

Emotions and Preventive Health Behavior: Worry, Regret, and Influenza Vaccination

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The role of worry, regret, and perceived risk in preventive health decisions was explored in a longitudinal questionnaire study on influenza vaccination among 428 university employees. The study yielded 3 main findings. First, ratings of anticipated worry and regret were stronger predictors of vaccination than perceived risk and mediated the effect of risk on vaccination. Second, the anticipated level of emotions differed systematically from experienced emotions, such that vaccinated individuals anticipated more regret and less worry than they actually experienced. Third, anticipated and experienced emotions had implications for subsequent vaccination decisions. Those who did not vaccinate in the 1st year but had high levels of worry and regret were likely to be vaccinated the following year.

Keywords: emotions, perceived risk, influenza vaccination, health behavior

Recently, the role of emotion in decisions about preventive health behaviors has been a topic of increasing interest. For example, several theories of preventive health behavior posit a central role for emotions, including the *common sense model* (Leventhal, Diefenbach, & Leventhal, 1992), which postulates that decision makers seek to regulate not only the health threat but also their own emotional response, and the *cognitive–social health information processing (C-SHIP) model* (Miller, Shoda, & Hurley, 1996), which lays out the conditions under which affective states decrease or increase preventive health behaviors. Theories of decision making have also recently focused on affect. Examples include *decision affect theory* (Mellers & McGraw, 2001; Mellers, Schwartz, & Ritov, 1999), in which choices are guided by the anticipated emotional reaction to consequences; the *affect heuristic* (Slovic, Finucane, Peters, & MacGregor, 2002), in which fast, intuitive, affective processes guide decision making in situations of stress or cognitive load; and the *risk-as-feelings hypothesis* (Loewenstein, Weber, Hsee, & Welch, 2001), which proposes that anticipatory emotion experienced at the point of decision making often drives behavior, rather than a cognitive assessment of the risks.

The current article examines the role of two specific emotions—worry and regret—in the decision to engage in the preventive health behavior of accepting a free influenza vaccine (flu shot). Specifically, we address the question of whether anticipated worry

and regret mediate the association between cognitive appraisals of risk and preventive health behavior. In addition, we examine people's accuracy in forecasting their emotional experience and consider how predicted, experienced, and mispredicted emotional experiences influence decisions about subsequent preventive health behavior.

Our first research question addresses the relationship of worry and regret to risk likelihood and severity and to flu vaccination. Specifically, we hypothesized that worry and regret mediate the relationship of risk likelihood and severity to vaccination. The risk-as-feelings hypothesis and the affect heuristic would predict that cognitive assessments of risk likelihood and severity have their influence on behavior at least in part by way of emotions such as worry and regret. Indeed, emotion can cause behavior to depart from what would be expected merely on the basis of cognitive assessments of risk.

Our mediation hypothesis entails the idea that worry and regret are related to estimates of risk likelihood and severity and that all of these constructs are related to preventive health behavior. Previous research has indeed demonstrated that worry is correlated with risk estimates (Cameron & Diefenbach, 2001; Constans, 2001; Easterling & Leventhal, 1989; McCaul, Canevello, Mathwig, & Klein, 2003), although sometimes this relationship is modest (Sjöberg, 1998). In addition, worry is related to preventive health behaviors; for example, cancer worry predicts cancer screening (Diefenbach, Miller, & Daly, 1999; McCaul, Branstetter, O'Donnell, Jacobson, & Quinlan, 1998; McCaul, Schroeder, & Reid, 1996), and it predicts interest in genetic testing even after controlling for risk perception (Cameron & Diefenbach, 2001). Similarly, anticipated regret drives preventive behaviors such as condom use (Richard, de Vries, & van der Pligt, 1998; van der Pligt & Richard, 1994), exercise (Abraham & Sheeran, 2003), and childhood immunization (Connolly & Reb, 2003; Wroe, Turner, & Salkovskis, 2004). Finally, estimates of risk likelihood and severity are often related to preventive behaviors such as vaccination (for reviews, see Chapman & Coups, 1999; McCaul, Branstetter, Schroeder, & Glasgow, 1996).

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Little previous attention, however, has been paid to the question of whether worry and regret mediate the relationship between risk assessments and preventive behavior. In the only study that, to our knowledge, assessed such a mediation relationship, Cameron and Diefenbach (2001) examined women's interest in genetic testing for breast cancer. They measured perceived likelihood of getting breast cancer and worry about getting breast cancer. The results showed that worry mediated the association between risk perception and interest in genetic testing. In the current study, we tested whether both worry and regret mediate the relationship of perceived risk likelihood and severity to flu vaccination.

The second research question addressed by the current study is how accurately decision makers predict the worry and regret they will feel later during the winter after vaccinating or not. To evaluate the emotional outcomes of receiving the flu shot, decision makers must predict what emotions they will experience as a consequence of getting the shot. Will they experience peace of mind, or will they continue to worry? Recent research on affective forecasting has indicated that decision makers are not always accurate at predicting their emotional response to future outcomes (e.g., Gilbert & Wilson, 2000; Gilbert, Morewedge, Risen, & Wilson, 2004; Loewenstein & Schkade, 1999). For example, Sieff, Dawes, and Loewenstein (1999) found that 5 weeks after receiving a negative HIV test result, people did not feel as relieved as they had anticipated they would feel.

In the current study, during the fall, decision makers were asked how much they would worry about the flu and how much regret they would feel if they got the flu—measures of anticipated emotion. The following spring, decision makers were asked how much worry and regret they had actually experienced during the previous winter. The literature on affective forecasting indicates that the judgments of experienced emotion may differ systematically from the previous judgments of anticipated emotions.

Although affective forecasting has been examined in a number of domains, the Sieff et al. (1999) study is the only previous study to examine it in a preventive health behavior context. Affective forecasting is important to an understanding of decision making about preventive health behaviors because emotional benefits (e.g., peace of mind) are a large incentive for engaging in such behaviors. If people do not experience the emotions they anticipated feeling as a result of engaging in preventive health behavior, they may discontinue the behavior.

Many preventive behaviors, such as getting the flu shot, are (or can be) repeated regularly. Thus, emotions experienced as a result of one decision about whether to engage in the preventive behavior might influence subsequent similar decisions. A third research question addressed by the current study concerns how emotions anticipated and experienced in a given year affect subsequent decisions about preventive behavior. Examination of this research question extends current research on affective forecasting.

Method

Participants

The current study was part of the Health Promotion at Work longitudinal study of university employees. The participants were faculty and staff of two universities in New Jersey. All were offered free flu shots on campus by their employer in October and November of each year. Participants were mailed questionnaires each fall and spring from Fall 2001 to Fall 2002 (a total of three questionnaires).

In late November 2001, questionnaires were mailed to 1,027 employees at an arts and sciences university and to 438 employees of a neighboring medical school. Some (190) of the arts and sciences employees had completed a previous longitudinal questionnaire study during the 2 years prior to the current study. The remaining employees were randomly selected from a list of employees working in buildings close to one of the campus health centers that dispensed the flu shot. Random selection was subject to the constraint that 30% of the sample of 1,027 was faculty and 70% was staff (the same percentages as in the university population at large) and that equal numbers of men and women were selected within the faculty and staff categories. Medical school employees were randomly selected from a list of employees who worked in clinical departments where staff have contact with medical patients. Random selection was subject to the constraint that 40% of the sample of 438 were physicians and 60% was nonphysician staff (comparable to the percentages in the medical school at large) and that equal numbers of men and women were selected within the physician and nonphysician categories. Of the 1,465 people who were mailed the Fall 2001 mailing, 673 completed the Fall 2001 questionnaire (a 46% response rate), and 434 completed all three questionnaires (30% of the original sample).

Procedure

In each of the three questionnaire waves, participants were mailed a warning postcard 1 week before the questionnaire mailing. The questionnaire mailing contained a questionnaire booklet along with a cover letter, a return envelope, and a small incentive gift. For each wave, participants who returned completed questionnaires were entered into a lottery with a 1 in 6 chance to win \$60. Those who did not win the lottery were given compensation gifts of ice cream or movie gift certificates. Participants who did not respond within 2 weeks received a reminder postcard. Those who did not respond by 1 week later received a reminder phone call or e-mail and a second copy of the questionnaire. Fall questionnaires were mailed in late November of each year so that any participants who were going to get vaccinated that fall would almost assuredly have done so by the time they received the questionnaire. The spring questionnaire was mailed in early April, following the end of flu season.

Measures

The questionnaire items used in the present study are summarized in Table 1. The complete wording of the items is available at <http://www.rci.rutgers.edu/~hpaw/hpaw/emotions.html>. As shown in Table 1, each fall, participants were asked if they had received a flu shot (vaccination), and in the spring they were asked if they intended to receive a flu shot the following fall (intention). The risk and emotion variables assessed in Fall 2001 were used to predict vaccination assessed in Fall 2001 (a cross-sectional prediction) as well as intention assessed in Spring 2002 and vaccination assessed in Fall 2002 (prospective predictions).

Three items assessed perceived risk in Fall 2001. Two of these assessed likelihood and one assessed severity of the flu. Participants were asked about their perceived likelihood of getting the flu if they were to get the flu shot or were not to get the flu shot. Responses to both of these likelihood questions were given on an 11-point scale that ranged from 0% to 100% in 10% increments. Risk likelihood estimates were estimated conditional on getting the flu shot and conditional on not getting the flu shot, as these two items are predicted to have opposite relationships to vaccination (Weinstein & Nicolich, 1993). Participants were predicted to get vaccinated if they think they have a high risk of flu if they do not get the flu shot and a low risk of flu if they do get the flu shot. Participants were also asked how severe they thought the flu would be, if they were to get it. Responses were made on a 5-point Likert-type scale. Perceived severity was conditional on not receiving the flu shot.

Four items assessed anticipated emotions in Fall 2001. Participants were asked how worried they would be about the flu if they were to get the shot

Table 1
Time of Measurement of Study Variables

Item description	Time of measurement		
	Fall 2001	Spring 2002	Fall 2002
Vaccination			
Flu vaccination	x		x
Intention to vaccinate		x	
Perceived risk			
Likelihood of flu without flu shot	x		
Likelihood of flu with flu shot	x		
Severity of flu without flu shot	x		
Worry			
Anticipated worry if no flu shot	x		
Anticipated worry if get flu shot	x		
Experienced worry about getting flu		x	
Regret			
Anticipated regret if no flu shot and get flu	x		
Anticipated regret if get flu shot and get flu	x		
Experienced regret about getting/not getting flu shot		x	

or not get the shot. As with the risk likelihood items, these two worry items elicited ratings conditional on getting the flu shot and on not getting the flu shot. In addition, participants were asked how much regret they would feel during the coming winter if they were to get (or not get) the shot and subsequently get the flu. Responses to the worry and regret items were made on 5-point Likert-type scales.

To simplify analyses and presentation, we converted likelihood, worry, and regret ratings to difference scores. A risk likelihood difference score was computed as the perceived likelihood of flu if not vaccinated minus the perceived likelihood of flu if vaccinated—in essence, the risk likelihood reduction resulting from vaccination. Analogous difference scores were computed for worry and regret ratings, indicating the amount of worry and regret reduction resulting from vaccination.

Anticipated emotion was operationalized as follows. For participants who received a flu shot in Fall 2001, anticipated worry was defined as rated worry conditional on getting the shot. For participants who did not receive a flu shot, anticipated worry was defined as rated worry conditional on not getting the shot. Anticipated regret was similarly defined.

Two items assessed experienced emotions in the spring. Participants were asked how worried they were about the flu during the past winter. The 5-point response scale was the same as that used for the anticipated worry items. Experienced regret was assessed by asking participants whether they felt pleased or felt regret at having (not) received a flu shot the previous fall (this question was the only item to use wording specific to each participant's vaccination status). The 5-point Likert-type response scale ranged from *very pleased* to *much regret* and differed somewhat from that used for the anticipated regret item so that the experienced regret item could be asked of all participants, regardless of whether they reported having the flu.

Results

Of the 434 participants who completed all three waves of the study, 6 were excluded because of missing data on one or two of the three dependent variables (vaccination in each of two falls and intention to vaccinate in the spring). This left 428 participants in the analyses. Of these, 16 were missing one or two of the independent variable measures. These missing values (0.4% of the data) were replaced with item means, allowing all analyses to be based on the same *N*.

The mean age of participants was 46 (range = 23–72), 58% were female, and 81% were White. The median annual household income category was \$75,000–\$100,000, 46% of participants had administrative or clerical–secretarial positions, 23% were nonclini-

cal faculty, 17% were clinical health care personnel, and 14% were service–maintenance or technical staff.

Table 2 shows the means and standard deviations for each of the main measures. Results are shown separately for participants who did and did not vaccinate in Fall 2001. In Fall 2001, 50% of participants reported receiving a flu shot, and in Fall 2002 50% of participants reported being vaccinated. In Spring 2002, 57% of participants said they intended to get a flu shot the following fall. The vaccination and intention measures were strongly correlated with one another ($r_s = .70-.77$, $N = 428$). In Spring 2002, 15% of participants reported having had the flu during the previous winter.

Perceived Risk, Anticipated Emotion, and Vaccination Decisions

Relationship between perceived risk items and anticipated emotion items. The first research question concerned whether the anticipated emotion items mediated any relationship of risk likelihood and severity to vaccination. We tested this research question using mediational analysis (Baron & Kenny, 1986). One criterion for such a mediation relationship is that the emotion items must be correlated with the risk likelihood and severity items. Thus, we examined the relationship between the perceived risk items and the anticipated worry and regret items assessed in the Fall of 2001. As explained earlier, likelihood, worry, and regret ratings were converted to difference scores that expressed the extent to which risk likelihood, worry, and regret were expected to be reduced by vaccination. As shown in Table 3, perceived risk likelihood reduction was correlated with anticipated worry and regret reduction. Perceived risk severity (which is not a difference score) was also correlated with anticipated worry and regret reduction.

Relationship of perceived risk and anticipated emotion items to vaccination. A second criterion of the mediation relationship is that risk likelihood and severity, as well as anticipated worry and regret, should predict vaccination. We therefore examined how well perceived risk and anticipated emotions assessed in Fall 2001 predicted vaccination measured at the same time, intention to vaccinate measured in Spring 2002, and vaccination measured in Fall 2002. Again, with the exception of risk severity, the predictor

Table 2
Mean and Standard Deviation of Variables at Each of Three Time Points for Participants Who Did and Did Not Vaccinate in Fall 2001

Variable	2001 flu vaccination status					
	Vaccinators (n = 214)			Nonvaccinators (n = 214)		
	M	%	SD	M	%	SD
Fall 2001						
Likelihood reduction ^a	33.86		22.29	10.57		22.63
Severity of flu ^b	3.50		0.92	2.80		1.05
Worry reduction ^c	1.61		1.36	-0.13		1.31
Regret reduction ^c	1.29		1.66	-0.81		1.85
Anticipated worry ^b	1.63	0.73	1.84	0.95		
Anticipated regret ^b	2.81		1.48	2.50		1.24
Spring 2002						
Experienced worry ^b	2.24		1.14	1.93		0.97
Experienced regret ^b	1.50		0.79	2.52		1.04
Intention to vaccinate		96			18	
Fall 2002						
Vaccination		86			14	

^a Difference score on a scale ranging from -100 to +100. ^b Measured on a 5-point scale (ranging from 1 to 5). ^c Difference score on a scale ranging from -4 to +4.

variables used were difference scores: perceived risk likelihood or anticipated emotion conditional on nonvaccination minus perceived risk likelihood or anticipated emotion conditional on vaccination.

The top portion of Table 4 shows the simple correlations between each predictor variable and each vaccination dependent variable. Risk and emotion predictor variables were moderately correlated with all three dependent measures. The higher the perceived risk severity and the larger the reduction in risk likelihood, worry, or regret expected to result from vaccination, the more likely was the participant to (intend to) vaccinate.

The final criterion of a mediation relationship is that risk likelihood reduction and severity should be less predictive of vaccination after statistically controlling for anticipated worry and regret reduction. The bottom portion of Table 4 shows the results of logistic regression analyses that assessed this step. The regression coefficients shown are log odds ratios (ORs). Vaccination was a dichotomous variable (yes-no). Intention was a trichotomous variable (yes-unsure-no) that we dichotomized by grouping the *unsure* response with the *no* response, in order to make it more analogous to vaccination. For each dependent variable, one regression (Model I) included only risk likelihood reduction and risk

severity as predictor variables. Both risk likelihood reduction and risk severity were significant predictors of each of the three vaccination dependent variables. A second regression (Model II) included risk likelihood reduction and severity, worry reduction, and regret reduction as predictor variables. Two results indicate mediation. First, when all four predictors are included in the model, worry and regret reduction were still predictors of vaccination; indeed, they were better predictors than risk likelihood reduction and severity. Second, the regression coefficients for risk likelihood reduction and severity were reduced when worry and regret reduction were added to the model, indicating that worry

Table 3
Pearson Product-Moment Correlations of Perceived Risk Items and Anticipated Reduction in Worry and Regret in Fall 2001

Emotion measure	Perceived risk measure	
	Likelihood reduction	Severity
Anticipated worry reduction	.64**	.46**
Anticipated regret reduction	.42**	.45**

Note. N = 428.
** p < .0001.

Table 4
Relationship of Flu Vaccination and Flu Vaccination Intention to Perceived Risk, Worry, and Regret

Predictors (Fall 2001)	Vaccination (Fall 2001)	Intention (Spring 2002)	Vaccination (Fall 2002)
Zero-order correlations			
Likelihood reduction	.46**	.49**	.42**
Severity of flu	.33**	.39**	.31**
Anticipated worry reduction	.55**	.57**	.49**
Anticipated regret reduction	.51**	.57**	.48**
Regression Model I			
Likelihood reduction	.44**	.52**	.38**
Severity of flu	.42*	.61**	.37*
Regression Model II			
Likelihood reduction	.21*	.28*	.19*
Severity of flu	.05	.26	.05
Anticipated worry reduction	.61**	.69**	.45**
Anticipated regret reduction	.47**	.66**	.42**

Note. The top portion of the table shows the simple correlations between each predictor variable and each vaccination dependent variable. The bottom portion shows the results of logistic regression analyses; the regression coefficients shown are log odds ratios.
* p < .05. ** p < .0001.

and regret reduction partially mediated the relationship between perceived risk likelihood reduction and the decision (or intention) to vaccinate and fully mediated the relationship between perceived risk severity and vaccination.

These results indicate that anticipated worry and regret reduction together mediated the relationship of perceived risk likelihood reduction and severity to vaccination, suggesting that emotions are the more proximal driver of preventive behavior.¹ Specifically, the greater the perceived risk likelihood reduction and severity, the greater the anticipated reduction in worry and regret, which in turn was linked with a higher likelihood of vaccination and intention to vaccinate.

Anticipated and Experienced Emotions

The second research question was whether anticipated emotions rated in the fall would correspond to experienced emotions assessed in the spring. As explained earlier, for participants who received a flu shot in Fall 2001, anticipated worry (regret) was defined as rated worry (regret) conditional on getting the shot. For participants who did not receive a flu shot that fall, anticipated worry (regret) was defined as rated worry (regret) conditional on not getting the shot. In the Spring of 2002, all participants rated how much they had actually worried about the flu and how much regret they had actually experienced during the preceding winter.

We examined mean levels of anticipated and experienced emotion. Figure 1 shows the mean anticipated and experienced worry and regret ratings for participants who got the flu shot and those who did not. Mean ratings are on a 5-point (1 to 5) scale where higher numbers indicate more worry or regret. The top panel shows worry ratings, and the bottom panel shows regret ratings.

Consider the top panel. For participants who got the flu shot, experienced worry was higher than anticipated worry, whereas for those who did not get the flu shot, mean experienced worry was comparable to mean anticipated worry. Worry ratings were subjected to a 2 (vaccination status) \times 2 (anticipated vs. experienced emotion) analysis of variance (ANOVA), with the first factor between subjects and the second factor within subjects. Table 5 shows the ANOVA results, including the interaction indicating that experienced worry was higher than anticipated worry for those who got vaccinated but not for those who did not. These results indicate that vaccination does not bring the relief from worry that the vaccinators anticipate. Instead, vaccinators experience worry levels as high as or even higher than nonvaccinators.

Although the worry experienced by vaccinators ($M = 2.24$) was higher than anticipated ($M = 1.63$), it was still lower than the level those vaccinators anticipated would have resulted had they not been vaccinated ($M = 3.23$). (Indeed, this large anticipated worry reduction presumably drove the decision to vaccinate.) Vaccinators expected that vaccination would result in 1.60 points (3.23–1.63) of worry reduction, when in fact it only resulted in 0.99 point (3.23–2.24) of reduction. Thus, they achieved some but not all the peace of mind that they had anticipated. In contrast, nonvaccinators' anticipated mean level of worry was similar if they were to get vaccinated ($M = 1.84$) or not get vaccinated ($M = 1.97$). (Indeed, this small anticipated worry reduction presumably drove the decision not to vaccinate.) Mean experienced worry ($M = 1.93$) was very similar to the worry these participants anticipated would occur whether or not they vaccinated.

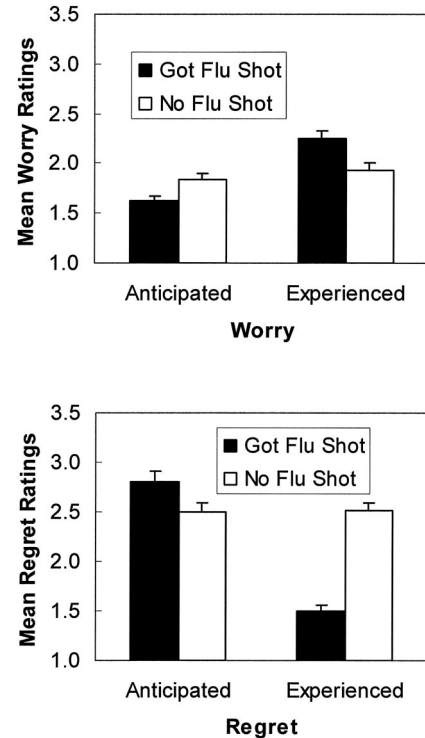


Figure 1. Mean anticipated and experienced worry and regret ratings ($N = 428$). Error bars represent the standard error of the mean.

The bottom panel of Figure 1 shows rated anticipated and experienced regret. The ANOVA (see Table 5) revealed an interaction such that vaccinators experienced less regret than anticipated, whereas nonvaccinators experienced as much regret as anticipated. The same results were obtained if the analysis was limited to only those participants ($n = 58$, data not shown) who reported getting the flu—presumably the event that would trigger experienced regret—or to those participants who reported not getting the flu.² Thus, as with the worry ratings, the vaccinators showed a discrepancy between anticipated and experienced regret, whereas the nonvaccinators did not. Interestingly, although the

¹ Separate analyses (not shown) examined whether worry and regret reduction each individually mediated the relationship of likelihood and severity to Fall 2001 vaccination. Worry and regret reduction both partially mediated the effect of risk likelihood reduction on vaccination, with worry playing the larger role. Worry reduction fully mediated and regret reduction partially mediated the effect of severity on vaccination, with worry again playing the larger role (data not shown). Thus, worry reduction is a stronger mediator than is regret reduction, and risk severity is more mediated than is risk likelihood reduction.

² The ANOVA in Table 5 was repeated with the additional factor of getting the flu. Getting the flu had a main effect such that people who got the flu experienced more regret. Of more importance, however, the three-way interaction was marginally significant, $F(1, 395) = 3.44, p = .06$. This interaction indicates that the pattern for those who did not get the flu is like that shown in Figure 1. The pattern for those who did get the flu is like that shown in Figure 1 except that regret ratings were, overall, higher and nonvaccinators experienced more regret than anticipated. Vaccinators experienced less regret than anticipated among both those who got the flu and those who did not.

Table 5
Analysis of Variance for Anticipated and Experienced Worry and Regret (Fall 2001–Spring 2002)

Factor	Dependent measure					
	Worry			Regret		
	<i>F</i> (1, 426)	<i>MSE</i>	η^2	<i>F</i> (1, 426)	<i>MSE</i>	η^2
Anticipated vs. experienced emotion	50.13**	0.54	.10	76.40**	1.17	.13
Vaccination status (Fall 2001)	0.36	1.29	.00	17.47**	1.54	.04
Anticipated vs. Experienced Emotion \times Vaccination Status (Fall 2001)	27.22**	0.54	.05	80.92**	1.17	.14

** $p < .0001$.

vaccinators experienced more worry than anticipated, their experienced regret ratings ($M = 1.50$) were lower than the regret they had anticipated whether they did ($M = 2.81$) or did not ($M = 4.10$) get vaccinated. Thus, they experienced much more regret reduction (relative to if they had not vaccinated) than anticipated. Nonvaccinators experienced about the same amount of regret ($M = 2.52$) as they had anticipated if they did not get vaccinated ($M = 2.50$), which was less regret than they had anticipated they would feel if they had been vaccinated ($M = 3.31$).

Effects of Anticipated and Experienced Emotion on Subsequent Vaccination Decisions

The final research question concerned how anticipated emotion from the fall of Year 1 and experienced emotion from the following spring predicted vaccination intention in the spring and vaccination the following fall. We also examined whether the discrepancy between anticipated emotion in the fall and experienced emotion the following spring predicted subsequent vaccination decisions. Table 6 shows the correlations of anticipated and experienced emotions to subsequent vaccination decisions. Results are shown separately for participants who vaccinated in Year 1 and those who did not. We computed the correlations separately by previous vaccination status because previous vaccination is strongly related to subsequent vaccination and is also related to anticipated and experienced emotion (as shown in Figure 1). We did not want anticipated and experienced emotions to predict

subsequent vaccination merely because they were stand-ins for previous vaccination.

Several findings are apparent in Table 6. First, for participants who did not vaccinate in Year 1, both anticipated and experienced emotions were correlated with intention and vaccination. That is, people who did not vaccinate in Year 1 were more likely to vaccinate in Year 2 if they anticipated and experienced high levels of worry and regret in Year 1. In contrast, for participants who did vaccinate in Year 1, anticipated and experienced emotions were for the most part uncorrelated with vaccination in Year 2. The exception is that experienced regret in Year 1 was negatively associated with vaccination in Year 2, indicating that participants who regretted getting vaccinated in Year 1 were likely to decide against vaccination in Year 2. Thus, the correlations shown in the first four rows of Table 6 are strikingly different for people who vaccinated in Year 1 compared with those who did not. Indeed, in six of eight cases the correlations for previous vaccinators were significantly lower than those for nonvaccinators, as demonstrated by logistic regressions that revealed significant interactions between previous vaccination status and emotion in predicting Year 2 intention or vaccination ($\ln ORs > 5.25$, $ps < .04$, for all but the relationship of anticipated worry to intention and vaccination).

Finally, for the most part, the discrepancy between experienced and anticipated emotions was uncorrelated with subsequent vaccination. Thus, although people who did not vaccinate in Year 1 were likely to vaccinate in Year 2 if they had experienced high

Table 6
Zero-Order Correlations Between Anticipated and Experienced Emotion and Subsequent (Intention About) Flu Vaccination

Emotion	Spring 2002 intention		Fall 2002 vaccination	
	Flu shot last year ($n = 214$)	No flu shot last year ($n = 214$)	Flu shot last year ($n = 214$)	No flu shot last year ($n = 214$)
Anticipated				
Worry	.00	.37**	.02	.23*
Regret	.02	.40**	.00	.22*
Experienced				
Worry	.02	.37**	.00	.21*
Regret	-.31**	.36**	-.18*	.21*
Experienced-anticipated				
Worry discrepancy	.02	.01	-.01	-.01
Regret discrepancy	-.17*	-.09	-.09	-.04

* $p < .05$. ** $p < .0001$.

levels of worry and regret, experiencing more worry or regret than anticipated did not in itself push people toward vaccination. The one exception is that the regret discrepancy predicted the decision not to vaccinate for previous vaccinators, reflecting the fact that for this group, anticipated regret was unrelated to subsequent vaccination but experienced regret had a negative association.

Discussion

The results of the current study are largely consistent with recent work on emotion and decision making. First, the present results support the supposition of the risk-as-feelings hypothesis (Loewenstein et al., 2001) and the affect heuristic (Slovic et al., 2002) that emotions are more immediate precursors of decisions than are calculations of the risk probabilities and severity. Second, the results are consistent with previous work on affective forecasting that shows that anticipated emotions often differ systematically from experienced emotions. Finally, both anticipated and experienced emotions guide future preventive health decisions, but the discrepancy between the two did not in itself predict future decisions.

Emotion and Risk

The current study indicates that there is a large degree of overlap between perceived risk likelihood and severity on the one hand and worry and regret on the other. Nevertheless, risk and emotion are clearly separate constructs. The anticipated reduction in worry and regret resulting from vaccination predicted vaccination decisions above and beyond risk perceptions. More important, the relationship between perceived risk and vaccination was mediated by anticipated emotion. This suggests that worry and regret are the more primary causal factors driving the decision to take preventive action, consistent with the risk-as-feelings hypothesis. Although risk analysts conceptualize risk as likelihood and severity of an adverse outcome such as getting the flu, laypeople conceptualize risk in terms of emotional responses to potential adverse events (Slovic, 1987). To a layperson, risky events are ones that trigger worry, dread, or regret about not taking preventive action, not necessarily events that have a high likelihood of a severe outcome. It is this emotional side of risk that appears to drive preventive health behavior.

Interestingly, the mediational analyses suggest that perceptions of high risk likelihood and severity trigger worry and regret, which in turn prompt preventive action. This sequence of events is in contrast to an alternative scenario in which feelings of worry and regret cause one to conclude that the risk level is high, which in turn prompts preventive action. The current data are correlational and so cannot definitively distinguish between these two possibilities, or a third, in which risk and emotion operate in parallel (cf. Leventhal et al., 1992). If risk perception triggers worry and regret (rather than vice versa), then experimentally manipulated risk communications would be expected to affect preventive behavior by way of worry and regret. In contrast, experimental emotion inductions would be expected to affect preventive behavior directly, not by way of risk perception.

Affective Forecasting

The anticipated worry and regret that play a large role in vaccination decisions can be thought of as affective forecasts—

that is, predictions about one's later emotional experience. The current results indicate that these predictions are not always accurate. Nonvaccinators showed fairly accurate affective forecasting. Their mean levels of experienced worry and regret were similar to mean levels of anticipated worry and regret. In contrast, vaccinators showed systematic forecasting errors. They worried more than anticipated and experienced less regret than anticipated.

Why did vaccinators fall prey to forecasting errors that nonvaccinators escaped? A plausible explanation stems from the fact that vaccination is an active intervention, whereas nonvaccination constitutes maintaining the status quo. Nonvaccinators may have anticipated that the worry (or regret) they would experience during the coming winter was the amount of worry (or regret) they currently experienced. If that level of emotion continued through the winter, or did not change systematically, those predictions would be fairly accurate. For vaccinators, in contrast, anticipated worry (or regret) constitutes a prediction of how much lower worry (or regret) would be as a result of the intervention of vaccinating. The currently experienced worry or regret may not be a good guide. Vaccinators provided anticipated worry (and regret) ratings in late November, shortly after receiving the vaccine. They may have experienced intense relief from worry about the flu immediately after receiving the vaccine and then projected (incorrectly) that that same level of peace of mind would persist throughout the winter. Such an error would constitute a durability bias (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 2002) whereby decision makers project that an initial emotional reaction will persist longer than it actually does.

Why did vaccinators underestimate worry but overestimate regret? This difference may simply reflect the character of these two emotions. Overestimation of regret has been demonstrated previously (Gilbert et al., 2004). Shortly after receiving the vaccine, participants anticipate that if they later get the flu, they will experience high regret. At that point in time, the salience of having recently been vaccinated may prompt them to think that, given all the effort they invested in preventing the flu, an illness episode would trigger high regret. They anticipate that this frame of mind will persist throughout the winter. Months later, this focus on the preventive action has faded and they report experiencing low levels of regret. Thus, the overestimation of regret may also be an example of durability bias. In contrast to vaccinators, nonvaccinators experience about the level of regret they anticipated. At the time of giving anticipated regret ratings, there is no recent salient event (vaccination) to which they can erroneously ascribe enduring influence.

Effect of Past Emotion on Future Preventive Health Decisions

Although vaccinators demonstrated affective forecasting errors, these errors did not appear to have a deleterious effect on future preventive health decisions. Indeed, among people who vaccinated in Year 1, neither Year 1 anticipated worry or regret nor Year 1 experienced worry predicted Year 2 vaccination. Furthermore, experiencing emotion levels higher or lower than anticipated also did not predict Year 2 vaccination.

In contrast, among people who did not vaccinate in Year 1, anticipating and experiencing high levels of worry and regret predicted subsequent vaccination. Having higher than anticipated levels of worry or regret did not, however, predict subsequent

vaccination. This is because high levels of both previously anticipated and previously experienced worry and regret predicted vaccination the following year.

Why did Year 1 emotions predict Year 2 vaccination only for previous nonvaccinators? If a nonvaccinator anticipated or experienced a lot of worry or regret in Year 1, there is something he or she might consider doing to reduce worry and regret in Year 2: Get a flu shot. In contrast, if a vaccinator anticipated or experienced a lot of worry or regret in Year 1, it is not possible to address this by altering vaccination strategy. Vaccinating again in Year 2 is unlikely to lead to different levels of worry and regret, whereas deciding not to vaccinate in Year 2 might actually increase worry and regret. Thus, previous levels of worry and regret do not determine which Year-1 vaccinators vaccinate again in Year 2 and which do not. The current findings have the practical implication that emotion induction might be effective in encouraging vaccination among previous nonvaccinators, but it is unlikely to influence the maintenance of vaccination levels among previous vaccinators. An alternative account of the results is that Year 1 emotions do not causally drive Year 2 vaccination but instead are simply a marker for overall positive attitude toward the vaccine. Thus, someone who did not vaccinate in Year 1 but did have high levels of worry and regret might be someone who feels positively about the vaccine and usually does vaccinate but for some reason did not manage to vaccinate in Year 1.

The fact that Year 1 emotions predicted Year 2 vaccination decisions only for people who did not vaccinate in Year 1 may explain why affective forecasting errors had no implications for subsequent decisions. The Year 1 nonvaccinators did not show any affective forecasting errors, but they did show a relationship between Year 1 emotions and Year 2 vaccination decisions. For Year 1 vaccinators, in contrast, there were affective forecasting errors; however, Year 1 emotions did not predict Year 2 decisions. Affective forecasting errors will have no implications for subsequent decisions if they occur only in situations in which emotions do not predict subsequent behavior.

Limitations

The current findings should be interpreted in light of the limitations of the study. Vaccination behavior was assessed by self-report, making reporting biases possible. Perceived risk and anticipated affect were assessed in Year 1 after participants had already decided whether or not to vaccinate for that year. In addition, ratings of experienced worry and regret were assessed at the end of the flu season and thus may have entailed some reconstructive memory about the levels of worry and regret experienced earlier in the flu season.

Clinical Implications

The current results are correlations, but if further research indicates that these results stem from a causal effect of emotion on preventive health behavior, a number of clinical implications would follow. First, interventions that appeal to emotions are more likely to change health behavior than are interventions related to risk statistics. Second, because beliefs about risk likelihood and severity have their effect on behavior by way of emotion, cognitive interventions that have a large influence on emotion will be more effective than those that do not. Third, clinical interventions to

reduce anxiety or similar negative emotions may have to allow for the fact that affective forecasts can systematically over- or underestimate the level of emotion experienced later (especially for those who take a precautionary measure). Finally, because emotions experienced in one time period can influence preventive health behavior undertaken in subsequent time periods, a negative emotional response to one health episode can be exploited to encourage healthier behavior in the future.

The present results regarding perceived risk and emotions likely generalize beyond flu vaccination. Worry and regret are likely to be important predictors of a variety of preventive health behaviors. Worry has been shown to predict behaviors such as cancer screening (Diefenbach et al., 1999; McCaul et al., 1998; McCaul, Schroeder, & Reid, 1996) and genetic testing (Cameron & Diefenbach, 2001), anticipated regret has been shown to predict contraception behavior (Richard et al., 1998; van der Pligt & Richard, 1994), and perceived risk has been found to predict an array of health behaviors (van der Pligt, 1998). Flu vaccination has some noteworthy characteristics. It is (or can be) repeated annually, thus requiring repeated decision making. Each decision is followed by feedback (getting a flu illness or not) prior to the next decision. Other health behaviors that have a similar pattern of repeated decisions with regular feedback include contraception, dieting to lose weight, exercise for short-term goals (fitness or weight loss), and regular disease screening (e.g., annual pap smear). With such behaviors there is the potential for emotions experienced in one decision-making episode to influence subsequent decisions. Thus, further examination of both the emotional components of risk perception and the interplay of anticipated and experienced emotions and preventive health behaviors is likely to be a fruitful avenue to explore with respect to a variety of health behaviors.

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