

Effects of fear on risk and control judgements and memory: Implications for health promotion messages

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Health promotion messages that evoke fear are often used to decrease unrealistic optimism regarding risks, convince people to control their behaviour, and make risks memorable. The relations among emotions, risk and control judgements, and memory are not well understood, however. In the current study, participants ($N = 94$) were assigned to fearful, angry, happy, or neutral emotion-elicitation conditions. They then rated the likelihood of experiencing 15 negative and 15 positive matched outcomes and rated their degree of control over each outcome. A surprise memory test followed. Fear decreased unrealistic optimism, but the greater the intensity of fear reported the less control participants believed they had over outcomes. Fear also led to poorer memory for outcomes. Across all participants, the lower their ratings of optimism and control concerning outcomes, the less likely they were to recall them. Implications for the use of emotionally evocative material in health promotion messages are discussed.

Increasing preventative behaviours, such as wearing seatbelts or completing medical screening tests, is a primary goal of many health promotion messages in order to lower death rates, reduce actions that endanger others, and provide early treatment for disease. If health promotion messages are to alter risky behaviours, the following three conditions must exist: people must view themselves as at risk, believe that they can control their behaviour, and remember the information. The first step alone, perceiving risk, is difficult to achieve due to the presence of unrealistic optimism regarding negative outcomes (Bauman & Siegel, 1987). Unrealistic optimism is the tendency for people to perceive

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themselves to be at lower risk for negative life outcomes than their peers: The “it won’t happen to me” belief. This belief has been identified as a primary reason that people begin and continue risky behaviours and fail to take preventive measures (Salovey, Rothman, Detweiler, & Steward, 2000; Weinstein & Lyon, 1999).

For years, public policy has focused on providing people with information about health risks in the hope that they will objectively assess their risk and take precautionary measures. However, simply exposing people to accurate information often has little impact on unrealistic optimism (Bauman & Siegel, 1987). Surprisingly, receiving accurate information can even lower people’s perceptions of risk (Weinstein & Klein, 1995). Another common approach to reducing unrealistic optimism about health risks has been the use of fear-inducing messages. Warnings designed to elicit fear are often used to increase people’s sensitivity to their vulnerability and convince them to control their behaviour. Fearful messages are also thought to be memorable (Hale & Dillard, 1995; Schneider et al., 2001; Sturges & Rogers, 1996). The relations among emotions, risk and control judgements, and memory are not well understood, however. The current study used motivated reasoning theory (for reviews, see Kunda, 1990, 2000; see also Protection Motivation Theory, Rogers, 1975) and appraisal theories of emotion (for a review, see Scherer, 1999) as a basis for exploring these relations. We had three specific goals. The first was to investigate the relations between people’s tendency to be unrealistically optimistic about outcomes and their beliefs about their degree of control over those outcomes. The second goal was to assess the effects of specific emotions on people’s judgements of risk and control. The third goal was to assess the effects of specific emotions on memory and to explore the relations between risk and control judgements and memory.

Unrealistic optimism and control judgements

Many investigators do not distinguish between judgements of risk and control. Questions about how much control people feel they have over outcomes are often used as a measure of perceived risk (e.g., Reed & Aspinwall, 1998; Roysamb, 1997). It is assumed that people who perceive that they have control over an outcome also perceive themselves to be at low risk for the outcome. For instance, if a man believes he can control how much he drinks, he is less likely to believe he might become an alcoholic. Consistent with this view, past research shows that people who have a greater sense of control over negative outcomes are more optimistic about being able to avoid them and take greater risks (Hoorens & Buunk, 1993; Roysamb, 1997; Weinstein, 1987). Some researchers have argued further that the influence of unrealistic optimism stems from an accompanying illusory sense of control (McKenna, 1993).

The vast majority of studies that have examined the relation between judgements of risk and control have assessed judgements concerning negative

events only. In a study of unrealistic optimism for both negative and positive events, however, judgements of optimism and control were not equivalent. Weinstein (1980) found that people were more optimistic about avoiding negative outcomes than attaining positive outcomes, even though they judged themselves to have more control over positive than negative outcomes. To explain this finding, Weinstein pointed out that the positive and negative outcomes in his study differed. Whereas all participants may have wanted to avoid the negative outcomes (e.g., dropping out of school), only some of the participants may have desired the positive outcomes (e.g., winning an award), thus they were relatively less optimistic about the possibility of attaining the positive outcomes. An alternative explanation is suggested by motivated reasoning theory (e.g., Kunda, 1990). According to this view, people maintain optimistic beliefs in order to minimise the negative emotion associated with considering themselves to be at risk. The more threatening the information, the more likely it is to be discounted (e.g., Burger & Burns, 1988). From this perspective, outcomes judged as being outside a person's control may be especially likely to evoke optimism. This prediction is also supported by Protection Motivation Theory (Rogers, 1975), which stresses the importance of perceived response efficacy in reducing biased processing.

In order to find out whether unrealistic optimism can be accounted for by beliefs about control, we assessed perceptions of risk and control for both positive and negative outcomes. In contrast to Weinstein (1980), however, we had participants rate positive and negative frames of the same outcomes. For example, if participants want to avoid the negative outcome of "getting lung cancer", they should also want to attain the positive outcome of "remaining cancer-free". If participants judge negative outcomes to be less controllable than positive outcomes, but are also more optimistic about negative outcomes, this finding would contradict the view that unrealistic optimism is equivalent to illusions of control (e.g., McKenna, 1993).

Emotions and judgements of risk and control

Unrealistic optimism is resistant to many types of interventions, such as providing accurate information about the prevalence of negative outcomes or having people describe personal risk factors (Weinstein, 1980; Weinstein & Klein, 1995). But people are not completely impervious to relevant information when making risk judgements. For instance, although smokers rate themselves as less likely to succumb to smoking-related diseases than other smokers, they do rate themselves as more susceptible to these diseases than non-smokers (McKenna, Warbuton, & Winwood, 1993). One salient source of information that may alter people's perceptions of risk and control is their emotional state. Emotions have been found to serve as compelling sources of information when making a wide variety of judgements (Epstein & Pacini, 1999; Schwarz & Clore, 1983).

In the current study, we examined the effects of three emotions on judgement. Fear, anger, and happiness were chosen because health promotion messages are often constructed to evoke these emotions in the hope that they will motivate preventive behaviours. Appraisal theories describe the types of appraisals or interpretations of events that typically lead to and follow the experience of specific emotions (e.g., Frijda, 1987; Levine, 1996; Oatley & Johnson-Laird, 1987; Roseman, Antoniou, & Jose, 1996; Scherer, 1984; Smith, Haynes, Lazarus, & Pope, 1993; Smith & Lazarus, 1993; Stein & Levine, 1989). According to appraisal theories, emotions provide information about the status of goals and lead to states of physiological and cognitive readiness to engage in goal-directed action. These action and appraisal tendencies may affect judgements of risk and control, even for events that were not the cause of the emotion (Lerner & Keltner, 2000).

Fear is an emotion that specifically addresses the possibility of the future occurrence of negative outcomes. According to Scherer (1984), fear is evoked by appraisals that a goal has been threatened, the outcome is uncertain, and the individual has little power or control over the situation. Because fearful people are focused on the need to avoid future harm, they should be less optimistic about the future compared to people experiencing other emotions, such as anger and happiness. Consistent with this view, people who were anxious about an upcoming event also rated negative outcomes associated with the event as more likely to occur (Butler & Mathews, 1987; Dewberry, Ing, James, Nixon, & Richardson, 1989). In contrast to fear, happiness and anger are often associated with a focus on goal attainment or reinstatement and with appraisals of certainty and high power or control (e.g., Frijda, 1987; Scherer, 1999). Although there is disagreement about the necessity of appraisals of certainty and control for eliciting anger (e.g., Smith & Lazarus, 1993), anger is often associated with these appraisals. Therefore both happiness and anger might be expected to lead to increases in optimism. Lerner and Keltner (2000, 2001) examined the differing influences of fear, anger, and happiness on risk perception. They found that fearful participants expressed pessimistic risk estimates and tended to avoid risky choices compared to happy and angry participants.

These findings indicate that specific emotions differ in their effects on risk judgements and that fear might be a useful emotion to induce in health promotion materials in order to increase people's perceptions of risk. Because fear is associated with appraisals of low power or control, however, fearful people may also perceive themselves as having less control over negative outcomes. Sturges and Rogers (1996) found that threatening communications were effective in increasing healthy intentions only if people believed they could cope with the danger. If fear decreases unrealistic optimism, but also decreases people's belief that they can control negative outcomes, then evoking this emotion would be of limited use in health interventions.

Emotions, judgement, and memory

To design memorable health promotion messages, the influence of emotions on memory must also be understood. Appraisal theories and motivated reasoning theory lead to contrasting predictions concerning the effects of emotions on memory. According to appraisal and evolutionary accounts, negative information should be remembered well because it frequently has important consequences for survival (Baumeister, Bratslavsky, Finkenauer, & Vohs, 2001; Rozin & Royzman, 2001; Scherer, 1999). People experiencing fear should be particularly attentive to the environment in order to prevent future goal failure. As a result, fearful people would be expected to encode information accurately, particularly negative information that is relevant to the source of their fear (Wessel & Merckelbach, 1998).

Motivated reasoning accounts support very different predictions about the effects of emotions on memory in situations wherein immediate preventative action is not possible. If a threat is immediate, for instance, an onrushing car at a dangerous intersection, then consistent with appraisal accounts, fear should motivate people to avoid the car, survive, and subsequently remember to carefully negotiate the intersection. However, if no immediate threat exists and no immediate action is possible, for instance increased risk of skin cancer due to having neglected to use sunscreen, people may be motivated to ignore or discount threatening information in order to alleviate their fear (Brown, 2001; Rogers, 1975). Consistent with this view, Reed and Aspinwall (1998) found that people in a negative mood remembered less information about a threatening message than people in a happy mood. Thus, people may ignore or forget information in order to repair a negative mood or avoid making it worse.

In the present study, we investigated judgements concerning future outcomes for which no immediate preventative action was possible. Consistent with motivated reasoning accounts, we predicted that participants experiencing fear would recall fewer outcomes than participants experiencing happiness or anger. We further predicted that participants would have poorer memory for outcomes that they judged to be risky and uncontrollable.

The present investigation

This study was designed to extend previous research on emotion, risk and control judgements, and memory. These issues are rarely studied together, yet for any practical intervention utilising emotional materials to be effective, the effects of emotions on all three processes must be understood. Whereas many studies of risk perception have used a gambling paradigm, we asked participants to judge their risk for life and health outcomes so that the results may generalise more readily to health interventions. Participants were assigned to fearful, angry, happy, or neutral emotion-elicitation conditions. They then rated their likelihood

of experiencing positive and negative matched outcomes and their degree of control over each outcome. After a brief delay, they were given a surprise recall test on the outcomes they had rated.

Based on motivated reasoning theory, we predicted that participants would display greater optimism about avoiding negative outcomes than attaining positive outcomes, even though negative outcomes were expected to be judged as less controllable. Although health promotion materials are often designed to evoke fear, appraisal theories of emotion and motivated reasoning theory suggest that this approach may have unintended negative consequences. We predicted that, in comparison to happiness and anger, inducing fear would lead to a decrease in unrealistic optimism, but would also lead to a decrease in participants' judgements of their degree of control over outcomes and to poorer memory for the outcomes. Finally, we predicted that participants would be less likely to recall those outcomes that they judged to be risky and uncontrollable.

METHOD

Participants

A total of 94 undergraduate students in an introductory psychology course participated in the study for course credit (age range: 18–46 years, $M = 20$ years). Of the participants, 76% were female. The ethnic distribution of the participants, closely resembling that of the campus, was 48% Asian Americans, 31% European Americans, 10% Hispanic Americans, 6% Middle East Americans, 3% African Americans, and 2% other.

Procedure

Participants were tested individually for 1 hour in a laboratory on the university campus. Participants were informed that they would be taking part in two separate studies during the experimental session to minimise expectancy effects associated with the emotion elicitation procedure. Based on the debriefing at the conclusion of the experiment, this procedure was effective, as no participants reported suspecting that the two experiments were related.

Participants were randomly assigned to one of four emotion-elicitation conditions (fearful, angry, happy, neutral). They were informed that the first study was designed to explore students' written accounts of life events. Participants recalled a life event in the past 5 years that made them feel intensely fearful, angry, or happy. They were asked to picture the event happening and record the event as vividly as possible with all the important details (Forgas, 1999). Participants in the neutral condition were asked to recall the last time they went grocery shopping and to record all important details. Before and after the emotion elicitation, participants completed a brief mood scale, rating how intensely they felt 13 emotional and physical states on a scale ranging from 1

(*not at all*) to 5 (*extremely*). The states rated were fearful, angry, happy, sad, sleepy, excited, relaxed, curious, anxious, irritated, bored, down, and contented.

The second phase of the experiment was introduced as a separate study. Participants made comparative risk judgements regarding 15 positive and 15 negative matched outcomes (see Appendix). The outcomes, which were presented in a random order, concerned smoking (e.g., remaining lung cancer-free; getting lung cancer), general health (e.g., remaining healthy; becoming ill), terrorism (e.g., being safe if there was a terrorist attack; being injured if there was a terrorist attack), and life events (e.g., remaining happily married; getting a divorce). Thus, participants were asked to make judgements concerning a wide range of possible life events. For each outcome participants were asked: "Compared to the average college student, your same age and gender, what are your chances of outcome (e.g., becoming an alcoholic)?" Participants responded by indicating their comparative risk on a 7-point scale, ranging from -3 (*far below average*) to 3 (*far above average*). This procedure is frequently used in risk perception research (e.g., Price, Pentecost, & Voth, 2002; Weinstein, 1980). Participants were then asked, "How much control do you have over *outcome*?" Participants rated their level of control over each outcome using a 7-point scale ranging from 1 (*very little control*) to 7 (*a lot of control*).

Next, participants completed a brief card sorting distraction task. This was followed by an unexpected memory assessment of the previously rated outcomes. Participants were asked to recall as many of the outcomes as possible. They then completed a final mood rating scale and a demographic survey that included questions concerning participants' prior experience with the outcomes. Finally, participants were debriefed and participants in the negative emotion elicitation conditions watched a happy film clip.

Data analyses

As described above, participants rated their comparative risk on a 7-point scale, ranging from -3 (*far below average*) to 3 (*far above average*). With the exception of one analysis, which is noted below, for all analyses of risk judgements, ratings for negative outcomes were reverse coded to give an equivalent measure of optimism for positive and negative events. Thus, higher scores indicated greater optimism; a score of zero indicated that participants viewed themselves as at the same risk level as the average person; a score less than zero indicated that participants viewed themselves as at greater risk than the average person.

RESULTS

The results section is organised in four parts. First, we checked whether the emotion elicitation procedure effectively evoked the intended emotions. Second, we assessed whether participants displayed unrealistic optimism in their risk

judgements and examined the relations between unrealistic optimism and beliefs about control. Third, we assessed the effects of specific emotions on participants' judgements of risk and control. Finally, we examined participants' memory for the outcomes they had rated, and the relations among participants' emotions, judgements, and memory.

Emotion elicitation

The first set of analyses was conducted to find out whether the emotion elicitation procedure was effective. A one-factor, repeated measures ANOVA was conducted to confirm that, prior to the emotion elicitation procedure, participants did not differ across emotion elicitation conditions in their baseline ratings of fear, anger, and happiness. As expected, the results showed no significant differences in baseline ratings by emotion condition (all $ps > .34$). Table 1 shows the mean intensities of fear, anger, and happiness reported by participants in each emotion condition after the emotion elicitation procedure.

A one-factor, repeated measures ANOVA was conducted to determine if self reported intensity of fear, anger, and happiness differed by condition (fear, anger, happiness, neutral) following the emotion elicitation. A significant interaction was found between intensity ratings and condition, $F(6, 180) = 17.16$, $p < .001$. Table 1 presents individual contrasts between the emotion conditions. The results showed that the emotion elicitation was successful. Participants in the fear condition reported greater fear than participants in the other conditions and participants in the happy condition reported greater happiness than parti-

TABLE 1
Mean and (standard deviation) intensity ratings and post hoc comparisons for fear, anger, and happiness by emotion condition

<i>Intensity rating</i>	<i>Emotion condition</i>	<i>M</i>	<i>(SD)</i>	<i>Contrast</i>	<i>t</i>
Fear rating	Fear	2.32	(1.62)		
	Anger	1.21	(0.51)	fear vs. anger	3.21**
	Happiness	1.21	(0.28)	fear vs. happy	3.05**
Anger rating	Neutral	1.25	(0.53)	fear vs. neutral	3.07**
	Anger	3.04	(1.63)		
	Fear	2.23	(1.90)	anger vs. fear	1.57
	Happiness	1.08	(0.28)	anger vs. happy	5.81***
Happiness rating	Neutral	1.13	(0.34)	anger vs. neutral	5.65***
	Happiness	5.13	(1.36)		
	Fear	2.77	(1.19)	happy vs. fear	6.21***
	Anger	3.54	(1.47)	happy vs. anger	3.87***
	Neutral	4.42	(1.32)	happy vs. neutral	1.83*

Note: Participants rated the intensity of their emotions on a scale ranging from 1 (*not at all*) to 5 (*extremely*). * $p = .07$; ** $p < .01$; *** $p < .001$.

participants in the other conditions. Participants in the anger condition reported greater anger than participants in the other conditions, with the exception that there was no difference in the intensity of anger reported by participants in the anger and fear conditions. Participants also rated their mood at the end of the hour-long experiment to allow us to determine whether the effects of the emotion elicitation had lasted throughout the procedure. In this final manipulation check, no significant differences were found across conditions in the intensities of self-reported fear, anger, or happiness.

Because certain emotions received higher intensity ratings in more than one condition (i.e., anger ratings were elevated in both the anger and fear conditions; happiness ratings were elevated in both the happiness and neutral conditions), we conducted analyses on emotions and judgements in two ways: by emotion condition (using ANOVAs), and by self-reported emotional intensity across all conditions (using regression analyses).

Risk and control judgements for positive and negative outcomes

To find out whether participants displayed unrealistic optimism, we examined whether their mean optimism scores for positive and negative outcomes were significantly greater than zero (average risk). One-sample *t*-tests indicated that, across all emotion-elicitation conditions, participants rated themselves as significantly more likely than average to attain positive outcomes ($M = 0.31$, $SD = 0.68$), $t(90) = 5.45$, $p < .001$, and avoid negative outcomes ($M = 1.03$, $SD = 0.59$), $t(90) = 14.34$, $p < .001$. Although the positive and negative outcomes were different frames of the same events (e.g., “remaining healthy” vs. “becoming ill”), a paired-comparison *t*-test showed that the degree of optimism differed for positive vs. negative outcomes. Participants viewed themselves as more likely to avoid negative outcomes than to attain positive outcomes, $t(89) = 12.99$, $p < .001$.

Some investigators have argued that unrealistic optimism results from illusions of control. To investigate the relation between participants' judgements of risk and control, Pearson's correlations were computed between the two types of judgements for positive outcomes and for negative outcomes. Significant but moderate correlations were found. The more control participants felt they had, the more optimistic they were about attaining positive outcomes, $r(90) = .29$, $p < .001$, and avoiding negative outcomes, $r(89) = .26$, $p < .05$.

To further explore the relation between optimism and judgments of control, a paired-comparison *t*-test was conducted on mean ratings of control for positive vs. negative outcomes. In contrast to their optimism ratings, participants rated themselves as having more control over positive outcomes ($M = 4.30$, $SD = 0.68$), than negative outcomes ($M = 4.03$, $SD = 0.63$), $t(90) = 4.78$, $p < .001$. To compare ratings of optimism and control more directly, control ratings were

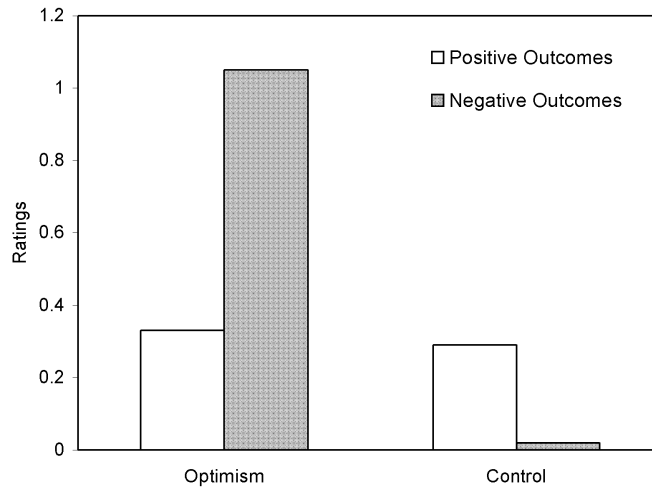


Figure 1. Mean optimism and control ratings for positive and negative outcomes.

recoded on a -3 to $+3$ scale (like the optimism scale) with higher ratings indicating greater control. A repeated measures ANOVA was conducted on participants' mean scores with outcome valence and judgement type (optimism vs. control) as within-subject factors. As Figure 1 shows, an interaction was found between outcome valence and judgement type, $F(1, 87) = 116.12$, $p < .001$. Although participants were more optimistic about avoiding negative outcomes ($M = 1.03$, $SD = 0.59$) than attaining positive outcomes ($M = 0.33$, $SD = 0.58$), they rated themselves as having less control over negative outcomes ($M = 0.03$, $SD = 0.63$) than positive outcomes ($M = 0.30$, $SD = 0.68$).¹

In summary, participants displayed unrealistic optimism concerning both positive and negative outcomes. The more control participants felt they had over the outcomes, the more optimistic they were. However, unrealistic optimism could not be explained solely in terms of beliefs about control because participants were far more optimistic about avoiding negative outcomes than

¹ In comparison to negative outcomes, many positive outcomes depicted lasting states rather than specific events (e.g., remaining happily married vs. getting a divorce). To ensure that the interaction found between outcome valence and judgement type was not actually due to outcome duration, we divided outcomes into lasting states vs. specific events. Participants were more optimistic about negative than positive outcomes for both outcome types, $t_s(90) > 5.75$, $p_s < .001$. Participants rated positive outcomes as more controllable than negative outcomes for lasting states, $t(90) = 2.97$, $p < .01$; control ratings for specific events differed in the same direction, but this difference was not significant, $t(90) = 1.23$, $p = .22$. Thus, differences in outcome duration did not provide a compelling alternative explanation for the findings.

attaining positive ones, even though they rated themselves as having more control over positive outcomes than negative ones.

Effects of emotions on judgements of risk and control

Risk judgements. Figure 2 shows participants' mean optimism ratings for positive and negative outcomes by emotion condition. We predicted that fear would lead to decreased optimism relative to the anger, happiness, and neutral conditions. Preliminary analyses indicated that participants in the anger, happiness, and neutral conditions did not differ significantly in either their risk or control judgements, (all F s < 1.48, p s > .20) so data from participants in these three conditions were combined into one group. We then conducted a repeated-measures ANOVA with participants' optimism scores for positive and negative outcomes as the dependent variables, and emotion condition (fear vs. happiness, anger, and neutral) as the independent variable. The results showed a significant interaction between outcome type and emotion condition, $F(1, 88) = 5.17, p < .05$. Post hoc tests indicated that, when judging the likelihood of negative outcomes, fearful participants were less optimistic ($M = 0.79, SD = 0.78$) than other participants ($M = 1.12, SD = 0.66$), $t(89) = 1.94, p = .05$. When judging the likelihood of positive outcomes, however, no significant difference was found between participants in the fear condition ($M = 0.17, SD = 0.59$) and other participants ($M = 0.39, SD = 0.60$), $p = .13$.

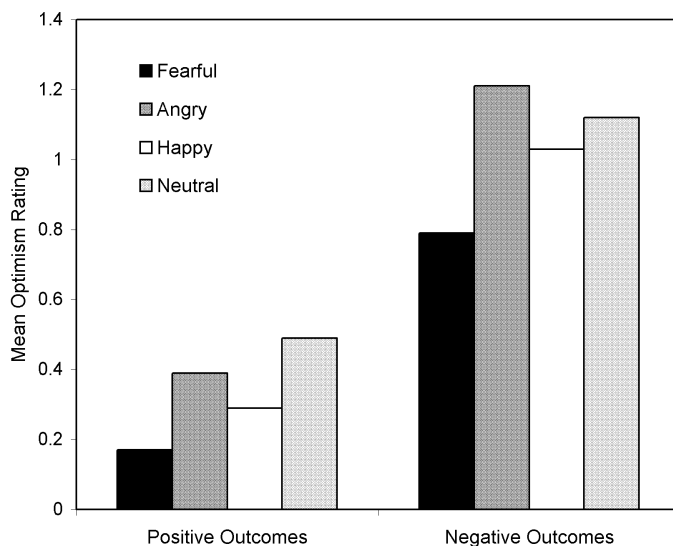


Figure 2. Mean optimism ratings for positive and negative outcomes by emotion condition.

To find out if the intensity of fear reported across emotion elicitation conditions was associated with lower optimism ratings, we conducted two regression analyses. The dependent variables were participants' mean optimism ratings for positive outcomes and for negative outcomes. Self-reported emotional intensities after the emotional elicitation (fear, anger, happiness) were entered simultaneously as predictor variables. The results showed that, the greater the intensity of fear reported, the less optimistic participants were (i.e., the greater their likelihood ratings) when judging the likelihood of negative outcomes, $t(90) = 3.57, p < .05, \beta = .27$. The intensity of fear did not predict optimism concerning positive outcomes ($p = .76$). Intensity ratings for anger and happiness did not predict optimism ratings for negative or positive outcomes.

Control judgements. To investigate the effects of specific emotions on participants' judgements of control, a one-factor, repeated measures ANOVA was conducted. The results showed that perceived control over positive and negative outcomes did not differ by emotion condition. To find out if the intensity of fear reported across emotion elicitation conditions was associated with judgements of control, we again conducted two regression analyses. The dependent variables in these analyses were participants' mean control ratings for positive outcomes and for negative outcomes. Self-reported emotional intensities after the emotion elicitation (fear, anger, happiness) were entered simultaneously as predictor variables. The results showed that the greater the intensity of fear reported, the less control participants felt they had over both negative outcomes, $t(90) = -2.16, p < .05, \beta = -.14$, and positive outcomes, $t(89) = -2.59, p < .05, \beta = -.17$. Intensity ratings for anger and happiness did not predict participants' control judgements.

In summary, participants in whom fear had been induced were less optimistic about the likelihood of avoiding negative outcomes than were other participants. Moreover, across emotion conditions, the greater the intensity of fear reported, the less optimistic participants were about the likelihood of avoiding negative outcomes and the less control participants believed they had over both negative and positive outcomes.

Emotions, judgements, and memory

Participants were given a surprise memory test in which they were asked to recall all of the outcomes that they had previously rated. Analyses were conducted on the total number of positive and negative outcomes recalled, and on the number of positive and negative intrusion errors (i.e., recalling a positive or negative outcome that had not been presented, for example, "finding a job" or "being fired").

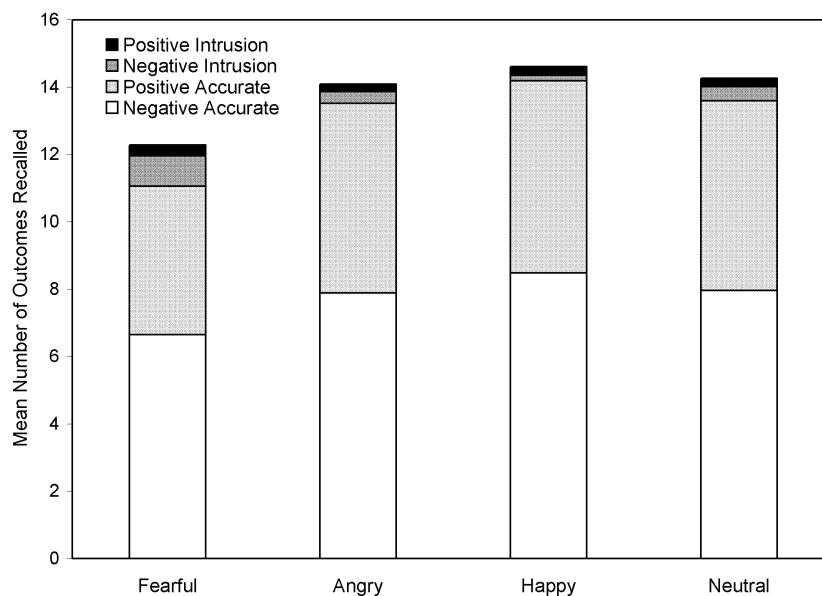


Figure 3. Mean number of positive and negative outcomes recalled, and positive and negative intrusion errors, by emotion condition.

Effects of specific emotions on memory. Figure 3 shows recall performance by emotion condition. Preliminary analyses revealed no significant differences between the happy, angry, or neutral conditions on any recall measure (all p s > .78), therefore, the data from participants in the anger, happiness, and neutral conditions were combined into one group. We then conducted a one-factor, repeated measures ANOVA to find out whether participants in the fear condition differed from other participants with respect to the mean number of outcomes recalled. The results showed that participants in the fear condition recalled fewer outcomes ($M = 12.18$, $SD = 3.11$) than other participants ($M = 14.08$, $SD = 3.93$), $F(1, 92) = 4.32$, $p < .05$.² In addition, across emotion conditions participants

² Preliminary analyses revealed no significant differences among the anger, happiness, and neutral conditions with respect to the number of outcomes recalled, control judgements, or risk judgements. In subsequent analyses, we combined participants from these three conditions because of our theoretical interest in contrasting the effects of fear with emotional states likely to differ from fear on appraisals of certainty and control. When analyses were conducted including each emotion condition separately, the results were similar to those reported: A significant effect of condition was found for recall, $F(3, 90) = 3.23$, $p < .05$, and no significant effect of condition was found for control judgements. The one exception was that, for risk judgements, the effect of emotion condition did not reach significance, $F(3, 86) = 2.04$, $p = .11$.

recalled more negative outcomes ($M = 8.22$, $SD = 2.60$) than positive outcomes ($M = 5.63$, $SD = 2.52$), $F(1, 91) = 39.22$, $p < .001$.

We also conducted a repeated measures ANOVA to find out whether the number of positive and negative intrusion errors differed by emotion condition. The results showed that participants in the fear condition made more intrusion errors ($M = 1.36$, $SD = 1.43$) than did other participants ($M = 0.55$, $SD = 1.17$), $F(1, 91) = 7.31$, $p < .01$. In addition, across emotion conditions, participants made more negative intrusion errors ($M = 0.91$, $SD = 0.97$) than positive intrusion errors ($M = 0.45$, $SD = 0.74$), $F(1, 91) = 7.33$, $p < .01$.

In summary, as predicted, participants in whom fear had been induced recalled fewer outcomes than other participants. Fearful participants also made more errors in the outcomes they did recall. Across emotion conditions, negative outcomes were recalled more frequently than positive ones, and intrusion errors were more often negative than positive.

Risk and control judgements and memory. A final set of analyses was conducted to assess the relations between participants' risk and control judgements concerning outcomes and their memory for those outcomes. For each participant, mean optimism and control ratings were computed for remembered and forgotten outcomes. Paired-comparison *t*-tests contrasting remembered and forgotten outcomes showed that participants were more optimistic about remembered outcomes ($M = 0.77$, $SD = 0.76$) than forgotten outcomes ($M = 0.42$, $SD = 0.51$), $t(90) = 6.04$, $p < .001$. Remembered outcomes were also judged as more controllable ($M = 3.63$, $SD = 1.80$) than forgotten outcomes ($M = 3.35$, $SD = 1.63$), $t(90) = 3.74$, $p < .001$.

To further explore this finding, we conducted a logistic regression analysis, which allowed us to examine the relation between risk and control judgements and memory for individual outcomes. The dependent variable was whether an outcome was recalled or forgotten. Risk judgement, control judgement, and outcome valence were entered simultaneously as predictors. The results showed that the adjusted odds of recalling an outcome were greater with increasing optimism (OR = 1.10, CI: 1.04 to 1.15, $p < .01$) and with increasing control (OR = 1.09, CI: 1.05 to 1.14, $p < .01$). The adjusted odds of recalling an outcome were also more for negative outcomes than positive outcomes (OR = 1.89, CI: 1.83 to 1.97, $p < .01$). Thus, people recalled those outcomes for which they were optimistic and felt they had greater control. This finding held for optimism judgements for positive and negative outcomes, although people also remembered more negative outcomes.

DISCUSSION

People generally believe that they will attain positive outcomes and avoid negative outcomes. This belief is one of the primary reasons that people do not take necessary measures to protect themselves from risks (Roysamb, 1997;

Salovey et al., 2000). Although unrealistic optimism is difficult to alleviate, emotions may serve as a salient source of information that alters risk perceptions. Specifically, fear may heighten perceptions of risk. However, inducing fear to make people aware of their risk may have unintended negative consequences, such as a reduction in perceived control and poorer memory for risk information. Because emotions are often utilised in health communications, it is important to understand how they influence judgements and memory. The present study was designed to investigate the effects of fear on risk and control judgements and memory and the relations among these processes.

Unrealistic optimism and control judgements

Unrealistic optimism has been demonstrated in many groups of people and under a wide variety of circumstances (e.g., Bauman & Siegel, 1987; Dewberry et al., 1989; McKenna et al., 1993; Weinstein, 1980, 1987). Consistent with previous findings, participants in the current study displayed unrealistic optimism, reporting that they were more likely than the average person to attain positive outcomes and avoid negative ones. According to McKenna (1993), the influence of optimism on judgements stems from illusions of control. Indeed, investigators often ask people to rate how much control they have over outcomes as a measure of perceived risk (e.g., Reed & Aspinwall, 1998; Roysamb, 1997). The assumption that judgements of risk and control are equivalent, however, is based on studies that included only negative outcomes. In the current study, we investigated the relation between risk and control judgements by having participants judge positive and negative versions of the same events. Motivated reasoning theory suggests that people maintain optimistic beliefs about threatening events in order to guard against the unpleasant feelings evoked by considering themselves to be at risk (Kunda, 1990, 2000; see also Rogers, 1975). Because negative outcomes are more threatening, but often less controllable, than positive outcomes, we expected that including both types of outcomes would highlight the disparities between judgements of risk and control.

We found a moderate correlation between judgements of risk and control for both negative and positive outcomes. The more control participants felt they had, the more optimistic they were. However, participants' judgements of risk and control were not equivalent. As predicted, participants were more optimistic about avoiding negative outcomes than attaining positive outcomes, even though they felt they had less control over negative outcomes than positive outcomes. In their judgements of the likelihood of avoiding negative events, participants appeared to be defending against a lack of perceived control by believing themselves to be at low risk, akin to the statement: "There's nothing I can do about it anyway, so why worry about it?" Because negative outcomes are more threatening and salient, people may want to believe they are at lower risk in order to maintain a positive mood. These findings indicate that researchers should not assume that control judgements are a good proxy for risk evaluations.

They also suggest that framing health interventions as positive outcomes or gains rather than losses (Rothman & Salovey, 1997) may be more effective for minimizing unrealistic optimism and maximising judgements of control.

Emotions and judgements of risk and control

Our second goal was to assess the effects of fear, anger, and happiness on risk and control judgements. Appraisal theories posit that emotions signal changes in the status of goals and motivate the types of thinking and action needed to maintain or reinstate goals (e.g., Levine, 1996; Scherer, 1999). Fear is evoked when people perceive that their goals are in jeopardy and the future is uncertain. Consistent with this view, we found that participants in whom fear had been induced were less optimistic about negative outcomes than participants in the other emotion conditions. Moreover, across all participants, the greater the intensity of fear reported, the less optimistic participants were about avoiding negative outcomes. This finding is consistent with those of Lerner and her colleagues (Lerner, Gonzalez, Small, & Fischhoff, 2003; Lerner & Keltner, 2000, 2001), who found that fear was associated with pessimistic risk estimates and anger was associated with optimistic risk estimates.

Considered in isolation, these findings suggest that fear inducing health messages would be useful for heightening sensitivity to risks. Appraisal theories also hold, however, that people experiencing fear feel they have little control over outcomes. In the current study, participants in the fear-elicitation condition did not differ in control ratings from other participants. Why did the fear-elicitation procedure affect judgements of risk but not control? A mood check at the end of the study showed that elicited emotions did not last throughout the hour-long procedure. Experimentally elicited fear may have dissipated by the time participants rated the controllability of the outcomes. Regression analyses indicated, however, that across all emotion conditions, the greater the intensity of fear reported, the less control participants felt they had over both positive and negative outcomes. People who feel they have less control over a threatening event are less likely to take action (Salovey et al., 2000). Therefore, even if health promotion messages that elicit fear heighten people's feelings of vulnerability, they may not be effective in getting people to alter risky behaviours.

The fact that participants in all emotional states displayed unrealistic optimism is evidence of the strength of the phenomena.³ Although inducing fear resulted in a reduction in unrealistic optimism, the phenomenon was not

³ Schneider (2001) states that people are unrealistically optimistic when they rate uncertain future events, but realistic when events are familiar. In our study, participants who had experienced alcoholism and depression reported they were less likely than the average person to experience these recurrent diseases, $F_s(1,92) > 7.68, ps < .001$. Thus, participants displayed unrealistic optimism even for familiar outcomes.

eliminated. Some theorists have argued that positive illusions, including unrealistic optimism, are necessary for mental health and success (Taylor & Brown, 1988). Therefore, maintaining a general sense of optimism about the future may be healthy and impossible to eliminate completely through any intervention. Complete elimination of unrealistic optimism may be associated with depression and anxiety, a side effect that outweighs any benefit to be gained from such an intervention.

Emotion, Judgement, and Memory

If people are to act on an intervention message, they must also remember the message. Previous research has documented enhanced attention to and memory for fear-inducing stimuli, sometimes at the expense of memory for threat-irrelevant details (Cahill, Roosendahl, & McGaugh, 1997; Levine & Pizarro, 2004; Reisberg & Heuer, 2004; Wessel & Merckelbach, 1998). In the current study, participants did attend to and remember negative information. They recalled more negative than positive outcomes, and made more negative than positive intrusion errors. When an action is not immediately available to alleviate a threat, however, people that are afraid may choose to improve their negative mood by ignoring the information (Brown, 2001; Kunda, 1990, 2000). As predicted, we found that participants in whom fear had been induced recalled less information and were less accurate, recalling information that had not been presented.

In the current study, fear was elicited using an autobiographical memory task that was independent of the outcomes to be remembered. It is possible that fearful individuals showed poorer memory for these outcomes because they were irrelevant or peripheral to the source of their fear. This issue was addressed in part by investigating the relation of optimism and control judgements to memory. Participants showed better memory for outcomes about which they were more optimistic and perceived as more controllable; they were more likely to forget outcomes they perceived as threatening. These findings, and the finding that induced fear led to poorer recall, are consistent with motivated reasoning theory, which holds that people attempt to alleviate negative emotions by selectively remembering information.

The fact that participants forgot outcomes they found more threatening may be indicative of a problem for health interventions directed toward increasing people's awareness of their vulnerability to health risks. Poorer memory for threatening outcomes may have resulted because the information to be recalled concerned possible future threats rather than present threats, and no immediate action was available for coping with the threats (e.g., having a heart attack). When people cannot act, they may alleviate or avoid negative emotions by ignoring information (Brown, 2001; Kunda, 1990), whereas when an immediate action is available, people may remember information about health risks. In

future studies, researchers might assess whether the presence of information about immediate preventative actions enhances memory for threatening information. Another issue for future investigation is whether forgetting risk information leads to improvement in subsequent mood.

Recommendations and limitations

This study extended previous research by examining optimism, control judgements, and memory together, and by examining interactions among these processes. It would be useful for future work to further differentiate how optimism and control judgements predict subsequent behaviour. Limitations of this study should also be noted. Importantly, the emotion induction was not related to the outcomes people were asked to rate. In a practical intervention, the emotional material would most likely surround and possibly contain the health message. For instance, a commercial focused on smoking would induce fear by conveying threatening negative consequences of smoking. Therefore, future research should assess the effects of specific emotions on risk perception, control perception, and memory when the emotions are elicited by the health message. It is possible that the effects of fear on memory would be different if the fear-eliciting stimulus and the recalled information were the same. Also, the current findings concern brief emotions that might be induced while processing health messages. The effects of emotion on risk judgements may differ when the emotions are part of a chronic affective disorder (Salovey, et al., 2000).

Implications for health promotion messages

Recently, there has been an increase in research exploring the role of emotions in facilitating risk communication (Roysamb, 1997). This approach is promising because emotions are a salient source of information. A clearer understanding of the effects of specific emotions on risk perception and behaviour could help reduce the number of people that suffer preventable health problems. For any practical intervention to reduce risky behaviour or increase preventive behaviour, people must feel they are at risk, have control over their behaviour, and remember the message. The current findings demonstrate that inducing fear increases feelings of vulnerability to risks, but at the cost of decreased feelings of control and poorer memory for risks that may be perceived as distant. Therefore, inducing fear alone in health promotion messages may not be an effective means of reducing risk behaviour. This is contrary to the common conception that people must be scared to take a message seriously, but it supports previous findings that evoking a high level of fear is not useful for practical interventions (Janis & Feschbach, 1953).

It may be useful to elicit different emotions in specific phases of an intervention procedure. Inducing fear would be useful in the stage of health promotion messages designed to convey risks but must be accompanied by

interventions dedicated to enhancing feelings of self-efficacy and information retention. Inducing happiness or anger may be effective during a phase of the intervention that provides information about what people can do to reduce their chances of experiencing negative outcomes (e.g., Reed & Aspinwall, 1998). In addition, providing people with an immediate action to alleviate the threat may help them take the message seriously and remember the information. Exposure to accurate information alone has repeatedly been found ineffective in changing risky behaviours (Bauman & Siegel, 1987). These findings are a step toward identifying strategies to help people recognise the need to protect themselves from the dangers inherent in many behaviours.

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APPENDIX
Comparative risk judgements

<i>Positive outcomes</i>	<i>Negative outcomes</i>
<i>A. Smoking related</i>	
Being able to breathe easily throughout life	Getting emphysema
Remaining lung cancer-free	Getting lung cancer
If I smoke, suffering no serious effect	Becoming ill from smoking
Staying cardiovascularly fit	Getting heart disease
<i>B. General health</i>	
Remaining healthy	Becoming ill
Staying happy	Becoming depressed
If I drink, suffering no serious effect	Becoming alcoholic
Having a healthy child	Having a child with a physical disability
<i>C. Terrorism</i>	
Being safe from bioterrorist disease	Being exposed to anthrax
Being safe from a missile attack	Experiencing a missile attack
Being safe if there was a terrorist attack	Being injured if there was a terrorist attack
<i>D. Life events</i>	
Avoiding being sued	Being sued
Remaining happily married	Getting a divorce
Completing college	Dropping out of college
Choosing a career I love	Being unhappy in my career

