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Anticipatory Anxiety and Risk Perception[1]

Gillian Butler
University of Oxford

Andrew Mathews
University of London

This study tested the prediction that anxiety, arising from anticipation of a stressful examination (state anxiety), would be associated with an inflation of subjective risk in judgments of negative events related to oneself. The subjective probability of pleasant and unpleasant events was rated on two occasions, 1 month and 1 day before the examination date. Increases in anticipatory anxiety as the examination approached were associated with increased subjective risk of examination failure, while the more stable personality trait of anxiety was associated with perceived risk of all self-referred negative events whether or not they related to examinations. These results were taken as providing general support for a cognitive view of anxiety, in which a relationship exists between state anxiety and the accessibility of information relating to personal threat, while trait anxiety relates to the extent or range of such personally threatening information in memory.

KEY WORDS: anxiety; subjective probability; cognitive processes.

Previous research on the estimation of risk has suggested that individuals make use of the availability heuristic when rating the likelihood of future events. According to this heuristic, the frequency of a class of events is esti-

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mated by the ease with which examples of such events can be brought to mind (Kahneman, Slovic, & Tversky, 1982). In the judgment of likely causes of death, for example, risk estimations appear to be disproportionately increased by recent exposure to information about lethal events (Lichstenstein, Slovic, Fischoff, Layman, & Coombs, 1978). In studies where subjects have been required only to imagine themselves experiencing certain events, subsequent estimates of actual probability have also been shown to be inflated, presumably because the imagined scenarios become more easily accessible from memory and thus influence probability judgments (Carroll, 1978, Gregory, Cialdini, & Carpenter, 1982).

Probability judgments are influenced by manipulations of affect as well as by cognitive manipulations. Indeed, affect appears to have a surprisingly pervasive effect on estimates of risk. In a study by Johnson and Tversky (1983) subjects who had read newspaper accounts describing the death of an individual in detail showed "global" increases in estimated risk across all causes of death, rather than "local" increases relating to similarity between the newspaper account and the causes of death to be rated. Reading a happy newspaper story had opposing but equally general effects, such that the perceived probability of negative events was reduced, again in a global rather than a local way.

A similar global increase in the subjective probability of a range of disasters was also found by Bower (1983) in ratings completed after induction of an unhappy mood by hypnotic suggestion. Bower used an extension of his general network model of emotional state-dependent effects (Bower, 1981) to explain these results. Hence, the induction of (say) unhappy mood would render examples of negative events more accessible and thus increase their perceived probability.

In a previous published report by the present authors (Butler & Mathews, 1983) evidence broadly consistent with the results described above was found using an emotionally disturbed population. In this study, normal, anxious, and depressed subjects rated the risk of a range of positive and negative events, in relation both to themselves and to others. No significant differences were found between the groups in the analysis of ratings for positive events. On the other hand, ratings of negative events showed highly significant differences, with both anxious and depressed subjects rating negative events as more likely to happen than did normal controls. Furthermore, although normal individuals did not differentiate between probability ratings for themselves and for others, ratings of negative events made by both anxious and depressed subjects for themselves were significantly higher than ratings of the same items when made for another person.

We had expected that anxious individuals would make higher predictions for threatening events referred to themselves than to other people. This is because memories of threatening events associated with anxiety are pre-

sumed to be organized and stored together in long-term memory (Mathews & MacLeod, 1985). When an individual becomes anxious again, this material should be relatively easy to bring to mind (Bower, 1981) and may therefore influence estimates of the future likelihood of self-related unpleasant events. Ratings of similar events occurring to other people are likely to be less inflated by anxious mood because there may be relatively little information about such events coded in memory, and any such information should be less strongly associated with anxiety.

Inducing a mood experimentally, by reading newspaper accounts (Johnson & Tversky, 1983) or by hypnotic suggestion (Bower, 1983), may have advantages in terms of control and precision but may produce effects that differ considerably from those of emotional states arising in other ways. We do not yet know whether mood changes in response to a "real" stressful event will have effects on the perception of risk that are identical to those produced by experimentally induced mood changes. Conceivably, a mood state that is closely related to a particular real-life event may have more specific consequences for judgments of risk that are related to that event.

We suggest that the mood state induced by an event such as an examination is cognitively distinct from that induced by the usual laboratory procedures. Previous research on test anxiety shows that in susceptible individuals, examinations are associated with intrusive self-evaluative thoughts that interfere with efficient task performance (e.g., Wine, 1980). Presumably, these intrusive and disruptive thoughts arise from cognitive structures in long-term memory, concerned with evaluating the likelihood and consequences of personal failure, which are increasingly activated as an examination approaches. The persistent focus of worry on this specific area might be expected to produce relatively local increases in subjective risk—that is, increases in the subjective risk of events related to examination failure. However, more global increases in the risk of other negative events may be expected in the case of high trait-anxious individuals. This prediction arises because we suppose that high levels of trait anxiety are associated with relatively extensive and elaborated schemata in memory concerned with threatening events, such that activation can spread readily from one area to others.

In order to address these issues we selected a group of subjects anticipating an examination having important consequences for the individuals concerned. We compared risk estimates made by these students with those made by a second group who were not expecting an examination in the near future but who were in all other respects very similar. We studied both groups of students at two different times, 1 month and 1 day before the examination date. In pilot work, it had already been established that marked increases in subjective anxiety occurred between 1 month and 1 day prior to an examination, accompanied by systematic increases in subjective probability ratings concerning the likelihood of examination failure (Braier, 1982).

To look for evidence of local or global effects, we constructed a new subjective probability questionnaire that was designed to sample systematically across a range of events, divided according to their relationship to the examination and to the rater. This questionnaire thus contained subsets of items varying in Valence (positive or negative items), Reference (referring to oneself or to some other person), Content (referring to the examination or to other miscellaneous events), and Performance (events influenced by the behavior of the rater or events over which the rater had no control). We predicted an increase in the expectation of failure as the examination approached, and that this would occur mainly in ratings made for oneself rather than for others. Second, we predicted that the inflation of subjective risk would be relatively specific in the case of low trait-anxious individuals, and more global in those with high levels of trait anxiety.

METHOD

Subjects

Subjective Probability Questionnaires (see below) were given to 62 Oxford University undergraduates, randomly selected from three colleges within the university. Complete data were available from 57 of them. Twenty-six of these (17 men and 9 women) had no examinations at the time, and 31 (21 men and 10 women) expected a major university examination in 4 weeks' time.[2] The timing of these examinations is predetermined by the subject studied, and the full range of subjects was represented in both groups. The average age of the students in the two groups was not significantly different: nonexamination group = 19.8 years, examination group = 20.5 years. The sex ratio was the same in both groups, and there were equal numbers of students taking 1st-year and final examinations. Subjects were paid on the second occasion of testing.

Procedure

All students completed questionnaires on two occasions, 4 weeks apart. For those in the examination (E) group, the first occasion (T_1) was 4 weeks

[2]These examinations, usually consisting of about eight 3-hour papers, are the sole determinants of grades at this university. The first examination tests all the work covered during the 1st year and qualifies the student to continue the course. The final examination covers the rest of the course, the work of 2 or 3 years, and can be taken only once. Both these examinations are therefore a major source of stress.

before, and the second occasion (T_2) was a day before the examination. Students in the E group were also asked to complete the questionnaire a third time, 1 week after the examination, but before results were known (T_3). Data from all three occasions are available from 20 students in the E group. Students in the NE group completed the questionnaire on two occasions only, matched in time with those taking an examination.

Students were asked to participate in research on reactions to stress. They were told that students had been selected for study because they had experienced, or shortly would experience, examination stress. They were also told that the questionnaire would be repeated in 1 month in order to find out whether thoughts about future events change over time. The experimenter did not mention the idea that expectations might change with mood.

On every occasion students completed mood rating scales and a subjective probability questionnaire. Trait anxiety was measured at T_1 only, with the State-Trait Anxiety Inventory (STAI-T; Spielberger, Gorsuch, & Lushene, 1970). State anxiety was measured with the STAI (STAI-S) on each occasion.

Subjective Probability Questionnaire

This questionnaire is an experimental instrument developed on the basis of theoretical suppositions. The items have high face validity, and the question of interest in this case is whether ratings of these items change with the proximity of a relatively major stress event. Items were selected on the basis of pilot work to ensure they were not subject to floor and ceiling effects or to excessive between-subject variance. Also, the presentation was checked to ensure that both the items and the instructions were sufficiently clear and simple to be easily understood.

Forty-eight items were rated on a 9-point scale in answer to the question "How likely is it that...?" Half of the items referred to positive and half to negative events. Within each set items were paired according to the reference of the event, so that one version referred to oneself (e.g., "You will do far better than you could have hoped in your next exam") and the other referred to some other person (e.g., "Sam, sitting the same examination as you, will do much better than expected"). A particular other person was specified to ensure that students rated probabilities for one person as opposed to a group of people. The other person specified had no obvious connection with the rater and was referred to by a name that could apply to either sex. Thirty-two of the items referred directly to the examination (Ex. items, e.g., "The next exam paper you sit will be an unusually hard one") and 16 referred to other miscellaneous events, such as social success or failure, that would be relevant to students (Misc. items, e.g., "If you borrowed a

friend's tape recorder you would damage it accidentally"). These two content categories were further subdivided into performance-related events and events over which the rater could have no control (nonperformance events). For the performance items the behavior of the rater would influence the outcome (e.g., "During your next examination you will fail to read one of the questions carefully enough"). For the nonperformance items the rater's behavior would have no effect on outcome (e.g., "This year's examiners will mark the papers unusually severely").

Data Analysis

Since there were different numbers of items in the Examination and Miscellaneous categories (Ex. = 32, Misc. = 16), the analysis used mean scores for each category. There was no significant difference in variance between categories.

Results were analyzed using repeated-measures analysis of variance. Students within groups were further divided according to their trait anxiety score as measured by the STAI. Two methods of making this division were considered: splitting the total population ($N = 57$) at the median, or splitting the NE and E groups at separate medians, in order to equalize the size of all subgroups. As there were more high anxious students in the E group and more low anxious ones in the NE group, the methods produce differing distributions of students between subgroups. The analysis using trait anxiety as the second grouping factor was run in both ways, and results are reported only if they were significant in both cases. Significance figures quoted are from the analysis using the whole population split.

The imbalance between numbers produced by splitting the population at the median was greater in a subsidiary analysis using state rather than trait anxiety as the second grouping factor. At T_2 there were only six high anxiety students in the group not taking an examination, and only nine low anxiety students in the group expecting an examination the next day. It was therefore considered preferable to equalize the numbers in the subgroups, and the NE and E groups were split at their own medians.

RESULTS

Changes in Mood

As expected, mood changed over time in the E group but not in the NE group. Mean and standard deviation scores for the group tested twice and for the subgroup that completed the questionnaire three times are shown

Table I. Mean Anxiety Scores as a Function of Group and Time

		STAI anxiety measure			
		A-trait scale		A-state scale	
Group		*M*	*SD*	*M*	*SD*
No-examination group	(n = 26)				
Time 1		35.5	8.5	35.2	10.1
Time 2				34.5	10.2
Examination group	(n = 31)				
Time 1		38.2	7.3	37.1	7.8
Time 2				48.5	10.1
Examination subjects tested 3 times	(n = 20)				
Time 1		38.1	7.5	37.6	8.2
Time 2				50.5	10.6
Time 3				35.2	12.2

in Table I. There was no significant difference between the groups at T_1 in trait or state anxiety.

Mood did not change significantly in the NE group between T_1 and T_2. At T_2 students in the examination group were significantly more anxious than at T_1 ($t(30) = 6.17, p < .001$) and significantly more anxious than those in the NE group at T_2 ($t(55) = 5.16, p < .0001$). The subgroup of students in the E groups who were tested three times changed to the same extent as the whole examination group between T_1 and T_2, and by T_3 (1 week after the exam) they had reverted to their original condition. It is clear that the occasions selected for testing were adequate to reflect a significant mood change in a nonclinical population. This replicates the finding of Kendall, Finch, Auerbach, Hooke, and Mikulka (1976) showing that STAI state scores in student populations are responsive to threat. However, in the present study we did not find that the students with high trait anxiety changed more than those with low trait anxiety.

Subjective Probabilities

The main analysis included five within-subject factors, or levels, and two grouping factors, examination group and trait anxiety. The five levels were Time (T_1 and T_2) and four categories of subjective probability items. Valence refers to positive versus negative items, Reference to self versus other, Content to examination-specific versus miscellaneous items (Ex. vs. Misc.), and Performance to whether or not the rater had control over the event. Significant effects that do not include an interaction with valence are not reported. These would be difficult to interpret because positive and negative probabilities are scored at very different points on the scale $F(1, 53) = 92.83$,

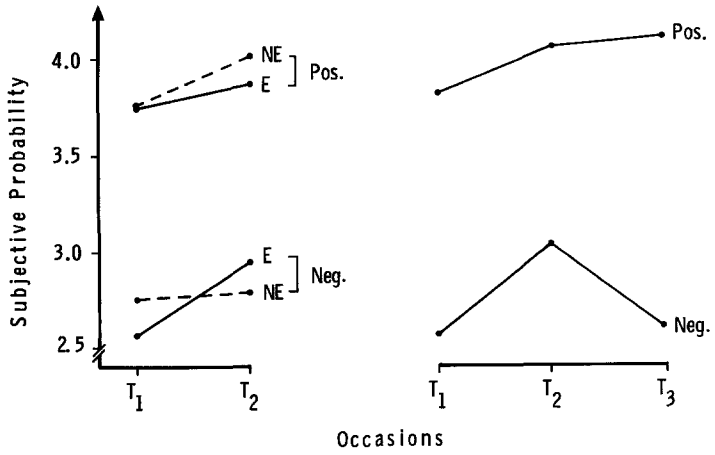

Fig. 1. Changes in positive and negative probabilities over time. Data from both groups are shown on the left (NE = nonexamination group, E = examination group), and from the E subgroup who were tested three times on the right.

$p < .0001$) and are opposed in their meaning. Effects that include neither of the grouping factors are also excluded. In the absence of a nonstudent control group these are of little interest and may simply reflect differences in the overall probabilities of the events sampled.

Analysis Using Trait Anxiety as a Grouping Factor

The groups differed over time in their rating of positive and negative events in such a way as to reflect a global effect. This is shown in the interaction involving Valence, Time, and Examination group ($F(1, 53) = 6.29$, $p < .02$), illustrated in Figure 1. The most striking effect observed here, and found consistently throughout, reflects higher rating for positive events than for negative events. This could indicate a general positivity bias or reflect differences in the objective probabilities of the events sampled. These possibilities are not discussed further since they have no bearing on the main questions of relevance, which concern interactions between grouping factors (proximity of examination and anxiety) and expectancy ratings.

In order to locate the source of the V × T × G interaction, positive and negative ratings were analyzed separately. There was a significant Times by Groups interaction in the negatives ($F(1, 53) = 4.78$, $p < .05$) but none in the positives. This shows that negative expectancy tended to increase in time for students in the examination group relative to the controls. This is a global effect since there was no further interaction with Reference, Content, or Performance. The increase over time in the subjective probabilities for negative events in the examination group alone failed to reach significance by Tukey test.

This global effect is also observed in data from the E subgroup who were tested three times. A Valence by Time effect ($F(2, 36) = 4.45$, $p < .05$) suggests that negative expectancy rose and then fell in synchrony with the changes in mood. Again the effect of time was significant for negative items ($F(2, 36) = 7.46$, $p < .005$) but not for positive items, and there is no further interaction with Reference, Content, or Performance.

The second significant interaction found in the main analysis shows a less global effect: a Valence by Reference by Anxiety interaction ($F(1, 53) = 13.79$, $p < .0005$). This seems to reflect greater probabilities for self-referred negative items in subjects with high rather than low trait anxiety, whereas self-referred positive events show the reverse trend. Probabilites for both positive and negative events referred to someone else remain very close, regardless of anxiety, while those for events referred to oneself vary according to the level of trait anxiety. In the high trait-anxious group negative self-related events are rated as relatively more likely and positive events as less likely. Despite the high significance of this interaction, the individual means for the positive and negative events do not differ significantly (Tukey tests). This implies that more than one set of means contributes to the interaction.

In the first analysis there was only one further significant interaction. This involved Valence, Content, and both grouping factors, examination group and trait anxiety ($F(1, 53) = 10.77$, $p < .005$). High trait anxiety was associated with higher probabilities for all negative items and lower probabilities for all positive items. However, this trend was more marked for miscellaneous items in the examination group, and more marked for the examination items in the case of the nonexamination group. This complex interaction is consistent with the view that high trait anxiety is associated with relatively global effects in the sense that these are observed in items not of immediate concern to the subject. However, since the interaction was not predicted in this precise form and is difficult to interpret, it will not be discussed further.

Analyses with State Anxiety as a Grouping Factor

A second set of analyses was considered necessary because differences in probability judgments between groups over time, assumed to reflect the effects of increased state anxiety, could be influenced by other factors. In the main analysis it was assumed that differences between E and NE groups reflected changes in state anxiety. This relationship may not be direct, however, since availability and salience of examination-related thoughts could influence probability judgments directly. Second, a wide range of state anxiety scores was observed in both groups (E = 22 to 67, NE = 22 to 62), indicating that in some students state anxiety was not related to the proximity of an examination.

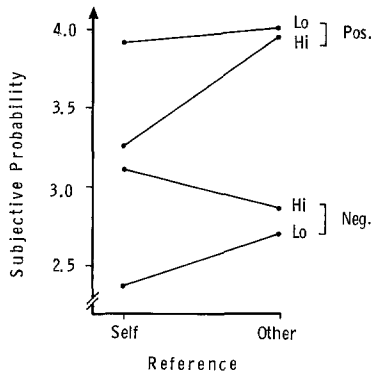

Fig. 2. Variation in positive and negative subjective probability ratings according to Reference (self vs. other) and Trait Anxiety (Hi = high, Lo = low STAI-T scores).

The second stage of the analysis examined the relationship between subjective probabilities and state anxiety directly by using STAI-S scores. Separate analyses of data from the two main occasions were carried out because state anxiety varied over time, and separate splits were performed for each occasion. As before, only interactions involving valence and one or more grouping factors are reported.

The only relevant finding at T_1 was a replication of the interaction involving Valence, Reference, and Anxiety already mentioned above ($F(1, 53) = 8.15$, $p < .01$). This interaction also occurred at T_2 ($F(1, 53) = 8.14$, $p < .05$) and looks very similar to the same interaction in the main analysis illustrated in Figure 2.

As expected, there was more evidence for content specific local effects at T_2, immediately before the examination. An interaction involving Valence, Reference, Content, and examination group ($F(1, 53) = 4.12$, $p < .05$) is shown in Figure 3. No systematic variation was observed in ratings of positive items, and presentation of the results focuses on ratings of the negative items. Self-referred items relating to the examination are rated as more likely than all miscellaneous items only by students taking an examination. The differences between ratings of self-related examination items by the E group and all the ratings of the Misc. items is significant ($p < .05$, Tukey tests).

DISCUSSION

The present results show that naturally occurring anxiety in a nonclinical population is associated with covariations in subjective probabilities. In

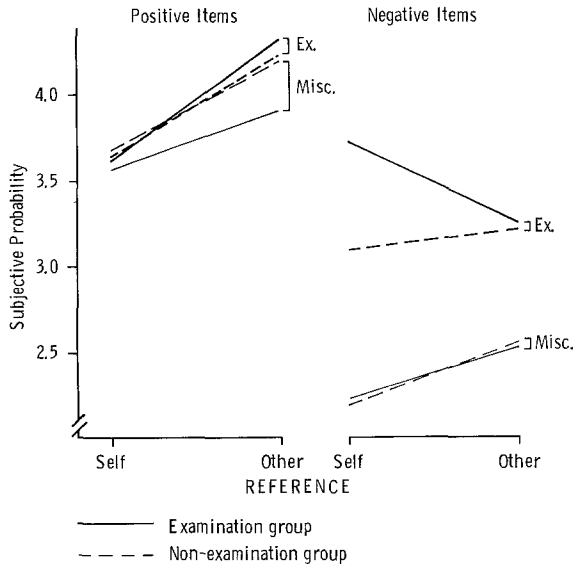

Fig. 3. The interaction of Valence (positive vs. negative), Reference (self vs. other), Content (Ex. = examination related events, Misc. = miscellaneous events), and Group (NE = nonexamination group, E = examination group) on the second occasion of testing.

examination candidates there was evidence of a general tendency to rate negative events as more likely as the examination approached. Risk estimates tended to fall again after the examination, and these changes were not specifically related either to oneself or to any particular set of events.

Irrespective of examination group or occasion, trait anxiety and personal reference interacted differently for positive and negative events. There was little difference according to anxiety in the predictions made for others. However, individuals high in trait anxiety tended to predict that all positive events were less likely, and all negative events were more likely, to happen to themselves. State anxiety interacted with personal reference in a similar way.

Specificity according to content was observable only on the second occasion of testing. At this time students about to take an examination rated negative, examination-related events as significantly more likely than miscellaneous negative events, and tended also to rate them as more likely to occur to themselves than to others. No interesting variation was observed in ratings of positive events.

Discussion of these results has been guided by the following considerations: Only the three analyses of variance that were necessary to test our initial hypotheses were performed, in order to reduce the probability of making

a Type 1 error. Only interactions including the Valence term and at least one of the grouping factors are reported, since only these relate directly to the questions of interest. All significant interactions including these terms are reported, and only significant interactions are discussed. Because interactions involve more than one factor, more than one set of means may contribute to the interaction, and post hoc tests may not show significant differences between individual sets of means.

Global versus Local Effects. The results of the present study suggest that there are local as well as global effects of anxious mood on risk estimation. Global effects are more evident in the main analysis with trait anxiety, and local effects in the analysis with state anxiety of data collected immediately before the examination.

The main global effect shows a widespread increase in perceived probability of all negative items immediately before the examination. All but one of the remaining significant interactions involve the personal reference term; that is, effects differ according to whether judgments are made for oneself or for others. While the exception demonstrates that not all emotional effects are confined to self-ratings, the findings strongly support the view that they are often specific in this respect at least. Thus, judgments of events related to oneself are more affected than judgments related to others, by the presence or absence of an impending examination, by the level of state anxiety experienced, and by variations in trait anxiety.

The most consistent effect of reference is illustrated in the interaction with valence and trait anxiety shown in Figure 2. There is a general tendency for high trait-anxious individuals to estimate self-referent negative events as more likely, and self-referent positive events as less likely, than less anxious individuals. Although specific to events happening to oneself, this effect is not confined to those subjects about to take an examination, nor does it differ according to item content or time of testing. It is therefore rather unlikely that the result can be explained in terms of examination anxiety per se, since this would not account for the persistence of the effect in students not taking an examination. Rather it would appear that there is a general tendency for high trait anxiety to be associated with high perceived risk to oneself for all negative events.

Clearer local effects were found in the analysis with state anxiety, when content-specific effects were shown only in ratings made immediately prior to the examination. Students about to take the examination perceived their chances of failure in the examination to be significantly inflated by comparison with other risks, and were the only group to show a tendency to rate the examination-specific risk as higher for themselves than for others (Figure 3). At this stage, therefore, there was clear evidence of specificity in relation to type of event (examination vs. other negative events) and suggestive evi-

dence of specificity in relation to the subject of the rating (self vs. other people).

The main differences between this study and previous ones are differences in mood manipulation, in mood measures (state and trait), and in types of risk sampled. We suggest that these factors made it possible to observe local effects, which were predicted on the grounds that potentially threatening information about examinations and about personal competence should be particularly easy to access just before taking an important examination.[3]

Such a conclusion seems at odds with that put forward by Bower (1983) on the basis of studies using hypnotically induced mood. In an unpublished study (Harrison, 1984) we attempted to replicate Bower's findings using 12 hypnotically susceptible subjects in a repeated-treatment design. Happiness, depression, and anxiety were induced using the method described by Bower, and with similar results. All negative events were rated as more probable during unhappy or anxious moods, regardless of their relation to the situation used to induce that mood. For example, subjects made to feel anxious by imagining a forthcoming examination did not respond differently to examination items than those made anxious or depressed by other means. The implication of this apparent discrepancy between hypnotically induced emotion and the effect of a real examination is that generalizations between the two paradigms may be limited. One explanation, advanced in the introduction, is that real-life emotional events may direct associated cognitive processes in a more focused way than does hypnotic induction.

Cognitive Processes in Trait and State Anxiety. While the results may be interpreted in various ways, we have found it useful to consider them within the context of an information-processing view of anxiety. Although anxiety is the focus of our interpretation, we do not claim that other emotional states, such as depression, may not have similar cognitive correlates. In fact, self-ratings of depression using a visual analogue scale were included in the present study, but results were not reported in detail since analyses based on depression gave rise to only one significant result. Immediately before the examination there was an interaction between depression level and valence of events: More depressed subjects rated negative events as relatively likely and positive events as less likely ($F(1, 53) = 6.2, p < .05$). While this parallels findings for trait anxiety, the effect seems weaker and no other in-

[3]Since no postexperimental debriefing data were collected, we are unable completely to rule out "demand" explanations of our results. However, we consider these to be unlikely because this would require subjects to recall accurately their responses made 4 weeks earlier, and because demand would supposedly apply equally to all types of ratings, including the positive ones, in which little variation was observed.

teractions were significant. We therefore believe that anxiety is more relevant for understanding the results of the present study.

We suggest, as other have done (e.g., Beck, 1976), that anxiety may arise from the processing of events as threatening, and that such processing depends upon the activity of cognitive structures in long-term memory. Furthermore, we would speculate that trait anxiety levels reflect the extent, elaboration, or accessibility of these cognitive structures. That is, high trait anxiety is associated with extensive, well-elaborated schemata that encompass a wide range of threatening information. The activation and use of such structures in the interpretation of ambiguous events is thought to give rise both to anxiety and to worrying thoughts about such events. Owing to the increased accessibility of threatening information, judgments of future risk across a wide range of negative events is also elevated. Low trait anxiety, in this view, is associated with less extensive and elaborated threat-related information in memory. Under appropriate circumstances, however, such as immediately before an important examination, specific information pertaining to a current threat will be accessed. For individuals with low as opposed to high levels of trait anxiety this will lead to local, rather than global, elevations in subjective risk. Spread to other areas is limited by the restricted extent of, or interconnections among, threat schemata when trait anxiety is low.

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