Consequences of Regret Aversion: Effects of Expected Feedback on Risky Decision Making

MARCEL ZEELENBERG

University of Amsterdam, Amsterdam, The Netherlands

JANE BEATTIE

University of Sussex, Brighton, United Kingdom

AND

JOOP VAN DER PLIGT AND NANNE K. DE VRIES

University of Amsterdam, Amsterdam, The Netherlands

Previous research has considered the question of how anticipated regret affects risky decision making. Several studies have shown that anticipated regret forces participants towards the safe option, showing risk-aversion. We argue that these results are due to the previous confounding of the riskiness of the options with the feedback received. Our design unconfounds these factors, and we predict that participants will always tend to make *regret-minimizing* choices (rather than risk-minimizing choices). We present three experiments using a "choices between equally valued alternatives" paradigm. In these experiments we manipulate whether the risky or safe gamble is the regret-minimizing choice by manipulating which gamble(s) will be resolved. As predicted, participants tend to choose the regret-minimizing gamble in both gains and losses and in both relatively high risk and relatively low risk pairs of gambles. We consider the implications of these results for the role of regret in choice behavior. © 1996 Academic Press, Inc.

If a decision turns out badly, we often kick ourselves for not having done something different. This is especially true if we learn that the alternative course of action would have resulted in a more favorable outcome. In these situations we experience the feeling of regret. "Regret is a more or less painful cognitive and emotional state of feeling sorry for misfortunes, limitations, losses, transgressions, shortcomings or mistakes" (Landman, 1993, p. 36). Regret can affect people in two different ways: First, it can lead people to try to undo the effects of their regretted choice, *after* the decision is made (see, e.g., Gilovich & Medvec, 1995). Second, it can affect people's choices *before* the decision is made, when they anticipate the regret they may feel later (if the decision turns out badly) (see, e.g., Bell, 1982; Janis & Mann, 1977; Loomes & Sugden, 1982; Sage & White, 1983; Savage, 1951). Bell (1982) and Loomes and Sugden (1982) explicitly incorporated the anticipatory aspects of regret in their model of decision making, called "regret theory." Our paper also focuses on the effect of the anticipation of regret on later choices.

Regret theory differs from classical, prospect-based theories of decision making, which assume that the expected utility of a choice option depends only upon the possible pain and pleasure associated with the outcomes of that particular option (weighed by their probability of occurrence). In regret theory, an action-based theory, the utility of a choice option additionally depends on the feelings evoked by the outcomes of rejected options. Regret theory rests on two fundamental assumptions (Loomes & Sugden, 1982). The first assumption holds that people compare the actual outcome with what the outcome would have been, had a

TABLE 1
Outcomes and Probabilities of Choice Options A and B

	States of the world		
Choice	Blue (33.3%)	Yellow (33.3%)	Red (33.3%)
A	$50	$100	$0
B	$0	$50	$100

Note. The outcome of the choice options A and B depend on the color of ball that is randomly picked from an urn. All three colors have an equal chance of being picked.

different choice been made, and that they experience emotions as a consequence. People experience regret when the foregone outcome would have been better, and rejoicing when the foregone outcome would have been worse. For example, imagine the choice depicted in Table 1, where the outcome of the two options (A and B) depends on which ball is picked from an urn. If one chooses A and a blue ball is picked, one experiences the utility of the $50 and an additional amount of utility (rejoicing) due to the knowledge that choosing B would have produced $0. On the other hand, the same $50 won after choosing B (when Yellow is picked) results in less utility, since the utility of $50 is adjusted for the regret that one did not choose A and thus missed the $100 prize.

The second assumption of regret theory is that the emotional consequences of decisions are *anticipated* and taken into account when making decisions. Thus, the tendencies to avoid negative post-decisional emotions such as regret, disappointment, and self-recrimination and to strive for positive feelings and emotions such as rejoicing, elation and pride are assumed to be important determinants of individual decision making. Thus, in the example above, the decision maker must come to terms with the fact that either choice will leave him or her open to the possibility of regret; the decision maker must balance the fact that regret will be felt in B if either Blue or Yellow is picked against the extreme regret that would be felt in A if Red was picked.[1]

Implicit or explicit in most experimental work on anticipated regret is the idea that it leads to risk-aversion (Josephs, Larrick, Steele, & Nisbett, 1992; Richard, van der Pligt & de Vries, 1996; Simonson, 1992). Kardes (1994), for example, stated in a recent review that "Concern about regret that may follow a bad decision promotes extreme risk-aversion" (p. 448). In this article we argue that this is not always the case, and that the anticipation of regret can also cause risk-seeking. Bell (1985) provides a thought example of how

regret can also yield risk-seeking behavior. Empirical support showing that anticipated regret can make people relatively more risk-seeking in a negotiation scenario is provided in a recent paper by Larrick and Boles (1995). In their study participants negotiated about a signing bonus they could earn when deciding to work for a certain company ALPHA. Participants either expected to learn or expected not to learn the offer of a competing company BETA after they reached an agreement with ALPHA. Participants who expected to learn the offer of BETA could regret or rejoice about their decision to accept the bonus offered by ALPHA. These participants were more risk-seeking, wanted to have a higher bonus, and were less likely to reach agreement than participants who did not expect to learn the offer of BETA.

In the present article, we extend these ideas to choice situations. Our starting point is the assumption that people are *regret averse* (rather than risk-averse) and are therefore motivated to make *regret-minimizing* (rather than risk-minimizing) choices. Regret-minimizing choices may be either risk-avoiding or risk-seeking. Thus regret aversion can produce a behavioral tendency to select both the option with the lowest and the option with the highest risk. As we will show, the expectation of feedback (resolution) of the prospects will determine which options are regret-minimizing. We investigate this hypothesis in a series of experiments. We will look at both gains and losses because previous research suggests that the effects of regret may differ for these domains (Josephs *et al.*, 1992).

Resolution of both the chosen and the unchosen option(s) is central to regret theory: if you cannot compare what is with what would have been, there should be no reason for regret.[2] Research has shown that manipulations of feedback influence the levels of experienced regret or its positive counterpart (see, for example, Boles & Messick, 1995; Inman, Dyer & Jia, 1995; Ritov & Baron, 1995). Thus, feedback should also affect anticipated regret, and consequently decision making. Following the same line of reasoning, Bell concludes that the effect of expected feedback "is the predicted phenomenon on which experimentation should be concentrated" (1983, p. 1165). Larrick and Ritov and their collaborators (Larrick, 1993; Larrick & Boles, 1995; Josephs *et al.,* 1992; Ritov & Baron, 1995; Ritov, 1996) focused on this effect and demonstrated that decision makers do indeed make choices that shield them

---

[1] Note that A and B are identical in terms of outcomes and riskiness, and differ only in their propensity for regret and rejoicing.

[2] Regret can, of course, also occur when people compare reality to imagined alternatives (Sugden, 1985). Recent research on the effects of counterfactual thinking address this issue (for a review see Roese & Olson, 1995). We assume, however, that in the context of gambles the regret stemming from comparisons with imagined outcomes is less painful than regret stemming from comparisons with real foregone outcomes.

from possible regret-causing feedback on foregone alternatives.

A limitation of most previous research on the effect of anticipated regret on risky choice is that it has tended to use situations of *asymmetric feedback*. Participants in experiments on risky choice have usually been confronted with a choice between a certain option (a sure thing) and a risky option (Kelsy & Schepanski, 1991; Josephs *et al.,* 1992). The outcome of a certain option is, by definition, known in advance. Thus, choosing the risky option implies that you will always know what might have been had you chosen the certain (safe) option. However, it is normally not the case that the risky option is also resolved if one chooses the safe option. So the riskiness of the options is *confounded* with feedback on foregone outcomes; choosing the certain option prevents feedback on what might have been, whereas the risky option provides this information, and thus carries the risk of regret. The certain option is therefore regret-minimizing, and in this case anticipated regret promotes risk-aversion. For example, in Josephs *et al.,* (1992, Experiment 2), participants made a series of choices between a sure thing and a risky option. They were either told that they would learn the outcome of each decision (Feedback condition) or told that they would never learn the outcomes of any decision (No Feedback condition). Since the latter group of participants could not compare "what is" with "what would have been," there was no risk of regret and consequently no regret-minimizing option. Indeed, no regret effects were found in this group. Participants in the Feedback condition only learned the outcome of the risky option when they chose it, so the safe option was regret-minimizing. For these participants, increased risk-aversion was found under some circumstances. Josephs *et al.* (1992) concluded that "In general . . . [people] become more risk-averse in the face of threat, thereby reducing the possibility of regretting their decisions . . . . [and that] . . . an important process that underlies risk-aversion is the anticipation of regret . . ." (1992, p. 33).

Also when choosing between two options in real life, one can very often identify one option as being safe and the other as risky. Contrary to most experimental situations, however, the safe option in real life decisions is often not a sure thing, so real life decisions do not always involve asymmetric feedback. People may *occasionally* receive information about foregone outcomes. For example, people choosing to invest in particular stocks can learn about future stock prices for the chosen stocks, but also for the non-chosen stocks. Similarly, race-track bettors deciding not to bet on the long shot will learn after the race is finished whether this option would have resulted in a better outcome. But for important life decisions, such feedback is often not present. If you decide to go into business with someone or to marry someone, you will never find out how successful each enterprise would have been had you chosen either another partner or spouse, or none at all. In these cases, there is only feedback on the chosen option.[3]

The experiments reported below unconfound riskiness and feedback on foregone outcomes, allowing us to describe situations in which either the safe or the risky option is regret-minimizing. An example of the latter is a situation in which people know there will always be feedback on the outcome of the risky option, while the safe option will only be resolved if chosen. If people opt for the safe choice, they run the risk of learning that the risky option turned out to be better and thus the risk of suffering regret. Consider the following example in which there are two "twin" production plants in which the production system has to be changed (modified from Ritov & Baron, 1995). There are two alternative courses of action: Strategy R and strategy S. Both strategies should increase efficiency and thus lower the production costs, but it is not totally certain whether they will work out as planned. Strategy R results in a larger increase in efficiency than strategy S, but has a lower probability of success. In other words, strategy R is riskier than strategy S. Each of the managers of the production plants is given the choice whether to implement strategy R or S. Now imagine that one of the managers has to make a decision, knowing that the manager of the other plant has already decided to opt for strategy R. In this case the manager could realize that if she or he also opts for strategy R, she or he will not know what would have happened if she or he opted for strategy S. Thus the risky strategy R prevents the manager from possible threatening feedback and turns out to be the regret-minimizing option. Contrary to most previous research, in this case anticipated regret thus results in a preference for the *risky* option.

Feedback on foregone outcomes can also lead to the positive counterpart of regret, i.e., rejoicing. This emotion is experienced when one realises that the chosen option resulted in a better outcome than the unchosen option (e.g., winning $100 when the alternative choice would have gained only $50). People's decisions can also be influenced by the anticipation of rejoicing, which implies that they would like to receive feedback on the foregone outcomes. We expect, however, that the motive of regret aversion is a stronger decision motive than rejoicing seeking (cf. Larrick & Boles, 1995). This

---

[3] Of course you might run in to a person you rejected as a partner a few years before, and discover that he or she is currently more attractive than the partner you selected. Even in this case you do not know how your marriage or business would have been, had you initially selected this partner.

prediction is based on the finding that people are, in general, more influenced by negative information than by positive information (Taylor, 1991) and on Kahneman and Tversky's (1979) conclusion that losses loom larger than gains. Moreover, recent research by Beattie, Baron, Hershey, and Spranca (1994) found that while decisions are influenced by the anticipation of regret, there was no consistent support for the anticipation of rejoicing as a decision motive. Thus, for most individuals, in weighing regret and rejoicing, we expect the balance to be in favor of regret.

EXPERIMENT 1

Experiment 1 tests the hypothesis that people are motivated to make regret-minimizing (rather than risk-minimizing) choices. We asked participants to choose between two risky options: one relatively risky and the other relatively safe. There were three feedback conditions. In the *Choice Only Feedback* condition, participants would only learn the outcome of the chosen option. *Risky Feedback* participants would always learn the outcome of the risky option, but would only learn the outcome of the safe option if they chose it. Thus, they ran the risk of regret by comparing outcomes if they chose the safe (less risky) option, but not if they chose the risky option (as in the production plant example above). *Safe Feedback* participants would always learn the outcome of the safe option, but would only learn the outcome of the risky option if they actually selected it. Thus they ran the risk of regret by comparing outcomes if they chose the risky option, but not if they chose the safe option. We expected anticipated regret to cause people to choose the risky option more often in the Risky Feedback condition than in the Safe Feedback condition. The Choice Only Feedback condition should be intermediate between the Risky and the Safe conditions. The choice predictions for all three conditions and the feedback obtained, depending on the choice made, are summarized in Table 2.

Method

Design and Participants

Seventy-eight psychology undergraduate students of the University of Amsterdam participated in this experiment as part of a course requirement. They were randomly assigned to one of the three conditions (Choice Only Feedback vs Risky Feedback vs Safe Feedback). There were 26 participants in each condition.

Procedure

Participants were seated in separate cubicles and given a questionnaire. The experiment used a two-phase procedure.

TABLE 2
Feedback Obtained and Possibility of Regret, Depending on Participants' Choice, and Choice Predictions for All Three Conditions in Experiment 1

Feedback condition	Gamble chosen	Feedback obtained	Regret possible?	Regret-minimizing prediction
Choice only feedback	Risky	Risky only	No	
				R ≈ S
	Safe	Safe only	No	
Risky feedback	Risky	Risky only	No	
				R > S
	Safe	Both	Yes	
Safe feedback	Risky	Both	Yes	
				S > R
	Safe	Safe only	No	

Phase 1 (matching). In the first phase (the utility matching phase), participants considered two hypothetical gambles, gamble R (risky) and gamble S (safe), each of which could result in a positive outcome. Gamble R was more risky (higher payoff, lower probability of winning) than gamble S. The gambles are depicted below. The amount to be won in gamble R (130 Dutch Guilders) was approximately $75.

GAMBLE R		GAMBLE S
ƒ130 with 35%	vs	ƒ X with 65%
ƒ0 with 65%		ƒ 0 with 35%

The task in phase 1 was to make gamble S exactly as attractive as gamble R using a utility matching procedure (see Tversky, Sattah & Slovic, 1988). Each participant was asked to write down the value of X for which he or she found the gambles equally attractive. Next, he or she was asked to rate the attractiveness of each option on a scale ranging from not attractive (1) to very attractive (12). This allowed us to check whether the matching procedure indeed resulted in equally attractive gambles and to assess the absolute level of attractiveness of each option.

Phase 2 (choice between equally valued alternatives). In this phase, participants learned that, although they had made the gambles equally attractive, they were required to choose between them (see Slovic, 1975). Before they made the choice, however, participants learned about possible feedback on foregone outcomes. In the Choice Only Feedback condition, it was explicitly mentioned that they would only know the outcome of the gamble that they chose, and that they would not be able to compare their outcome with the outcome of the non-chosen gamble. In the Risky Feedback condition, participants read that they would always know the outcome of the risky gamble and the outcome of the

gamble they chose. They also read that they would be able to compare their outcome with the outcome of the non-chosen gamble if they selected gamble S, but not if they selected gamble R. In the Safe Feedback condition, participants read that they would always know the outcome of the safe gamble and the outcome of the gamble they chose. They also read that they would only be able to compare their outcome with the outcome of the non-chosen gamble if they selected gamble R, but not if they selected gamble S. Participants then made the choice (risky or safe gamble) and indicated the strength of their preference for the chosen option on a 12-point scale ranging from weak preference (1) to strong preference (12). Finally, participants were asked to write down reasons for their choice.

Results

Matching

The mean value of X for which the participants found gamble R as attractive as gamble S was 69.05 Dutch Guilders. As expected, there was no significant difference in X between the three conditions ($F(2,75) < 0.3$). In spite of the matching procedure, participants indicated that they found gamble R slightly less attractive than gamble S(M[gamble R] = 6.71 vs M[gamble S] = 7.41, $t(77) = -3.27$, $p < .01$).

Choices

Figure 1 shows participants' selection frequencies for the risky gamble (R) or safe gamble (S) for each condition. Overall there was a difference in the choice frequencies between the three conditions ($\chi^2(2) = 7.88$, $p < .02$). As predicted, participants were more risk-seeking in the Risky Feedback condition than in the
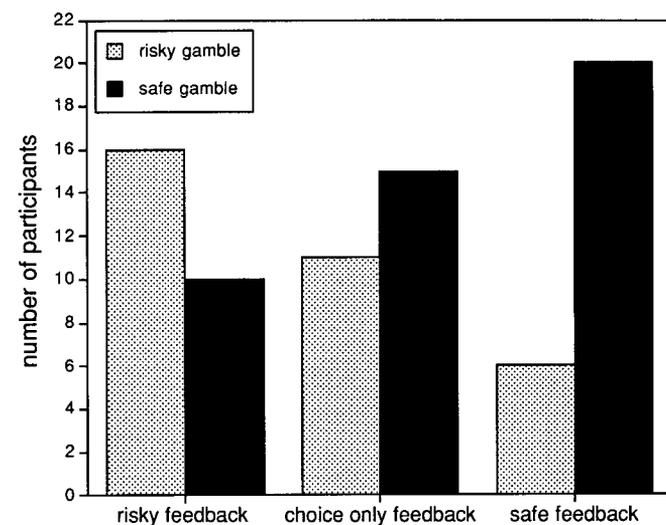

FIG. 1. Number of participants from Experiment 1 choosing the risky or safe gamble in each of the three feedback conditions.

Safe Feedback condition ($\chi^2(1) = 7.88$, $p < .005$). This confirms our hypothesis that expected feedback promotes risk-aversion and risk-seeking. Although neither the Risky Feedback nor the Safe Feedback conditions differed significantly from the Choice Only Feedback condition ($\chi^2(1) = 2.18$, and $\chi^2(1) = 1.93$), the Choice Only Feedback condition had, as predicted, an intermediate position in terms of preference for the two options.

Strength of Risk Preferences

Participants' choices were recoded as 1 if they chose the risky gamble and as −1 if they chose the safe gamble. These scores were multiplied by the strength of preference minus a half (*risk preference = choice ×* [*strength of preference − 1/2*]; the subtraction was done to create a scale that was evenly spaced around zero). This new variable, called risk preference, indicates the amount of risk-seeking (higher values indicate more risk-seeking). It ranges from −11.5 (extreme risk-aversion) to 11.5 (extreme risk-seeking) and enabled us to perform parametric analyses. An analysis of variance on these scores showed that the three conditions differed significantly (M[Risky Feedback] = 0.88, M[Choice Only Feedback] = −1.73, M[Safe Feedback] = −3.88; $F(2,75) = 3.46$, $p < 0.05$). Planned comparisons revealed the same pattern as in the choice data. The Risky Feedback and Safe Feedback conditions differed significantly ($t(75) = -2.63$, $p < 0.01$), but neither group differed significantly from the Choice Only Feedback group ($t(75) = 1.19$, ns, and $t(75) = 1.44$, ns, respectively). The means do, however, exhibit a significant linear trend ($F(2,75) = 6.90$, $p < 0.01$), which suggests equal differences between the conditions.

Justifications

Further support for the importance of regret aversion as a motive for decision making was found in the written justifications. Each justification was coded by two independent judges for whether it did or did not mention feedback or regret as a motivation for the participant's choice. The two judges agreed on 97.5% of the cases. Discrepancies were resolved by discussion. Only one participant in the Choice Only Feedback condition mentioned feedback or regret as a reason for the choice, even though the absence of feedback was explicitly mentioned in phase 2. This participant chose gamble R and wrote that "if I had chosen gamble S and won, I would still have the feeling that I lost, because in gamble R I would have won much more." This justification referred to regret related to imagined feedback on the unchosen option. In the Safe Feedback condition, 14 out of the 26 participants referred to feedback in their justifications. Ten stated that they did not

want to receive feedback. All 10 chose the safe gamble. Two typical statements are: "I don't have to feel annoyed about whether I should have preferred Gamble R, if I don't win," and "You will never know the outcome of Gamble R, therefore you don't have to bother about it (the feeling that you missed out on ƒ130)." One participant wrote: "I hated it in playing Monopoly when I had to pay ƒ1000, or draw a chance card. One day I decided to pay the ƒ1000 immediately, in order not to learn what I missed out on. This is exactly the same situation, and I stick to my choice; what you don't know, doesn't hurt. Hence I don't want to compare and just receive the ƒ70 or nothing."[4] Three participants who mentioned feedback chose the risky gamble. One of them chose R because "It is nice to learn both outcomes, especially when winning ƒ130". Contrary to those of previous participants, this justification shows that the anticipation of rejoicing can also be a determinant of choice behavior. Another participant chose R, indicating a preference for feedback in order to "know whether I made the right decision." The remaining participant who mentioned feedback indicated that (s)he was not interested in feedback. This participant chose the safe gamble.

In the Risky Feedback condition, 15 out of the 26 participants referred to the anticipation of feedback in their justifications. Ten of them chose the risky gamble and indicated that they did not want to receive feedback. Typical justifications were "To feel no regret afterwards about making the wrong choice" and "I want to win something or not, but I don't want to be disappointed because I could have won more money as well." The 5 remaining participants chose the safe gamble and indicated that they thought it was nice, or exciting, to know the other outcome. These participants seem to be more motivated by anticipated rejoicing than by anticipated regret.

In sum, concern about feedback was found to be a strong determinant of participants' choices. The preponderance of participants was motivated to avoid regret and thus chose the regret-minimizing option. However, as expected, a small number of participants wished to experience rejoicing and chose accordingly. Participants in the Safe Feedback condition were as likely to mention regret or feedback as a decision motive as participants in the Risky Feedback condition (14 or 15 out of 26 participants). In the Choice Only Feedback condition, none mentioned regret or feedback (0 out of 26 participants). This differed significantly from the two other conditions (0 vs 14, $p < .001$, and 0 vs 15, $p < .001$, two-tailed binomial test).

[4] Although this justification shows a good intuition about immediate feedback, the participant obviously did not realise that feedback would be present when the next player in the game chooses a chance card.

Discussion

The results of this experiment clearly indicate that the expectation of feedback, a possible cause of regret, influences people's choices. In a choice between two equally attractive options, the majority of our participants chose the option that precluded post-decisional comparisons of outcomes. Additional evidence for regret aversion was found in participants' justifications of their choices. Moreover, the experiment shows that regret aversion can result not only in risk-avoiding behavior, as the existing literature on this topic suggests, but also in risk-seeking behavior. This supports the hypothesis that participants tend to choose the regret-minimizing option.

EXPERIMENT 2

Experiment 2 explores the generality of the findings obtained in Experiment 1. We sought to replicate the dependence of risky choice on the expectation of feedback using gambles with different pay-offs and different probabilities. Specifically, we manipulated whether both gambles were relatively equal (Low Variance in pay-offs and probabilities) or quite different (High Variance in pay-offs and probabilities). In the Low Variance conditions, the risky gamble is only slightly riskier than the safe gamble, and therefore both gambles are very similar. In the High Variance conditions, the risky gamble is much riskier (with correspondingly higher payoff) than the safe gamble (see Table 3). This experiment also employs a more sophisticated utility matching procedure. In Experiment 1 we found that, despite being asked to make the two gambles equally attractive, participants would not always rate them as such. Thus in the present experiment we asked participants who made unequal attractiveness ratings to make further adjustments until the two options were rated as equally attractive.

TABLE 3
Outcomes and Probabilities of Gambles Used in the High and Low Variance Conditions of Experiment 2

Condition	Gamble	Probability	Outcome
High variance	Risky	10%	ƒ5200
		90%	ƒ0
	Safe	90%	ƒX
		10%	ƒ0
Low variance	Risky	40%	ƒ1300
		60%	ƒ0
	Safe	60%	ƒX
		40%	ƒ0

Note. X is set by each participant so that the Risky and Safe gambles are equally preferred for each pair.

Method

Participants and Design

Law students of the University of Amsterdam ($N = 104$) participated in this experiment as part of a paper-and-pencil session that lasted about 45 min. The present experiment was the first task that they performed. They were paid 15 Dutch Guilders (approximately \$9.50) for their participation. The experiment had a 2 (Variance: High vs Low) × 2 (Feedback: Safe vs Risky) factorial between-subjects design. There were 26 participants in each of the four conditions.

Procedure

The procedure was similar to Experiment 1, apart from the more elaborate matching procedure, and the fact that we used a more direct question to assess risk preference and did not ask for justifications. After making the gambles equally attractive and rating the attractiveness of the gambles as in Experiment 1, participants were asked to check whether they rated the two gambles as equally attractive. The instructions stated that if the ratings were not identical, the participants should adjust the matched value until the gambles were equally attractive.

After matching the gambles participants read the feedback instructions, which were similar to the Risky and Safe Feedback conditions of Experiment 1. Finally they were asked to choose between the gambles. In addition to this question, participants indicated the strength of their preference on a 13-point scale ranging from −6 (strong preference for gamble S) through 0 (no preference), to 6 (strong preference for gamble R). A negative score indicates risk-aversion, a positive score indicates risk-seeking, and a score of 0 indicates risk neutrality.

Results

Matching

The mean value of X for which the participants found gamble R as attractive as gamble S was submitted to a between-subjects 2 (Variance: High vs Low) × 2 (Feedback: Safe vs Risky) ANOVA. The analysis yielded a main effect for the variance factor, $F(1,100) = 4.79, p < 0.05$, indicating that in the High Variance conditions, the matched value for gamble S was lower ($X = 509.94$) than in the Low Variance conditions ($X = 787.46$). This effect was expected since the chance of winning when choosing gamble S in the Low Variance conditions was smaller than in the High Variance conditions. There was no other main effect or interaction.

Choices

Figure 2 shows participants' choices for the risky gamble or safe gamble for each condition. These data
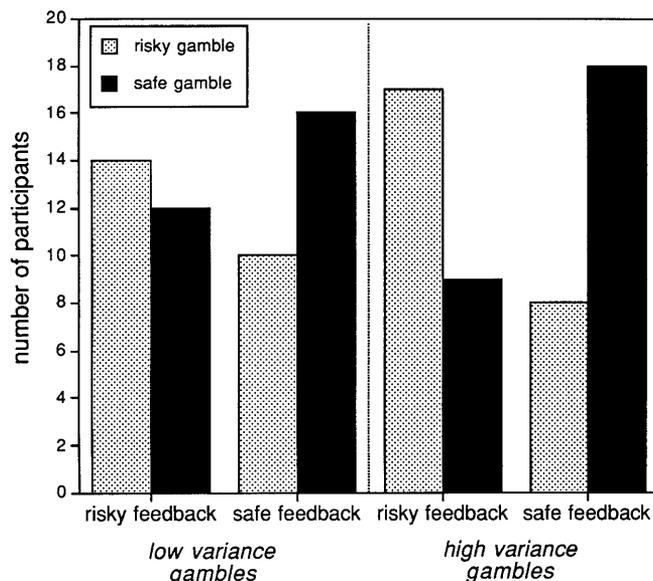

FIG. 2. Number of participants from Experiment 2 choosing the risky or safe gamble in each condition.

were submitted to a hierarchical loglinear analysis. Table 4 shows the likelihood ratio chi-square values (L^2), degrees of freedom, and the associated probabilities for a series of loglinear models with increasing complexity. Inclusion of a higher-order term implies inclusion of all lower-order effects. Models 1 and 2 differ only with respect to the Feedback × Choice term, which indicates a main effect of feedback. The L^2 value of the addition of the Feedback × Choice term can be obtained by subtracting $L^2(2)$ from $L^2(1)$. Results show that the most simple model indicates a reasonably good fit and cannot be rejected ($p < .15$). The addition of the Feedback × Choice term, however, resulted in a significantly better fit. Adding the Variance × Choice term, which represents the main effect for Variance, did not result in a better fit. The main effect for Feedback means that there was a difference in the choices between the two different feedback conditions, indicating that participants were more risk-seeking in the Risky Feedback condition than in the Safe Feedback condition. This was in accordance with our predictions. There was no main effect of Variance and no interaction effect.[5]

Strength of Risk Preferences

A 2 (Variance: High vs Low) × 2 (Feedback: Safe vs Risky) ANOVA on the risk preference data yielded a main effect of the Feedback factor, $F(1,100) = 12.09, p < .001$, and no other main effect or interaction. This

---

[5] The fit of model that included the main effect of Feedback (Model 2), was already so good that it could not be significantly improved. An improvement of L^2 by 1.06, which leads to a model with a perfect fit, would only be significant at .3 level.

TABLE 4
Results of Hierarchical Loglinear Analysis of the Choice Data from Experiment 2

Model	L^2	df	p
1. (Variance, Feedback, Choice)	7.65	4	.15
2. (Variance, Feedback × Choice)	1.06	3	.786
Δ 1-2: Feedback × Choice	6.59	1	<.02
3. (Feedback, Variance × Choice)	7.62	3	.055
Δ1-3: Variance × Choice	0.03	1	*ns.*

Note. Δ 1-2 and Δ 1-3 represent the tests for improvement of fit for model 2 and model 3 over model 1.

main effect indicated, as expected, that participants in the Safe Feedback conditions were more risk-averse (M = −1.35) than were those in the Risky Feedback conditions (M = 0.77). The t tests showed that this effect was present for both the High Variance (M[Safe Feedback] = −1.50 vs M[Risky Feedback] = 1.04, $t(50)$ = 2.84, $p < .01$) and the Low Variance conditions (M[Safe Feedback] = −1.19 vs M[Risky Feedback] = 0.50, $t(50)$ = 2.05, $p < .05$).

Discussion

The aim of Experiment 2 was to replicate and extend the main finding of Experiment 1. The present experiment again shows that manipulating the expectation of feedback can induce people to make risk-averse or risk-seeking choices. The fact that we found this pattern for both sets of high and low variance gambles suggests again that the effects of anticipated regret should not be interpreted as directly related to risk-aversion. As before, the anticipation of regret results in regret-minimizing choices, which can either be risk-averse or risk-seeking.

EXPERIMENT 3

Experiment 3 extends the findings of the previous experiments by examining decisions in the domain of losses. Experiments 1 and 2 focused only on gambles in the domain of gains. Previous research by Josephs *et al.* (1992) showed regret effects for gains, but not for losses. According to their reasoning, the experience of regret is a threat to a decision maker's self-image or self-esteem (see also Larrick, 1993). Hence, people minimize regret in order to protect their self-esteem. Josephs *et al.* argue that, when choosing between a risky and a certain gain, the certain gain is the regret-minimizing option, since one will always win something. The risky option can lead to regret if the decision turns out badly and one realises that one would have won more by choosing the certain option. This is en-

compassed by our hypothesis. However, in the domain of losses, Josephs *et al.* argue that there is no regret-minimizing choice: opting for a sure loss is threatening to self-esteem because it represents failure; opting for the risky loss can result in regret when having lost more than in the sure loss option, which again is threatening to self-esteem.

Our approach is somewhat different. We expect participants to make the regret-minimizing choice independent of whether the domain is losses or gains. According to our hypothesis, regret will only occur when the unchosen option is resolved and results in a superior outcome (whether for gains or losses). Thus, again, we predict that the regret-minimizing choice will be the option that leaves the unchosen gamble unresolved. The present experiment tests whether our earlier findings can also be obtained in the domain of losses.

Method

Students of the University of Amsterdam (N = 36) participated in this experiment as the first study in a session of computer tests that took about 1 hour to complete. They were paid 15 Dutch Guilders (approximately $9.50) for their participation. Participants were randomly assigned to the Risky Feedback or the Safe Feedback condition of the two-group design. There were 18 participants per condition. The procedure in this experiment was similar to that of Experiment 1, apart from the fact that we did not assess risk preference and did not ask for justifications. Participants were placed in separate cubicles, each containing an Apple Macintosh computer which presented the information and registered responses. Participants were presented with the same gamble as in Experiment 1, but this time the amounts of money were to be lost, not won. They were asked to make the safe gamble equal in attractiveness to the risky gamble, and to rate the unattractiveness of both gambles on two 12-point scales ranging from not at all unattractive (1) to very unattractive (12). Participants were then provided with the feedback information appropriate for their condition and asked to make a choice between the two gambles.

Results and Discussion

The overall mean value of X for which the participants found gamble R as unattractive as gamble S was 54.86 Dutch Guilders. Unexpectedly there was a nonsignificant tendency for the participants in the Risky Feedback conditions to assign a somewhat higher value to X than participants in the Safe Feedback Conditions (M Risky = 60.38 vs M Safe = 49.33). However, participants in both conditions did not differ in the unattractiveness assigned to gambles R and S (ns

for both conditions). Moreover, if this difference in matched value was to influence the choice between gambles, this influence would be in the direction opposite to our predictions. A higher value for X in the Risky Feedback condition would make the safe gamble more attractive in this condition than in the Safe Feedback condition, whereas we predicted that participants would be more likely to opt for the risky gamble in the Risky Feedback condition. Participants' choices are displayed in Fig. 3. As predicted, participants were more risk-seeking in the Risky Feedback condition than in the Safe Feedback condition ($\chi^2(1) = 4.05$, $p < .05$). This result thus extends the main findings of the first two experiments and supports our hypothesis about the impact of feedback on choice when confronted with losses.

GENERAL DISCUSSION

Taken together, the results of our experiments show that the anticipation of regret, caused by the manipulation of expected feedback on foregone options, can promote risk-averse *and* risk-seeking choices. This finding contradicts the claim that the anticipation of regret only results in *risk-aversion* (e.g., Kardes, 1994). The present approach shows that people are *regret averse,* i.e., make choices to minimize their possible future regret. These choices can be relatively risk-seeking or relatively risk-avoiding.

In all three experiments, participants were given a choice between a risky and a safe gamble. Possible feedback on one of the options was manipulated orthogonally to the riskiness of the gambles. Participants always expected to learn the outcome of the chosen option, but in addition they could sometimes receive feedback on the foregone outcome. Participants who expected to receive feedback on the safe option, regard-

less of their choice, were likely to choose this option, thereby protecting themselves from threatening feedback on the foregone outcome. Likewise, participants who expected to receive feedback on the risky option tended to choose the risky option. This pattern was found in both high and low variance gambles, but seems to be more pronounced in high variance gambles, and in gambles involving both gains and losses.

Our experiments did not include a condition in which there was always feedback on the outcomes of both gambles. In such a *Total Feedback* condition, possible regret is associated with both gambles, because one will always learn whether the non-chosen gamble would have resulted in a better outcome. What would happen in such a situation? Consider the example in Table 1, with feedback on both the chosen and unchosen option. Here the decision maker must balance the low intensity regret that will be felt after choosing B if either a Blue or Yellow ball is picked against the high intensity regret that will be felt after choosing A if a Red ball is picked. If there is perfect linear trade-off between the intensity and probability of regret, anticipated regret will not push the decision maker in either direction. However, if anticipated regret is determined more by the probability of regret, decision makers will have a preference for option B. If intensity of regret is more important, decision makers will have a preference for option A. Recent research by Ritov (1996) suggests that the probability of regret is the more important factor.

An additional finding of our research was that the effects of anticipated regret were obtained for both gains and losses. This is in contrast to Josephs *et al.* (1992), who found only regret effects in the domain of gains and did not find effects in the domain of losses. Our research showed that the safe and the risky option can minimize regret, and this applies to both losses and gains. A question that remains unresolved, however, concerns the relative importance of regret aversion in gains and losses. The findings of Experiments 1 and 3 suggest that these effects are roughly of equal strength. If, however, regret has a differential impact, we would expect stronger effects in the domain of losses. We know that losses are weighed more heavily than gains (Kahneman & Tversky, 1979), and that regret stems from a comparison between what is and what might have been. According to this line of reasoning, regret over not gaining $100 is likely to be less severe than regret over losing $100. If the regret associated with losing is more intense, we expect the anticipation of regret to have more influence on decision making in the domain of losses as compared to gains.

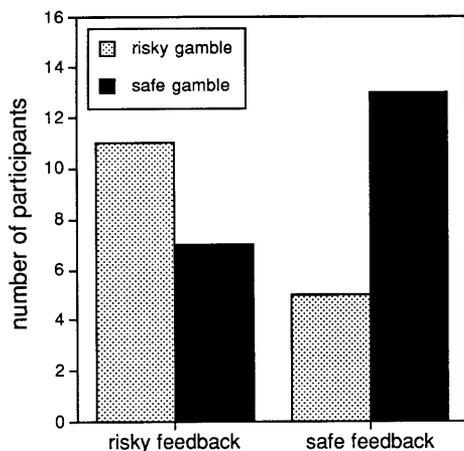Although our studies show clear effects of anticipated regret, they also show that some people are mo-

FIG. 3. Number of participants from Experiment 3 choosing the risky or safe gamble in each condition.

tivated to maximize rejoicing, instead of minimizing regret. As mentioned earlier, regret theory (Bell, 1982; Loomes & Sugden, 1982) incorporates the anticipation of rejoicing as a decision motive. A minority of our participants in Experiment 1 explicitly mentioned the anticipation of rejoicing in their justifications. Similarly, not all participants chose to minimize regret; some of them wanted to receive feedback on foregone options. Feedback could result in regret or rejoicing, thus their curiosity could be rewarded or punished. On average, however, our data indicated that anticipated regret weighs heavier than anticipated rejoicing (see also Beattie *et al.,* 1994, and Larrick & Boles, 1995).

Regret aversion is also likely to play a role in other stages of decision making. People's tendency to avoid feedback on foregone outcomes could be extended to post-decisional stages. We expect that *after* a choice has been made, people will also prefer to avoid information that might cause them to regret their decision. Feedback about the positive consequences of a rejected choice alternative, and about the negative consequences of the chosen alternative, can cause people to regret their initial decision. Likewise, feedback about the negative consequences of the rejected alternative and about the positive consequences of the chosen alternative can lead to rejoicing about the decision. Indeed, research shows that decision makers' post-decisional information search is biased in favor of information that supports their decision (Frey, 1986). Moreover, when people do not know whether feedback will be supportive or not, they show an overall tendency to avoid it (Northcraft & Ashford, 1990). We predict that regret would be especially painful when the choice is irreversible and expect effects of regret aversion on post-decisional information search to be most pronounced in these situations. When the possibility of reversing your decision exists, the regret caused by positive feedback on the rejected alternative will be less painful. In these situations, feedback can provide valuable information about how to improve your current position.

People's tendency to avoid regret could have serious implications for real life decision making. Our research shows that regret aversion results in choices that shield people from threatening feedback on forgone alternatives, and we suggest that this might generalize to post-decisional stages. Active avoidance of feedback can deter people from learning from experience (see also, Russo & Schoemaker, 1989). For example, organizational decision makers deciding to implement a certain reward system for their employees might avoid information about how the employees would have performed if another or no reward system was selected.

In conclusion, we argue that regret aversion is an important motive in several stages of the decision-making process. We have presented evidence showing regret effects in predecisional stages, and existing research also suggests effects in post-decisional stages. These findings provide further support for regret theory and cannot be explained by classical, prospect-based theories of decision making. Our findings do not address the relative importance of regret in decision making under uncertainty, or in other words, they do not provide information about the regret premium (Bell, 1983). The regret premium is the money people are willing to pay in order to avoid regret. The research by Larrick and Boles (1995) suggests that people are willing to sacrifice about 10% of the expected value of a prospect to prevent them from possible negative feedback. These findings, however, were not based on a traditional choice study, but on a negotiation study in which participants' task was to state the least amount of money they were willing to accept in a salary negotiation. Future research should help to estimate the size of the regret premium in other decision-making tasks, such as choice situations, and in different stages of the decision-making process.

REFERENCES

Beattie, J., Baron, J., Hershey, J. C., & Spranca, M. D. (1994). Psychological determinants of decision attitude. *Journal of Behavioral Decision Making*, **7,** 129–144.

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

Bell, D. E. (1983). Risk premiums for decision regret. *Management Science*, **29,** 1156–1166.

Bell, D. E. (1985). Putting a premium on regret. *Management Science*, **31,** 117–120.

Boles, T. L., & Messick, D. M. (1995). A reverse outcome bias: The influence of multiple reference points on the evaluation of outcomes and decisions. *Organizational Behavior and Human Decision Processes*, **61,** 262–275.

Frey, D. (1986). Recent research on selective exposure to information. *Advances in Experimental Social Psychology*, **19,** 41–80.

Gilovich, T., & Medvec, V. H. (1995). The experience of regret: what, when and why. *Psychological Review*, **102,** 379–395.

Inman, J. J., Dyer, J. S., & Jia, J. (1995). *A generalized utility model of disappointment and regret effects on post-purchase valuation.* Manuscript under review.

Janis, I. L., & Mann, L. (1977). *Decision making: A psychological analysis of conflict, choice, and commitment.* New York: The Free Press.

Josephs, R. A., Larrick, R. P., Steele, C. M., & Nisbett, R. E. (1992). Protecting the self from the negative consequences of risky decisions. *Journal of Personality and Social Psychology*, **62,** 26–37.

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk. *Econometrica*, **47,** 263–291.

Kardes, F. R. (1994). Consumer judgment and decision processes. In R. S. Wyer, Jr., and T. K. Srull (Eds.), *Handbook of social cognition, 2nd edition, Volume 2.* Hillsdale, NJ: Lawrence Erlbaum Associates.

Kelsey, D., & Schepanski, A. (1991). Regret and disappointment in

taxpayer reporting decisions-an experimental study. *Journal of Behavioral Decision Making*, **4,** 33–53.

Landman, J. (1993). *Regret: The persistence of the possible.* New York: Oxford Univ. Press.

Larrick, R. P. (1993). Motivational factors in decision theories: The role of self-protection. *Psychological Bulletin*, **113,** 440–450.

Larrick, R. P., & Boles, T. L. (1995). Avoiding regret in decisions with feedback: a negotiation example. *Organizational Behavior and Human Decision Processes*, **63,** 87–97.

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

Northcraft, G. B., & Ashford, S. J. (1990). The preservation of self in everyday life: The effects of performance expectations and feedback context on feedback inquiry. *Organizational Behavior and Human Decision Processes*, **47,** 42–64.

Richard, R., van der Pligt, J., & de Vries, N. K. (1996). *Anticipated regret and time perspective: Changing sexual risk-taking behaviour. Journal of Behavioral Decision Making,* in press.

Ritov, I. (1996) *Probability of regret: Anticipation of uncertainty resolution in choice. Organizational Behavior and Human Decision Processes,* in press.

Ritov, I., & Baron, J. (1995). Outcome knowledge, regret, and omission bias. *Organizational Behavior and Human Decision Processes,* **64,** 119–127.

Roese, N., & Olson, J. M. (1995). Counterfactual thinking: An overview. In N. Roese and J. M. Olson (Eds.), *What might have been: The social psychology of counterfactual thinking.* Hillsdale, NJ: Erlbaum.

Russo, J. E., & Schoemaker, P. J. (1989). *Decision traps: The ten barriers to brilliant decision-making and how to overcome them.* New York: Doubleday.

Sage, A. P., & White, F. B. (1983). Decision and information structures in regret: Models of judgment and choice. *IEEE: Transitions on Systems, Man, and Cybernetics*, **13,** 136–143.

Savage, L. J. (1951). The theory of statistical decision. *Journal of the American Statistical Association*, **46,** 55–67.

Simonson, I. (1992). The influence of anticipating regret and responsibility on purchase decisions. *Journal of Consumer Research*, **19,** 105–118.

Sugden, R. (1985). Regret, recrimination and rationality. *Theory and Decision*, **19,** 77–99.

Slovic, P. (1975). Choice between equally valued alternatives. *Journal of Experimental Psychology: Human Perception and Performance*, **1,** 280–287.

Taylor, S. E. (1991). Asymmetrical effects of positive and negative effects: The mobilization-minimization hypothesis. *Psychological Bulletin*, **110,** 67–85.

Tversky, A., Sattah, S., & Slovic, P. (1988). Contingent weighting in judgment and choice. *Psychological Review*, **95,** 371–384.