. Do you regret your decision?	(1)	(2)	(3)	(4)

Note: The answers give [REGRET-X] and [DISAPP-X].

A.3. *Other emotions*

A.3.1. *Experienced emotions:*

A number of statements which people have used to describe themselves are given below. Read each statement and then choose the appropriate number to the right of the statement to indicate how you *feel* right now, that is, *at this moment*. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all			Very much so
1. I feel surprised	(1)	(2)	(3)	(4)
2. I feel hopeful	(1)	(2)	(3)	(4)
3. I feel sad	(1)	(2)	(3)	(4)
4. I feel happy	(1)	(2)	(3)	(4)
5. I feel irritated	(1)	(2)	(3)	(4)

A.3.2. *Importance of emotions for decision*

At the end of the second questionnaire for STAI state, the following question was asked, to determine if subjects took emotions into account when making their decision:

Was your decision influenced by how you might feel after the rolling of the white dice, which will determine the outcome of project B? [EMOTION]

B. INSTRUCTIONS

Translated from the Dutch

B.1. *Announcement of global risk*

B.1.1. *GR-Pre*

Announcement earnings: At the start of phase 2 of this experiment there is a chance of 1/3 that you will lose *all* your working money and thus can't earn money.

Each participant has received with this announcement a red die. At the start of phase 2, thus **before** *deciding about the distribution of the working money*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your working money**. If the die shows 1, 2, 3 or 4, you will keep your working money. Please note, your earnings depend on the decision that you will take now, in phase 2, and on you keeping your working money.

B.1.2. *GR-Inter*

Announcement earnings: At the start of phase 3 of this experiment there is a chance of 1/3 that you will lose *all* your possible earnings.

Each participant has received with this announcement a red die. At the start of phase 3, thus **before** *the outcome of the projects is determined*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your possible earnings**. If the die shows 1, 2, 3 or 4, you will keep your possible earnings. Please note, your earnings depend on the decision that you will take now, in phase 2.

B.1.3. *GR-Post*

Announcement earnings: At the end of phase 3 of this experiment there is a chance of 1/3 that you will lose *all* your earnings.

Each participant has received with this announcement a red die. After the end of the phase 3, thus **after** *the outcome of the projects is determined*, each participant will be asked to roll this die a single time under supervision. If the die shows 5 or 6, you will lose **all your earnings**. If the die shows 1, 2, 3 or 4, you will keep your earnings. Please note, your earnings depend on the decision that you will take now, in phase 2.

B.2. *General instructions*

Information about projects

In this phase you have to make a *single* decision concerning your working money. You have to allocate the 15 euro [30 euro] that you received over two projects. These projects will be labeled on the computer screen, when you make your decision, with the letters A and B.

In project A you will get for every euro that you put into this project, 1 euro. Thus, project A always gives a certain return. For the amount that you put in project B the following holds. With probability one half (1/2) you will lose this amount and with probability one half (1/2) you will receive two and a half (2 1/2) times this amount. You can allocate your working money in multiples of 50 eurocent [1 euro] over the projects A and B in any possible combination that sums up to 15 euro [30 euro]. The table below shows for each possible combination that you can choose the returns and corresponding probabilities. All values are in euros.

B.2.1. *Baseline*

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw

this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5, or 6, you will lose the amount that you have put in project B.

B.2.2. *GR-Pre*

Before you will take your decision, you will be confronted with the risk of losing all your working money. Note: if this happens to you we still ask you to take a decision concerning the distribution of your working money over the projects (but you will not be paid out the earnings from the projects).

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

B.2.3. *GR-Inter*

At the beginning of the following phase, thus after you made your decision but before the outcome of projects is determined, you will be confronted with the risk of losing all your earnings. Only for those that keep their possible earnings the following will then hold: Chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B.

B.2.4. *GR-Post*

In the following phase, chance will determine for you the returns of project B. Each participant has just received a white die. In the next phase everyone will be asked to throw this die a single time under supervision. Also if you have put nothing in project B, you will have to throw the die. If the die shows 1, 2 or 3, you will receive two and a half (2 1/2) times the amount that you put in project B. If the die shows 4, 5 or 6, you will lose the amount that you have put in project B. At the end of the following phase, thus after the outcome from the projects is decided, you will be confronted with the risk of losing all your earnings.

Money in project A	Money in project B	Certain return	Chance of 1/2 for extra earnings of
0.00	15.00	0.00	37.50
0.50	14.50	0.50	36.25
1.00	14.00	1.00	35.00
1.50	13.50	1.50	33.75
2.00	13.00	2.00	32.50
⋮	⋮	⋮	⋮
13.50	1.50	13.50	3.75
14.00	1.00	14.00	2.50
14.50	0.50	14.50	1.25
15.00	0.00	15.00	0.00

Note: Full table was presented to subjects.

C. TABLES

TABLE V

Censored tobit regressions of investment on emotions

GR-Pre	Number of obs		48
	LR $\chi^2(5)$		8.08
	Prob $> \chi^2$		0.152
	Cox Snell R^2		0.155
INVESTMENT t1	Coef.	Std. Err.	$p > \|t\|$
ANXIETY-trait	−0.003	0.006	0.645
ANXIETY-1	−0.002	0.005	0.701
HOPE-1	0.052	0.081	0.526
IRRITATE-1	−0.037	0.081	0.649
REJOICE-R	0.080	0.034	0.024
Intercept	0.638	0.435	0.150
1 obs. left-censored; 11 obs. right-censored			
GR-Post	Number of obs		42
	LR $\chi^2(5)$		6.40
	Prob $> \chi^2$		0.269
	Cox Snell R^2		0.141
INVESTMENT t1	Coef.	Std. Err.	$p > \|t\|$
ANXIETY-trait	0.004	0.007	0.641
ANXIETY-1	−0.002	0.007	0.753
HOPE-1	0.079	0.088	0.378
IRRITATE-1	0.130	0.072	0.078
REJOICE-R	0.080	0.050	0.119
Intercept	0.137	0.446	0.761
1 obs. left-censored; 10 obs. right-censored			

TABLE VI

Censored tobit regressions of investment on emotions (treatments "high")

Baseline-high	Number of obs		39
	LR $\chi^2(5)$		10.35
	Prob $> \chi^2$		0.066
	Cox Snell R^2		0.233
INVESTMENT t1	Coef.	Std. Err.	$p > \|t\|$
ANXIETY-trait	0.001	0.006	0.841
ANXIETY-1	0.003	0.006	0.547
HOPE-1	0.234	0.088	0.012
IRRITATE-1	−0.014	0.099	0.891
REJOICE-R	0.108	0.042	0.014
Intercept	−0.395	0.447	0.383
1 obs. left-censored; 6 obs. right-censored			

GR-Post-high	Number of obs		29
	LR $\chi^2(5)$		23.75
	Prob $> \chi^2$		0.000
	Cox Snell R^2		0.559
INVESTMENT t1	Coef.	Std. Err.	$p > \|t\|$
ANXIETY-trait	−0.002	0.007	0.746
ANXIETY-1	0.000	0.006	0.999
HOPE-1	0.082	0.081	0.317
IRRITATE-1	0.133	0.101	0.200
REJOICE-R	0.153	0.028	0.000
Intercept	0.119	0.443	0.791
1 obs. left-censored; 7 obs. right-censored			

TABLE VII

Spearman correlations for anxiety, hope, and irritation

Baseline grouped	ANXIETY-trait	ANXIETY-1	HOPE-1
ANXIETY-1	0.539		
	($p = 0.000$)		
HOPE-1	−0.237	−0.391	
	($p = 0.039$)	($p = 0.001$)	
IRRITATE-1	0.253	0.333	−0.187
	($p = 0.028$)	($p = 0.003$)	($p = 0.106$)
GR-Post grouped	ANXIETY-trait	ANXIETY-1	HOPE-1
ANXIETY-1	0.320		
	($p = 0.007$)		
HOPE-1	−0.181	0.010	
	($p = 0.132$)	($p = 0.932$)	
IRRITATE-1	0.239	0.212	−0.340
GR-Post-low	($p = 0.212$)	($p = 0.178$)	($p = 0.027$)
GR-Post-high	0.246	0.153	−0.128
	($p = 0.116$)	($p = 0.430$)	($p = 0.509$)

TABLE VIII

Overview of investment behavior from all treatments (t1)

	N	Mean: fraction	[points]	Std. dev.: fraction	[points]
Baseline	37	0.521	[7.811]	0.226	[3.386]
Baseline-high	39	0.533	[16.00]	0.249	[7.459]
Baseline-without	43	0.584	[8.756]	0.234	[3.506]
GR-Pre	48	0.606	[9.083]	0.258	[3.865]
GR-Inter	39	0.662	[9.923]	0.274	[4.106]
GR-Post	42	0.623	[9.345]	0.273	[4.091]
GR-Post-high	29	0.554	[16.62]	0.306	[9.186]
GR-Post-without	40	0.575	[8.625]	0.253	[3.796]

TABLE IX

Significance levels for differences in investment

			Mann–Whitney Prob $> \|z\|$	Kolm.–Smirnov p
Baseline	vs.	Baseline-high	0.859	0.600
		Baseline-without	0.105	0.224
		GR-Pre	0.117	0.454
		GR-Inter	0.011	0.012
		GR-Post	0.062	0.103
		GR-Post-high	0.845	0.229
		GR-Post-without	0.378	0.653
Baseline-high	vs.	Baseline-without	0.121	0.132
		GR-Pre	0.154	0.086
		GR-Inter	0.025	0.031
		GR-Post	0.087	0.197
		GR-Post-high	0.830	0.738
		GR-Post-without	0.337	0.409
Baseline-without	vs.	GR-Pre	0.939	0.900
		GR-Inter	0.156	0.114
		GR-Post	0.620	0.680
		GR-Post-high	0.279	0.035
		GR-Post-without	0.530	0.851
GR-Pre	vs.	GR-Inter	0.247	0.312
		GR-Post	0.653	0.949
		GR-Post-high	0.276	0.039
		GR-Post-without	0.548	0.954
GR-Inter	vs.	GR-Post	0.495	0.676
		GR-Post-high	0.129	0.026
		GR-Post-without	0.103	0.161
GR-Post	vs.	GR-Post-high	0.196	0.092
		GR-Post-without	0.341	0.699
GR-Post-high	vs.	GR-Post-without	0.431	0.151

NOTES

1. Such risk concerns a specific case of "background risk" (see e.g., Gollier, 2001).
2. Alternatively, we could have followed the common procedure to present this decision problem as a binary choice problem concerning the prospects (A): (z) and (B): ($2.5 \times z, 0.5$), with (B) having the higher expected value. As will be shown below, however, this would have obscured the fact that most participants definitely did not perceive our problem as a binary choice problem.
3. According to Robinson and Clore (2002) self-reports are "the most common and potentially the best way to measure a person's emotional experience."
4. It seems that regret and rejoicing are not simply opposites of each other (Connolly and Zeelenberg, 2002). In our experiment we will therefore measure both emotions.
5. Only subjects that indicate that they took their emotions into account while making their decision (represented by the variable EMOTION in the table), are asked about anticipated regret and rejoicing.
6. For example, the experiment as a whole may be considered as a single dynamic choice problem or additional incentive effects may be induced through the accumulation of earnings. Note, furthermore, that applying a random lottery incentive procedure would in fact change the Baseline problem to a problem of type GR-Inter (see Cubitt et al., 1998).
7. Participants that lost were requested to remain seated till the experiment was over and to answer the money allocation question hypothetically.
8. Note that participants were not aware of this option when they made their investment decision. Only very few participants changed their investment decision (altogether 9).
9. See note 5 on the problematic nature of the latter procedure.
10. All tests in this paper are two-sided.
11. We find no effect of age, field of study (economics or not), and previous experience with economic experiments. In total only three subjects changed their investment when they had to confirm their investment decision. Therefore, in the sequel we will focus on the initial investment decision.
12. Anticipated rejoicing was only measured for subjects responding "yes" to EMOTION. If the answer was "no" REJOICE-R is set to equal to 0.
13. We do not include REGRET-R because in both treatments REGRET-R and REJOICE-R are strongly negatively correlated (Spearman:

-0.560; $p = 0.000$) and, as will be shown below, both variables can account for the same effect.

14. The mean intensity score for HOPE-1 equals 2.946 in Baseline and 3.282 in GR-Inter (Mann–Whitney, $p = 0.018$).
15. The mean intensity score for IRRITATE-1 (REJOICE-R) equals 1.459 (0.412) in Baseline and 1.846 (0.450) in GR-Inter. For REGRET-R the respective values are 0.471 and 0.450. (Mann–Whitney, regret: $p = 0.820$; rejoicing: $p = 0.834$; irritation: $p = 0.071$)
16. ANXIETY-1-ANXIETY-trait equals 5.385 in GR-Inter vs. 0.324 in Baseline (Mann–Whitney, $p = 0.043$).
17. In their terminology, the "scaled-up problem" vs. the "precommitment problem" and the "prior problem", respectively.
18. Investment of those who lost and could give only hypothetical answers is higher (mean: 0.68, std. dev: 0.27), but the difference is not significant (Mann–Whitney, $p = 0.266$).
19. The distribution of ANXIETY-trait in our experiment (all treatments: mean: 35.74, std. dev: 8.16) is very similar to the one observed in a psychology experiment at the same university, involving 493 subjects (mean: 35.29, std. dev: 9.69) (t-test, $p = 0.569$).
20. Controlling for trait-anxiety by taking the difference ANXIETY-1-ANXIETY-trait, we find for Baseline: 0.32, and for GR-Pre: 5.71 (Mann–Whitney, $p = 0.020$).
21. HOPE-1 equals 2.95 in Baseline vs. 3.35 in GR-Pre (Mann–Whitney, $p = 0.003$).
22. In all treatments experienced happiness is approximately 2.8 (Kruskal–Wallis, $p = 0.932$).
23. There is also no correlation between happiness and investment in the other treatments (Spearman, approx. -0.02, $p > 0.829$). Interestingly, though, sadness is negatively correlated with investment in GR-Pre (Spearman, -0.379, $p = 0.008$), whereas no correlation is observed in the other treatments (Spearman, approx. -0.06, $p > 0.597$).
24. If we substitute certainty equivalents at nodes and then calculate backwards (Segal, 1990), compared to Baseline, similar investment would be predicted for GR-Inter and for GR-Post (or possibly more for the latter; see Bosman and van Winden, 2005). The global risk should have no effect in GR-Inter, as is easily seen from the decision tree. In contrast, we have observed a substantial increase in investment in GR-Inter.
25. In contrast, Bosman and van Winden (2005) find a similar fraction of full investment for both their baseline and "post" treatment. We will return to this below.
26. A similar result is obtained if irritation is directly correlated with investment (Spearman, $+0.259$, $p = 0.099$).
27. See note 5.

28. We cannot reject that REGRET-A (B) and REJOICE-A (B) are from the same distribution across treatments (Kruskal–Wallis, $p > 0.180$).
29. For the correlations of estimated and experienced regret (REGRET-E and REGRET-X) and disappointment (DISAPP-E and DISAPP-X) we consider only participants who actually lost with project B and survived the global risk.
30. Experienced regret and disappointment are correlated with the amount of money the participant lost due to the negative outcome of the relevant risk. In all treatments, if money was lost due to the decision risk, regret is experienced (Spearman, ≈ 0.35, $p < 0.064$). For GR-Inter and GR-Post, we also find correlations between disappointment and the loss of money due to the global risk (Spearman, ≈ 0.55, $p < 0.000$).
31. Regressing experienced regret on estimated regret shows a coefficient smaller than 1.
32. For completeness sake, we mention two more differences with the design of Bosman and van Winden. First, in their study subjects had to put the bills and coins of their endowment in two cups on their table, whereas in our case the allocation decision was made on the computer (and, therefore, may have been less vivid). Second, in our GR-Post the resolution of the global risk took place in the lab, immediately after the resolution of the decision risk, while in the study of Bosman and van Winden this happened when participants were (individually) paid out. Finally, remember that in our case participants started with filling out the ANXIETY-trait questionnaire in the reception room, before they entered the lab.
33. Cubitt et al. (1998) did not measure emotions at all, while Bosman and van Winden only used self-reports after the investment decision.
34. Because anxiety in Baseline might lead to less risk taking, while additional anxiety in GR-Post might have the opposite effect.
35. Even though a study by Koebberling et al. (2007) suggests no effect of the change from guilders to euros. For empirical evidence of money illusion, see e.g., Fehr and Tyran (2007).
36. Experimental procedures were the same as for Baseline-low and GR-Post-low. However, in the *without* treatments participants did not have to fill out the ANXIETY-1 questionnaire and were not asked about experienced emotions before they had to make their decision. In total, 151 students participated. Participants received again 2.50 euro as show-up fee, while their average earnings were 14 euro (approximately $17) in the *without* treatments and 36 euro (approximately $44) in the *high* treatments.
37. Excluding extreme (full) investment, the difference becomes significant at the 20% level (Mann–Whitney, $p = 0.166$). Comparing the

without treatments with the respective earlier treatments, we find weak evidence of a difference for Baseline and Baseline-without, using a Mann–Whitney test ($p = 0.105$).

38. Compared to the lower stake treatments, we find weak evidence of a difference in distributions for GR-Post and GR-Post-high, using a Kolmogorov–Smirnov test ($p = 0.092$).
39. The different role played by irritation across these treatments also shows up in the fact that it is not correlated with (both trait and state) anxiety in GR-Post-grouped whereas there is a positive correlation in Baseline-grouped.
40. The difference ANXIETY-1–ANXIETY-trait is on average larger in the *high* treatments (2.410 vs. 0.324 in Baseline; 2.966 vs. 0.905 in GR-Post). This difference seems to point at some higher arousal in the treatments with a larger stake, in line with emotion theory.
41. Regression coefficients and significance for Baseline-grouped ($N = 119$): investment, 0.966 ($p = 0.000$); ANXIETY-2, -0.002 ($p = 0.000$); intercept, 0.074 ($p = 0.000$). Same for GR-Post-grouped ($N = 111$): investment, 1.000 ($p = 0.000$); ANXIETY-2, -0.001 ($p = 0.046$); intercept, 0.033, ($p = 0.042$). In both cases, the *without* treatment is included.

REFERENCES

Allais, M. (1953), Le comportement de l'Homme rationnel devant le risque: Critique des postulats et axiomes de l'Ecole Americaine, *Econometrica* 21(4), 503–546.

Bell, D. (1982), Regret in decision making under uncertainty, *Operations Research* 30(5), 961–981.

Bell, D. (1985), Disappointment in decision making under uncertainty, *Operations Research* 33(1), 1–27.

Bernasconi, M. (1994), Nonlinear preferences and two-stage lotteries: Theories and evidence, *The Economic Journal* 104(422), 54–70.

Bosman, R. and van Winden, F. (2005), Global risk, investment, and emotions, *working paper, University of Amsterdam*.

Camerer, C. (1995), Individual decision making, In: *The Handbook of Experimental Economics*, Princeton University Press.

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

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

Conlisk, J. (1989), Three variants on the allais example, *The American Economic Review* 79(3), 392–407.

Connolly, T. and Zeelenberg, M. (2002), Regret in decision making, *Current directions in psychological science* 11(6), 212–216.

Cubitt, R., Starmer, C. and Sugden, R. (1998), Dynamic choice and the common ratio effect: An experimental investigation, *The Economic Journal* 108, 1362–1380.

Fehr, E. and Tyran, J.-R. (2007), Money illusion and coordination failure, *Games and Economic Behavior* 58, 246–268.

Gollier, C. (2001), *The Economics of Risk and Time*, MIT Press.

Isen, A. (2001), The influence of positive affect on decision making in complex situations: Theoretical issues with practical implications, *Journal of Consumer Psychology* 11(2), 75–85.

Isen, A. and Simmonds, S. (1978), The effect of feeling good on a helping task that is incompatible with good mood, *Social Psychology* 41, 346–349.

Kahneman, D. (2000), Experienced utility and objective happiness: A moment based approach, In: Kahneman, D. and Tversky, A. (eds.), *Choices, Values and Frames*, Cambridge University Press.

Kahneman, D., Fredricksom, B. Schreiber, C. and Redelmeier, D. (1993), When more pain is preferred to less: Adding a better end, *Psychological Science* 4, 401–405.

Kahneman, D. and Tversky, A. (1979), Prospect theory: An analysis of decision under risk, *Econometrica* 47(2).

Kirchsteiger, G., Rigotti, L. and Rustichini, A. (2006), Your morals might be your moods, *Journal of Economic Behavior & Organization* 59, 155–172.

Kliger, D. and Levy, O. (2003), Mood-induced variation in risk preferences, *Journal of Economic Behavior and Organization* 52, 573–584.

Kline, P. (1993), *Handbook of Psychological Testing*, Routledge.

Koebberling, V., Schwieren, C. and Wakker, P. (2007), Prospect-theorys diminishing sensitivity versus economics intrinsic utility of money: How the introduction of the euro can be used to disentangle the two empirically, *Theory and Decision* forthcoming.

Krugman, P. (2001), Fear itself, *New York Times Magazine*, September 30, 2001.

Lazarus, R.S. (1999), Hope: An emotion and a vital coping resource against despair, *Social Research* 66(2), 653–678.

Leith, K. and Baumeister, R. (1996), Why do bad moods increase self-defeating behavior? Emotion, risk taking and self regulation, *Journal of Personality and Social Psychology* 71.

Lerner, J. and Keltner, D. (2001), Fear, anger and risk, *Journal of Personality and Social Psychology* 81(1), 146–159.

Loewenstein, G. and Schkade, D. (1999), Wouldnt it be nice? Predicting future feelings, In: Kahneman, D., Diener, E. and Schwarz, N. (eds.), *Well-Being: The Foundations of Hedonic Psychology*, Russell Sage Foundation Press, pp. 85–105.

Loewenstein, G., Weber, E. Hsee, C. and Welch, N. (2001), Risk as feelings, *Psychological Bulletin* 127(2), 267–286.

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

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

MacLeod, A. and Byrne, A. (1996), Anxiety, depression, and the anticipation of future positive and negative experience, *Journal of Abnormal Psychology* 105(2), 286–289.

Mano, H. (1994), Risk-taking, framing effects, and affect, *Organizational Behavior and Human Decision Processes* 57(1), 38–58.

Pope, R. (1995), Towards a more precise decision framework, *Theory and Decision* 39, 241–265.

Quiggin, J. (1982), A theory of anticipated utility, *Journal of Economic Behavior and Organization* 3, 323–343.

Raghunathan, R. and Pham, M. (1999), All negative moods are not equal: Motivational influences of anxiety and sadness on decision making, *Organizational Behaviour and Human Decision Processes* 79(1), 56–77.

Robinson, M. and Clore, G. (2002), Belief and feeling: Evidence for an accessibility model of emotional self-report, *Psychological Bulletin* 128(6), 934–960.

Rottenstreich, Y. and Hsee, C. (2001), Money, kisses, and electric shocks: On the affective psychology of risk, *Psychological Science* 12(3).

Sacco, K., Galletto, V. and Blanzieri, E. (2003), How has the 9/11 terrorist attack influenced decision making? *Applied Cognitive Psychology* 17, 1113–1127.

Schreiber, C. and Kahneman, D. (2000), Determinants of the remembered utility of aversive sounds, *Journal of Experimental Psychology General* 129(1), 27–42.

Segal, U. (1990), Two-stage lotteries without the independence axiom, *Econometrica* 58, 349–377.

Spielberger, C., Gorsuch, R. and Lusherie, R. (1970), *STAI Manual for the State Trait Anxiety Inventory*, Consulting Psychologists Press.

Tversky, A. and Kahneman, D. (1981), The framing of decisions and the psychology of choice. *Science* 211, 453–458.

Tversky, A. and Kahneman, D. (1986), Rational choice and the framing of decisions, *Journal of Business* 59, S251–S278.

Tversky, A. and Kahneman, D. (1992), Advances in prospect theory: Cumulative representations of uncertainty, *Journal of Risk and Uncertainty* 5, 297–323.

van der Ploeg, H., Defares, P. and Spielberger, C. (1980), *Handleiding bij de Zelf- Beoordelings Vragenlijst, een Nederlandstalige bewerking van Spielberger state-trait anxiety inventory*, Lisse, the Netherlands, Swets and Zeitlinger.

Wu, G. (1999), Anxiety and decision making with delayed resolution of uncertainty, *Theory and Decision* 46(2), 159–199.
Zeelenberg, M. (1999), Anticipated regret, expected feedback and behavioral decision making, *Journal of Behavioral Decision Making* 12, 93–106.
Zeelenberg, M., van Dijk, W.W., Manstead, A. and van der Pligt, J. (1998), The experience of regret and disappointment, *Cognition and Emotion* 12, 221–230.

Address for correspondence: Astrid Hopfensitz, CISA – Swiss Center for Affective Sciences, University of Geneva, Rue des Battoirs 7, 1205 Geneva, Switzerland. Tel.: +41-22-3799808; E-mail: hopfensitz@gmail.com
Frans van Winden, CREED, Department of Economics, University of Amsterdam, Roetersstraat 11, 1018 WB Amsterdam, The Netherlands. Tel.: +31-20-5254251; E-mail: f.a.a.m.vanwinden@uva.nl