THE OVERPREDICTION OF FEAR

by

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A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF

THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

in

THE FACULTY OF GRADUATE STUDIES

(Department of Psychology)

We accept this thesis as conforming

to the required standard

THE UNIVERSITY OF BRITISH COLUMBIA

August 1991

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Date OCTOBER 3, 1991

DE-6 (2/88)

ABSTRACT

Stimulus and response expectations play a central role in cognitive formulations of fear and avoidance. Research on this subject has been primarily concerned with the identification of various forms of expectations and their associated biases. Comparatively little is known about the cognitive structures or processes that produce biased expectations. The studies reported in this dissertation were intended to investigate the mechanisms of one bias of fear expectations, the overprediction of fear. This is a common phenomenon in which fearful people tend to overestimate the amount of fear that they will experience upon exposure to a threatening stimulus. Although overprediction is of interest in its own right, it is also important in that it promotes excessive avoidance behaviour, and so contributes to the maintenance of fear.

A theoretical framework, called the stimulus estimation model, was proposed for conceptualizing the overprediction of fear. This model consists of an algebraic expression of the elements of overprediction and a set of candidate cognitive mechanisms that generate the algebraic relations. The essence of the algebraic expression is that the overprediction of fear arises from the overprediction of the threatening elements of the feared stimulus, and the underprediction of the elements that confer safety. One of the cognitive components of this model, the selective recall model, states that overprediction arises from the selective retrieval of memories of highly fearful reactions to aversive events. Another cognitive component, the differential-weighting model, proposes that overprediction arises because environmental information about sources of safety has a greater influence on reported fear than on predicted fear.

The first experiment tested the selective recall model with a priming paradigm. One group of 50 spider-fearful subjects was required to recall highly fearful encounters with spiders (fear-relevant priming). A second group of 50 spider-fearful subjects was required to recall spider-irrelevant experiences (fear-irrelevant priming). The selective recall model predicts that the overprediction of fear in a subsequent fear-evoking task would be greatest after fear-relevant priming compared with fear-irrelevant priming. Contrary to expectation, predicted fear did not differ between the priming conditions. Reported fear was greatest after fear-relevant priming.

Thus, contrary to the selective-recall model, the magnitude of overprediction was smallest in the fear-relevant priming condition.

The second experiment tested the differential-weighting model. One hundred and twenty-one spider-fearful subjects were randomly allocated to one of two groups. One group received minimal safety information about a fear-evoking task. The second group received a high level of safety information about the task. It was found that the groups did not differ in their fear predictions, but the high information group made lower fear reports than the low-information group. As a result, the provision of safety information increased the magnitude of overprediction, thus supporting the model.

The third experiment attempted to replicate and extend the findings of Experiment 2, using a sample of 224 snake-fearful subjects. Danger and safety information were compared in their effects on predictions and reports of fear. All information effects were nonsignificant. The results of further analyses suggested that this was due to inadequate experimental manipulations rather than to an inadequacy in the model. The algebraic expression of the stimulus estimation model was supported by a series of analyses, including structural equation modeling. Thus, in the case of the fear of snakes, support was found for the hypothesis that the overprediction of fear is caused by overpredictions of the dangerousness, activity level, and size of the snake, and underpredictions of the safety and controllability of the situation. In the final chapter, the utility of the stimulus estimation model was considered, implications for other fear-relevant phenomena were set out, and directions for further investigation were explored.

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ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my supervisor, Dr. Jack Rachman, for his encouragement, enthusiasm, and sage advice throughout this research. I also would like to thank the other members of my committee, Dr. Dimitri Papageorgis and Dr. Peter Graf, for carefully reviewing the drafts of this dissertation, and for their thought-provoking comments. I am indebted to Judy Zaparniuk for her support and invaluable assistance in conducting the experiments. Thanks are also due to Eleny Goritsas for her contributions in carrying out Experiment 3.

CHAPTER 1. FEAR EXPECTATIONS

Cognitions such as stimulus and response expectations have long held an important role in theories of fear and avoidance (Bandura, 1986; Bolles, 1972; Craske & Barlow, 1988; Rachman, 1990; Rachman & Bichard, 1988; Reiss, 1987, 1991; Rotter, 1954). Even before the putative cognitive revolution in the behavioural sciences (Dember, 1974; Mahoney, 1974), fear expectations have been central concepts in explaining fear and avoidance (Tolman, 1932), although they have not always been described in such cognitive terms (Mowrer, 1939, 1960). Fear expectations can be defined as predictions about the likelihood of the occurrence of fear and fear-evoking events (Brewin, 1988; Kirsch, 1990). They may be concerned with (i) the nature of the threatening stimulus, its context, and pattern of occurrence; (ii) the instrumental or preparatory responses that are required to cope with, or avoid the threatening stimulus; and (iii) the affective consequences of such a stimulus, such as the intensity of fear or panic that it might evoke. The aim of this dissertation was to investigate the basis of a recently identified bias of fear expectations, the overprediction of fear. Before describing this bias, it will be placed in context by considering the psychological significance of predictions or expectations about aversive events.

Prediction and Control

It has often been claimed that "no dread is worse than that of danger unknown" (Hagen, 1870, cited in Jaspers, 1946/1963, p.98). Indeed, there is a good deal of evidence that the experience of unpredictability about aversive events plays a central role in anxiety and the anxiety disorders (Barlow, 1988). Humans and other organisms appear to prefer predictable to unpredictable aversive events (Mineka & Hendersen, 1985; Mineka & Kihlstrom, 1978). For example, rats have been shown to prefer signalled (i.e., predictable) shocks to unsignalled electric shocks (Badia, Harsh, & Abbott, 1979), even when the signalled shock is more intense than the unsignalled shock (Miller, Greco, Vigorito, & Marlin, 1983). Although the preference for predictability may be moderated by particular stimulus parameters (Abbott & Badia, 1986; Abbott, Schoen, & Badia, 1984; Arthur, 1986), it seems that organisms generally strive to predict accurately the nature and occurrence of aversive events. This may arise because predictability

increases the probability of controlling the impact of these events (Miller, 1979; Seligman, 1975). As we will see later, the preference for predictability is tempered by a bias to overpredict the likelihood and severity of threatening events.

The Overprediction of Fear

The bias toward the overprediction of fear is the tendency to overestimate the probability or intensity of fear that will be experienced in a given situation. Examples include the agoraphobic who overestimates the amount of fear that will be evoked by entering a department store, and the snake-phobic who anticipates more fear than is actually experienced when encountering a snake. The overprediction bias is a common, yet poorly understood phenomenon. As later chapters will show, it is not simply the result of random error in the prediction process. It is a systematic bias to expect fear-evoking events to be more frightening than they usually are.

When people make overpredictions of fear, what are they overpredicting? This begs questions of what is predicted in a fear prediction, and what is reported when people describe the levels of fear that they experience? Underlying these problems is the fundamental question, "what is fear?" Following Barlow (1988), Hallam (1985), Zillmann (1983), and others, it will be assumed throughout this dissertation that predictions and reports of fear represent ratings of the experiential component of this emotion. This consists of the subjective experience of apprehension or dread, and the experience and appraisal of cues to anxious arousal. The latter can be interoceptive (e.g., palpitations, increased muscular tension) and exteroceptive (e.g., perspiration, trembling) (Barlow, 1988; Hallam, 1985; Zillmann, 1983). Predictions and reports of fear are, by definition, the most basic units of analysis in the study of the overprediction of fear, at least at the current stage of investigation.

The overprediction of fear is of interest in its own right. The study of this phenomenon is also relevant to the understanding of fear processing in general, and may shed light on other types of cognitive distortions, such as those described by Beck (1976; Beck & Emery, 1985). The bias toward overprediction is of further interest because it is thought to promote excessive avoidance behaviour (Rachman, 1988, 1990), which contributes to the maintenance of fear (Foa & Emmelkamp, 1983; Marks, 1987). The importance of predictive biases was recently

underscored by Lucock and Salkovskis (1988) in a study of social phobia. They argued that "unless such biases are directly modified, treatment cannot be considered complete, as relapse would be highly likely" (p. 298). The eradication of these biases also may facilitate the generalization of treatment effects (Lucock & Salkovskis, 1988). These comments are not limited to social phobia since the overprediction of fear and related phenomena are found in a range of clinical and nonclinical conditions, as the following chapter will show.

To arrive at an understanding of the determinants of the bias toward the overprediction of fear, it may be useful to consider the nature of predictive biases for threat-relevant and other aversive events. The theory and findings regarding the overprediction of aversive experiences such as pain also may shed light on the overprediction of fear. It is also important to consider the way in which the bias toward overprediction interacts with other response tendencies, such as the preference for accurate predictions. These are some of the topics of the following chapter.

CHAPTER 2. REVIEW OF THE EMPIRICAL LITERATURE

The first section of this chapter presents a review of the research on the overprediction of dangerous and other aversive events. Historically, this work laid the foundation for the investigation of the overprediction of fear. Later chapters will show that the study of danger expectations also provides the conceptual foundation for a model of overprediction developed in this dissertation.

Following a review of the research on the overprediction of aversive events, the next three sections of the present chapter are concerned with the empirical work on the overprediction of fear, and work on a closely related phenomenon, the overprediction of panic. The findings regarding pain prediction are then discussed since they are similar in many ways to fear predictions, including the tendency toward overprediction. Pain prediction is also of relevance because the models developed for the overprediction of pain may be extended to account for the overprediction of fear. The covariation bias (Tomarken, Mineka, & Cook, 1989) is then discussed because of its potential relevance to the overprediction of fear. The penultimate section of this chapter concerns the issue of whether fear expectations are self-confirming. If self-confirming effects can be shown to exist, then the question arises as to how they are related to the overprediction bias. Such a relationship would present a complication that may need to be considered when constructing a comprehensive model of overprediction. The final section of this chapter will present a summary of the findings and conclusions about overprediction of fear and related phenomena.

The Estimation of Aversive Events

In 1966 Lazarus proposed that anxious people tend to regard their environment as fraught with hazards. Over the next decade, researchers began to examine closely the biases in the estimation of dangerous and other aversive events. The early work focused on the description of the cognitions reported by patients with anxiety disorders. Based on unstructured and semi-structured interviews, Beck, Laude, and Bohnert (1974) sampled the cognitions of 32 patients with anxiety neurosis, as diagnosed according to DSM-II (American Psychiatric Association, 1968). Beck et al. (1974) found that these patients tended to overestimate the

likelihood of personal threat, with common themes including the overprediction of disease, death, social rejection, and failure. Some patients were found to greatly overestimate the consequences and dangerousness of certain body sensations (e.g., as reflected in the belief that palpitations cause heart attacks). Other patients tended to overestimate the consequences of minor failures (e.g., a teacher interpreted a poor lecture performance as an indication that she would lose her job and become destitute). Others tended to overpredict the likelihood of injury from external sources (e.g., the likelihood of being attacked by intruders). Beck et al. observed that "despite a history of repeated disconfirmations, the expectancies of danger recurred when the patient was exposed to [particular fear-relevant] stimuli" (p. 321). The authors summarized their findings as follows.

> The anxiety-prone or anxious patient differs from the normal in that his judgment of danger is likely to be unrealistic: he systematically misconstrues innocuous situations as dangerous; he exaggerates the probability of harm in specific situations; and he perseveres in having thoughts or visual images about being physically or psychologically injured. (Beck et al., 1974, p. 324.)

Beck (1976) went on to classify these biases according to the processing errors that appeared to be at work (e.g., catastrophizing, dichotomous thinking, arbitrary inference, etc.). He further postulated that the clinically anxious individual possesses a "danger schema" that influences the way in which information is processed, stored, and retrieved. This concept will be examined in detail in Chapter 4.

The theoretical relevance of Beck's findings rests on the integrity of his methods of investigation. There were several limitations to the study by Beck et al. (1974). There was no normal control group against which to gauge the magnitude of the cognitive distortions. The data were not collected systematically, and the patients' reports could have been influenced by the theoretical orientation of the interviewers. Hibbert (1984) and Chambless (1988) suggested that the patients may have been specifically referred to Beck because their cognitive distortions were particularly salient. Despite these limitations, the findings raised the possibility that the overprediction of danger may be a characteristic feature of clinically anxious individuals. Given

the heterogeneity of the conditions encompassed within the diagnosis of anxiety neurosis, it appears that the overprediction of danger is not limited to a single disorder, as diagnosed by DSM-III-R (American Psychiatric Association, 1987). From the case descriptions presented by Beck et al., it appears that the sample contained patients from at least three DSM-III-R diagnostic categories: panic disorder, generalized anxiety disorder, and social phobia.

The findings of Beck et al. (1974) prompted a series of studies of the ideational components of anxiety. Mathews and Shaw (1977) reported a small study comparing thought-stopping and desensitization in 10 patients presenting with "generalized anxiety" associated with frequent, anxiety provoking cognitions. Although the authors provided little information about the contents of these thoughts, some of them appeared to contain exaggerated expectations of harm (e.g., unrealistic worries that buildings might collapse). Mathews and Shaw noted that these overpredictions were similar to those described by Beck et al. (1974).

Hibbert (1984) also replicated the findings of Beck et al. (1974) in a study of 25 patients with the DSM-III diagnosis (American Psychiatric Association, 1980) of either generalized anxiety disorder or panic disorder. These disorders were uncomplicated by other anxiety disorders or by major depression. Using a structured interview of anxiety-related cognitions, Hibbert found that the patients' expectations were characterized by exaggerated expectations of personal danger. Panic patients, for instance, tended to predict erroneously that panic attacks would lead to physical, psychological, or social disaster (e.g., death, insanity, ostracism). Thus, it was found that these patients tended to greatly overpredict the consequences of panic.

Butler and Mathews (1983) reported a more systematic, detailed investigation of exaggerated expectations of personal danger. The sample consisted of three groups: 12 patients with generalized anxiety disorder (GAD), 12 patients with a major depressive episode (MDE), and 12 normal controls. The diagnoses were made according to DSM-III criteria. Both clinical groups were significantly anxious and depressed, although the GAD group was the most anxious and the MDE group was the most depressed.

Subjects completed three questionnaires that required them to make judgements about various aversive and ambiguous events. The first questionnaire consisted of 10 brief, ambiguous

scenarios (e.g., "You wake with a start in the middle of the night, thinking you heard a noise but all is quiet"). Subjects were instructed to indicate the possible causes of the event (e.g., "It could be a burglar"). A second questionnaire assessed the subjective cost of 20 threatening events, such as being robbed. Here, subjects were asked to rate how bad each event would be for them. The final questionnaire required subjects to rate the probability of occurrence of 8 of the items in the second questionnaire, plus an additional 28 items. For example, subjects were asked to rate the likelihood that "if you surprised a burglar in your own home he would attack you" (p. 55).

Compared with the control group, the clinical groups were more likely to interpret the ambiguous situations as threatening. The clinical groups also differed from the controls by assigning higher probabilities and costs to the aversive events. Defining the threat value of an item as the subjective cost multiplied by subjective probability (Carr, 1974), the clinical groups evaluated the events as more threatening than did the control group. The only significant difference between the clinical groups was that the ratings of the subjective costs of the aversive events were significantly higher in the MDE group relative to the GAD group.

Since both clinical groups were anxious and depressed, and there were few differences between these groups in their responses, a problem arises in interpreting the results. Butler and Mathews (1983) concluded that the tendency to interpret aversive events as more probable and more threatening "may be common to both types of mood disturbance, at least when depression is accompanied by anxiety" (p. 60). The study did not demonstrate that these effects can be found in anxiety disorders uncomplicated by depression. It may have been that these effects were entirely due to depression. Though the results of Butler and Mathews (1983) are open to criticism, they are at least consistent with previous findings of an association between anxiety and exaggerated expectations of danger. Unfortunately, the levels of depression were not reported in the previous studies, and so the question remains about the affective specificity of the bias to overestimate threat.

In a later study, Butler and Mathews (1987) tested the prediction that anxiety, arising from anticipation of a stressful examination, would be associated with an inflation of subjective risk in judgments of negative events related to oneself. Subjects consisted of 57 university

undergraduate students. Thirty-one subjects expected a major university examination in a month's time, and 26 subjects had no forthcoming examinations at the time of testing. The subjective probability of each of a number of pleasant and unpleasant events were rated on two occasions; one month and one day before the examination date. Increases in anticipatory (state) anxiety as the examination approached were associated with increased subjective risk of examination failure, whereas trait anxiety was associated with perceived risk of a variety of negative events, regardless of whether the events were related to examinations.[1]

Butler and Mathews (1987) interpreted their findings as providing support for a cognitive theory of anxiety that posits a set of relationships between anxiety and the storage and retrieval of threat-relevant information:

> We would speculate that trait anxiety levels reflect the extent, elaboration, or accessibility of [threat-relevant] 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 worry thoughts about such events. Owing to the increased accessibility of threatening information, judgments of future risk across a wide range of negative events is [sic] also elevated. (Butler & Mathews, 1987, p. 564)

Butler and Mathews' (1987) study was correlational in nature, and limited in its assessment of emotion. Thus, like their previous study, it is difficult to determine the extent to which the changes in risk estimation were due to variations in depressed mood rather than anxiety. Even if risk estimation is largely the product of anxiety, it is possible that their findings revealed only a segment of a complex, interactive cycle, where state anxiety facilitates the retrieval of mood-congruent memories (Blaney, 1986; Bower, 1981) which, in turn, influences risk perception. The latter may then further increase state anxiety. These possibilities will be taken up in later chapters.

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[1] Trait anxiety refers to relatively stable individual differences in the tendency to respond to stressful situations with elevated state anxiety (Spielberger, 1983).

The final area to be reviewed in this section concerns the relationship between social anxiety and risk perception. Several studies have shown that socially anxious individuals tend to underestimate their levels of interpersonal skill (Edelmann, 1985; Trower, 1981). Lucock and Salkovskis (1988) hypothesized that socially anxious individuals also tend to overestimate the likelihood of socially threatening events. To test this, they obtained probability estimates of socially threatening situations from 12 social phobics (defined according to DSM-III criteria) and 40 undergraduate students matched for age and gender. A subjective probability scale was derived from that used by Butler and Mathews (1983). Subjects were asked to estimate the likelihood of each of several positive or negative events happening to them. The events were either social in nature (e.g., "You will have a serious disagreement with a friend in the next six months") or nonsocial (e.g., "When you next go on holiday the weather will be fine"). None of the items referred to the subject's social performance, and so assessed event predictions independent of performance expectations.

Relative to the control group, the social phobics tended to overestimate the probability of unpleasant social events. There was also a trend for the social phobics to underestimate the probability of pleasant social events. There were no differences between the groups in their estimates of the likelihood of pleasant or unpleasant nonsocial events. After the social phobics were treated with cognitive therapy (Beck & Emery, 1985), they showed decreases in their estimates of the probability of negative social outcomes. There were no changes in the probability estimates for nonsocial items. As in most of the previous studies, no measure of depression was reported by Lucock and Salkovskis (1988). Yet, the fact that the groups differed in ratings of social rather than nonsocial events suggests that the predictive bias was specific to social anxiety.

In summary, several studies have shown that anxious individuals tend to overestimate the likelihood of dangerous and other aversive events. The affective specificity of these results awaits a full investigation. Given the correlation between anxious and depressed mood (typically $r \geq .40$; Dobson, 1985), and the finding that the tendency to overestimate aversive events occurs in patients who are primarily depressed (Butler & Mathews, 1983), it is unclear whether the biases are specific to anxiety, or whether they also covary with depression. Since the cognitive contents of anxiety tend to be focused on potential future events, whereas depression is more associated with thoughts of the past (Tellegen, 1985; Williams, Watts, MacLeod, & Mathews, 1988), it may be that the overprediction of (future) aversive events is more closely associated with anxiety than depression.

Fear Expectations in Military Settings

Turning now to the overprediction of fear, some of the earliest work on this phenomenon was concerned with military personnel performing hazardous tasks. As part of an investigation of fear and courage, Rachman (1983) conducted a study of 21 psychologically well-adjusted trainee paratroopers. In the course of their training the recruits were required to complete several tasks related to parachute-jumping. The final, most hazardous task was a jump from an aeroplane. Recruits made pre- and post-training ratings of self-efficacy (i.e., perceived skill) for performing the final jump, and pre- and post-training ratings of state anxiety. They also made predictions and reports of their fear and performance, and of the dangerousness of the final jump. Each rating was made on 0-100 scale anchored such that 0 indicated the smallest amount of the attribute in question, and 100 was the maximum amount possible.[2]

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[2] This is the prototypic design of the predict-report studies to be reviewed in the remainder of this chapter. Here, the subject makes predictions about feature(s) of, or response(s) to an aversive stimulus. The subject is then exposed to the stimulus and then makes a report of what was perceived or experienced. The term "prediction" will be used to refer to the individual's expectations about the stimulus and about the responses that it will elicit. The term "report" will be reserved for the individual's rating of what was perceived or experienced upon exposure to the stimulus. In later chapters, predictions (expectations) will be distinguished from experimental predictions, which are deductions from the hypotheses under investigation.

The recruits' mean level of predicted fear was 48.09 [standard deviation (SD) = 26.09], which was significantly greater than the mean level of reported fear ($M = 40.00$, $SD = 19.87$; $p < .05$, effect size = 0.35 SD units). Thus, the recruits tended to overpredict their fears. There was no difference between predicted and reported performance in executing the jump, or between predictions and reports of the dangerousness of the jump. Predictions and reports of fear were correlated with pre- and posttraining ratings of state anxiety, and only reported fear was correlated with pre-training measures of self-efficacy. It is of interest to note that predicted fear was not correlated with pre-training self-efficacy. This raises the question of whether important task-relevant information (i.e., perceived skill) influenced reported fear but not predicted fear. The relationship between the overprediction of fear and the overprediction or underprediction of other aspects of the jump was not assessed.

McMillan and Rachman (1988) replicated and extended Rachman's (1983) investigation with a sample of 105 psychologically well-adjusted trainee paratroopers. The recruits completed ratings of self-efficacy for parachuting under various weather conditions, and made predictions and reports for various aspects of their first aeroplane jump. These included ratings of fear, performance, danger, and confidence in making the jump. As before, ratings were made on a 0-100 scale, where 0 indicated the smallest amount of the attribute in question, and 100 was the maximum amount possible. A cluster analysis was performed on the data collected from these and other ratings (measures of hypochondriasis, phobias, and anxiety-related bodily sensations). The most meaningful solution consisted of three clusters of recruits. These were interpreted as representing courageous, fearless, and overconfident paratroopers. The courageous group (66.67% of the sample) was so-labelled because they tended to report moderate levels of fear, yet also reported high levels of self-efficacy, confidence, and performance. The fearless group (25.81% of sample) was labelled as such because they endorsed the lowest levels of predicted and reported fear. They also reported high levels of self-efficacy, performance, and confidence at pre- and post-training. The subjects in the over-confident group (7.53% of sample) were so-labelled because they underpredicted the dangerousness of the jump and had lower post-training ratings of self-efficacy, confidence, and performance than the subjects in the other

clusters.

The authors did not statistically analyze the patterns of overprediction as a function of cluster, and there are insufficient data presented in the original paper to perform the necessary analyses for the present review. However, it is useful to compare the effect sizes to examine the relationships among cluster type, overprediction of fear, and the other dependent variables. Table 2.1 shows the descriptive statistics of predictions and reports of the dependent variables for each cluster type. The table also shows the effect sizes for the differences between the means of the predicted and reported values. The equation used to compute the effect sizes is given at the bottom of Table 2.1. Although a comparison of the effect sizes permits only tentative conclusions, the table clearly shows that all groups overpredicted the amount of fear they would experience on the final jump. When the data from the clusters are combined, McMillan and Rachman (1988) reported that the difference between predicted and reported fear was significant ($p < .01$). The effect size for this result is 0.40 SD units, which is comparable to the value of 0.35 obtained in the earlier study by Rachman (1983).

Table 2.1 shows that the recruits in the fearless group tended to experience the lowest level of fear and tended to be accurate in their danger expectations. Yet, these recruits also tended to be underconfident, and overpredicted their fears. They also underpredicted their performance. The subjects in the courageous group were the most underconfident, although they showed the smallest amount of fear overprediction, tended to underpredict the dangerousness of the jump, and tended to be accurate in their predictions of their performance. The recruits in the overconfident group underpredicted the dangerousness of the jump, despite overpredicting their fear and underpredicting their performance.

Although this analysis was based only on an informal comparison of effect sizes, it is clear that the overprediction of fear was not greatest for the most fearful subjects. Moreover, the overprediction of fear was not always associated with the underprediction of confidence or the overprediction of dangerousness. In each group the overprediction of fear tended to be associated with the underprediction of performance and lower self-efficacy before training compared with after training.

Table 2.1. Means and SDs for each dependent variable assessed for the final parachute jump for each of three clusters of novice paratroopers. Effect sizes are in SD units. (Data from McMillan & Rachman, 1988. Means and SDs were reported to one decimal place in the original.)

Dependent Variable	Cluster	Prediction M	Prediction SD	Report M	Report SD	Effect Size*
Fear	Courageous	52.6	22.6	41.5	27.4	0.44
	Fearless	35.0	21.1	14.4	17.9	1.06
	Overconfident	64.3	24.4	50.7	1.9	1.03
	Entire sample	49.1	23.2	38.7	29.2	0.40
Danger	Courageous	22.9	26.4	30.1	29.6	-0.26
	Fearless	21.9	28.6	19.8	21.4	0.08
	Overconfident	22.1	26.1	50.7	27.5	-1.07
	Entire sample	24.0	27.5	28.4	28.3	-0.15
Performance	Courageous	54.6	18.1	57.1	23.7	-0.12
	Fearless	81.2	21.1	85.7	19.6	-0.22
	Overconfident	50.0	0.1	50.7	1.9	-0.70
	Entire sample	61.6	21.8	67.5	41.1	-0.19
Confidence	Courageous	58.5	18.4	80.4	23.5	-1.05
	Fearless	90.7	15.1	95.8	7.0	-0.46
	Overconfident	63.6	25.0	52.1	5.7	0.75
	Entire sample	67.5	22.1	81.7	22.3	-0.64
		Pre-Training Estimate M	Pre-Training Estimate SD	Post-Training Estimate M	Post-Training Estimate SD	
Self-efficacy**	Courageous	54.3	27.4	82.9	18.2	-1.25
	Fearless	75.9	23.3	95.0	7.3	-1.25
	Overconfident	53.4	17.9	72.0	19.4	-1.00
	Entire sample	58.7	28.7	85.5	17.5	-1.16

* Effect size = $(M_P - M_R)/S_{pooled}$, where M_P = mean prediction, M_R = mean report, and S_{pooled} is the arithmetic mean of the SDs of prediction and report.

** The ratings for this variable were pre- and post-training estimates rather than predictions and reports.

The results reported by Rachman (1983) and McMillan and Rachman (1988) show that expectations for aversive events are sometimes, but not always concordant. Most notably, the overprediction of fear is not always associated with the overprediction of danger. This raises the question of what variables are consistently associated with the overprediction of fear. It may be that there were other threat-relevant aspects of the jump that were overpredicted or underpredicted. For example, the overprediction of fear may be associated with the underprediction of safety. This possibility will be examined later in this review.

Simple Phobia and Fear Predictions

Extending the study of overprediction, Rachman and Lopatka (1986a, 1986b, 1986c) conducted a series of investigations of the fear predictions and fear reports of simple phobics. A predict-report paradigm was used, where each subject rated the peak amount of fear that he/she expected to experience when exposed to a fear-evoking stimulus. Ratings were made on a 0-100 scale, where 0 = no fear, and 100 = extreme or terrifying fear. After making a fear prediction, each subject was exposed to the stimulus, and then reported the amount of fear that had been experienced. As mentioned earlier, the latter measure is known as the subject's level of reported fear.

The first experiment (Rachman & Lopatka, 1986a) used a sample of 44 snake-phobic university students. Each subject completed 10 trials of a task that required him/her to approach a live, harmless snake that was housed in a glass container. At the beginning of each trial the subject stood 20 ft (6 m) from the snake, which could be clearly seen at the end of the room. The subject then predicted the peak amount of fear that would be experienced at several distances from the snake. This procedure was used to establish the distance at which a given subject's predicted peak fear was 75/100. The subject was then asked to walk up to that point, view the snake for 15 seconds, and then return to the starting point and report the peak amount of fear that had been experienced.

The differences between prediction and report on each trial were classified in the following manner. A correct match was said to occur when predicted and reported fear differed by less than two points on the 0-100 scale. Mismatches were classified as overpredictions or

underpredictions. An overprediction was defined as a fear prediction that was two or more points greater than a fear report, and an underprediction was defined as a fear prediction that was two or more points less than a fear report. This classification scheme will be called the two-point criterion.

According to this classification, overpredictions occurred on 45.69% of trials, underpredictions on 22.68% of trials, and correct matches on 31.63% of trials. The mean level of predicted fear exceeded the mean level of reported fear on the first 5 of the 10 trials that each subject completed. When the t-tests comparing predictions and reports on each of the 10 trials are adjusted for Type I error using a Bonferroni-corrected alpha level of .1/10 = .01, the magnitude of overprediction was significantly greater than zero on the first and second trial. Overprediction was greatest for the first trial, where the effect size for the difference between predicted and reported fear was 0.95 SD units ($p < .001$.) The effect size for the second trial was 0.39 ($p < .01$). Thus, subjects displayed a bias toward overprediction, which was greatest during the first two trials. The bias toward overprediction occurred even though subjects made their predictions with knowledge of what the snake looked like and what the approach task involved.

To examine the effects of matches and mismatches on subsequent predictions and reports, Rachman and Lopatka (1986a) reported the following analyses. Each trial was classified as a correct match, overprediction, or underprediction according to the two-point criterion. The change in the predictions and reports from that trial (trial t) to the next trial (trial $t + 1$) was then examined. Each between-trial difference was classified as an increase, decrease, or no change from the preceding trial. In this way a 3 x 3 contingency table was formed: Match, overprediction, and underprediction on trial t, crossed with increase, decrease, or no change in predicted fear on trial $t + 1$. A second contingency table was constructed, where the type of match/mismatch on trial t was crossed with the type of change in reported fear on trial $t + 1$.

This method pools data over subjects and trials and so has the advantage of yielding a large number of observations from a comparatively small number of subjects. However, it confounds the between- and within-subject effects, which represents a violation of the assumption of independent observations. This assumption underlies the F, t, and χ^2 statistics, and its violation

precludes a reliable estimation of the Type I error rate (Hays, 1981). Thus, any conclusions regarding the consequences of matches and mismatches cannot be based on statistical tests, and must be drawn from on an informal interpretation of trends. The following results are therefore reported simply as frequencies whose "significance" is best indicated by their replicability rather than by statistical criteria.

In the trial following a correct match, the majority (67.74%) of fear predictions remained unchanged from the preceding trial. Reported fear declined on the majority (53.26%) of trials following a correct match. In the trial following an underprediction, predicted fear tended to increase (68.18% of trials) whereas reported fear tended to decrease (65.15% of trials). Although the relevant frequencies were not reported, inspection of the means reported by Rachman and Lopatka (1986a) suggests that underpredictions tended to be followed by overpredictions or by correct matches. In the trial following an overprediction, predicted and reported fear both tended to decrease (93.43% and 54.20% of trials, respectively). Overpredictions were prominent in the first few trials, giving way to increasingly accurate matches between prediction and report.

Rachman and Lopatka's (1986a) study revealed a dynamic and asymmetric interplay between predicted and reported fear. The occurrence of a match or mismatch had no effect on the level of fear reported on the next trial; fear levels steadily declined (habituated) regardless of the accuracy of the predictions. The presence of a match or mismatch seems to have had an influence on subsequent predictions. Predictions tended to remain constant after a correct match, increase after an underprediction, and decrease after an overprediction. The fear prediction of each trial tended to be almost identical with the fear report of the preceding trial (see Rachman & Lopatka, 1986a, Table 1), suggesting that subjects based their predictions on the level of fear experienced during the preceding trial. Thus, in the midst of a series of predict-report trials the bias toward overprediction would result if subjects based their fear predictions on the fear report of the previous trial, and neglected to consider that fear tends to habituate over trials. The results also suggest the hypothesis that overpredictions are caused by underpredictions. Underpredictions, in turn, may arise from unexpected aversive events, such as the sudden,

occasional movement of the snake. The question remains as to why overpredictions were most likely to occur on the first trial.

A replication of this experiment was carried out as part of a study by Rachman and Lopatka (1986b). A sample of 40 snake-phobic university students participated, and the design was the same as that of the previous study. The authors did not report the magnitude of the difference between prediction and report as a function of the number of trials the subjects completed. Using the two-point criterion, 44.11% of trials were overpredictions, 32.66% were correct matches, and 23.23% were underpredictions. These frequencies cannot be supplemented with statistical tests because of the violation of the assumption of independence of observations, as mentioned earlier. Still, the results do suggest a bias toward overprediction. Fear predictions were said to become increasingly accurate over trials.

The match/mismatch patterns observed by Rachman and Lopatka (1986b) were similar to those observed in their previous study. Following a correct match, predicted fear tended to remain unchanged (73.75% of trials), and reported fear tended to decrease (46.85% of trials) or remained unchanged (39.24% of trials). This suggests that matches were followed by either correct matches or by overpredictions. Following an underprediction, predicted fear tended to increase (67.19% of trials) whereas reported fear tended to decrease (75.00% of trials). This indicates that underpredictions tended to be followed by overpredictions or by correct matches. Following an overprediction, predicted fear tended to decrease (95.41% of trials) and reported fear tended to decrease (50.93% of trials). This suggests that overpredictions tended to be followed by increases in predictive accuracy.

In the third study of this series, Rachman and Lopatka (1986c) examined the predictions and reports of 60 university students who feared spiders or snakes. Subjects completed 10 predict-report trials in which they were exposed to either a live spider or snake, depending on the animal they feared the most. No differences were found between the pattern of results for the spider-fearful and snake-fearful subjects, and so the data were pooled. Trials were classified as overpredictions, underpredictions, or matches according to the two-point criterion. A bias toward overprediction was found, with overpredictions occurring on 48.99% of trials, underpredictions

on 12.12% of trials, and correct matches on 38.89% of trials. No data were presented on the magnitude of the difference between predictions and reports.

Following a correct match, most (75.53%) trials were followed by no change in predicted fear. Reported fear tended to either decrease (52.45% of trials) or remain unchanged (41.96% of trials) following a correct match. After an underprediction, predicted fear tended to increase (69.05% of trials) whereas reported fear tended to decrease (73.81% of trials). Following an overprediction, predicted and reported fear tended to decrease (99.41% and 68.82% of trials respectively). As before, these data suggest that underpredictions tended to be followed by overpredictions or correct matches.

Summary. Table 2.2 summarizes the results of the three studies presented in this section. A prediction index, which is a measure of the strength of the bias toward overprediction or underprediction, was devised for this review and applied to the findings of each study. This index compares the frequency of overpredictions and underpredictions according to the equation given at the bottom of Table 2.2. The index ranges from 1 to -1. A value of 0 indicates an absence of bias. The magnitude of positive values indicates the strength of the bias toward overprediction, and the magnitude of negative values indicates the strength of the bias toward underprediction. As the table shows, a bias toward overprediction was found in all three studies. The strength of the bias was similar in the first two studies, but considerably larger in the third. It is not clear why the bias should be greatest in the third study. Unlike the subjects in the first two studies, the subjects in the third study received four exposure trials before completing the 10 predict-report trials. Thus, prior to trial 1 the subjects of the third study had already gained experience with the fear-evoking stimulus for which they would make their fear predictions. The differences in the prediction index across the three studies may have been due to random error. There were insufficient data to determine whether the magnitude of the bias toward overprediction, as measured by the difference between the means of predicted and reported fear, was consistent across the three studies. All three studies suggest that underpredictions are a source of overpredictions. This hypothesis is based in the sequential patterns of predictions, reports, and the differences between the two, and is in need of experimental evaluation.

Table 2.2. Percentage of trials classified as overpredictions, underpredictions, or correct matches in the studies by Rachman and Lopatka (1986a, 1986b, 1986c).

Study	Overprediction	Underprediction	Correct Match	Prediction Index *
1986a	45.69	22.68	31.63	0.34
1986b	44.11	23.23	32.66	0.31
1986c	48.99	12.12	38.89	0.60
			Mean	0.42

* Prediction Index = (OP - UP)/(OP + UP), where OP = the percentage of trials classified as overpredictions, and UP = the percentage of trials classified as underpredictions. Values of this index range from 1 to -1. Positive values indicate a bias toward overprediction and negative values indicate a bias toward underprediction. Zero values indicate an absence of bias.

Some comments are in order concerning the use of the two-point criterion. Rachman and Lopatka (1986a) stated that this criterion was "used as part of a conservative approach to the phenomenon, but obviously, other definitions may be preferable for studies with different aims" (p. 388). This criterion is arbitrary and it is not known whether the prediction index changes with the use of different classification criteria, such as a 5 or 10 point difference. However, the demonstration of overprediction by the computation of effect-sizes (Table 2.1, p. 13) offers evidence that the bias toward overprediction is not an artifact of the method of analysis.

The Prediction of Panic

If subjects tend to overpredict their levels of fear then it seems likely that they should overpredict other forms of anxiety, such as panic. This was investigated as part of a study by Rachman and Levitt (1985). Subjects consisted of 17 claustrophobic university students. A predict-report paradigm was used that required each subject to complete a series of trials. In each trial the subject entered a small, darkened room for two minutes. At the beginning of each trial, the subject made a prediction of (i) the duration that he/she could remain in the room without becoming unduly upset; (ii) the amount of safety that would be experienced while in the room for the time estimated in prediction (i); (iii) the level of fear that would be experienced after being in the room for the time estimated in (i); and (iv) the probability of panicking while in the room. Fear, safety, and the probability of panic were rated on 0-100 scales, where 0 indicated the smallest amount of the variable in question, and 100 was the maximum amount possible. After completing the predictions and entering the test room, each trial ended with the subject leaving the room and rating the levels of fear and safety that had been experienced. Each subject also indicated whether he/she had experienced a panic, near panic, or had not panicked. ("Near panics" were classified as panics in the studies described in this section.)

Subjects completed between 4 and 20 predict-report trials ($M = 7.5$). Since the focus of the study was on the consequences of panic, the authors did not report whether subjects underpredicted the duration that they could remain in the room. Concerning the possibility of biases toward the overprediction of fear and underprediction of safety, Rachman and Levitt (1985) reported that "on 14 out of 16 comparisons there was no significant difference between predicted and experienced fear or safety" (p. 589). Further details of these comparisons were not presented. For the present purposes, the most interesting finding was that subjects tended to overpredict the probability of panic. The authors defined the subjects' ratings as predictions of panic or predictions of no-panic according to the following criterion. A rating of the probability of panic that was greater than 50/100 was defined as a prediction of panic, and a probability less than 50 was defined as a prediction of no-panic. By this criterion, the overprediction of panic occurred on 15.12% of trials, underprediction on 6.59% of trials, and a correct match on 78.29%

of trials.

As in the previous studies, a match/mismatch pattern was found. That is, following a correct match, fear predictions in the following trial tended to remain unchanged. Following an overprediction, fear predictions tended to decrease, and following an underprediction, fear predictions tended to decrease. The frequency of reported fear steadily declined over trials, regardless of the accuracy of the fear predictions. In a reanalysis of these data, Rachman, Levitt, and Lopatka (1987) found that the same pattern applied for the prediction and report of panic. Since the level of reported fear and frequency of reported panic steadily declined over trials, and predictions of fear and of panic tended to increase after underpredictions, these results suggest that underpredictions were one source of overpredictions.

Further studies of fear, panic, and prediction were conducted by Rachman, Levitt, and Lopatka (1988a) and Rachman, Lopatka, and Levitt (1988b). The sample of the latter study consisted of 20 patients with a DSM-III-R diagnosis of panic disorder. The predict-report paradigm was used, and exposure trials were tailored to the situations that each patient feared. These were places that were familiar to the patients, such as a shopping malls and department stores. On each trial the patient made a prediction of peak fear and then briefly entering the feared situation. The patient then reported the peak fear that had been experienced. Each patient completed a minimum of four trials.

Rachman et al. (1988b) reported that the mean predicted fear was consistently higher than the mean reported fear in the first four trials. Unfortunately, the significance level of the difference between the mean prediction and report for each trial was not reported, and there are insufficient data in the paper to present an analysis here. However, the effect sizes can be computed. Recall that the effect size for a given trial is the difference between mean predicted fear and mean reported fear, divided by the mean of the SDs (see the footnote to Table 2.1, p. 13). The effect sizes were 0.34, 0.53, 0.20, and 0.01 for trials 1 to 4 respectively. These results show that the panic patients tended to overpredict their fears on the first two trials, with this bias giving way to predictive accuracy on the later trials. The pattern of effect sizes is similar to those obtained by Rachman and Lopatka (1986a) for their sample of simple phobics. The exception is

that the mean size of overprediction was greatest on trial 2 rather than trial 1. The significance of this remains to be clarified; it may have been a random fluctuation in the progressive decline in overprediction across trials.

When the fear ratings of each trial were classified according to the two-point criterion, Rachman et al. (1988b) found that the overprediction of fear occurred on 62.22% of trials, underprediction on 27.11% of trials, and a correct match on 10.67% of trials. This provides further evidence of the bias toward overprediction. Following an overprediction, predicted and reported fear declined on most trials (90.20% and 66.67% of trials, respectively). After an underprediction, predicted fear tended to increase (62.50% of trials), whereas reported fear tended to decrease (73.68% of trials). Following a correct match, predicted and reported fear tended to decrease (75.00% and 53.85% of trials, respectively). These results suggest that underpredictions tended to be followed by overpredictions or by correct matches.

In the final paper to be reviewed in this section, Rachman et al. (1988a) reported two experiments on university student samples of claustrophobics. The first experiment used 26 claustrophobics. A predict-report paradigm was used where the subject completed a series of trials in which he/she entered a small, dark test room for a period of two minutes. Prior to the trials, the subjects viewed the room, and one group of 13 subjects was given safety information concerning oxygen availability and rate of oxygen consumption in the room. A candle was also lit and placed in the test room and these subjects were informed that there was sufficient oxygen so long as the candle remained burning. The 13 subjects in the control group were given safety-irrelevant information and the candle was not lit. At the beginning of each predict-report trial, the subject made predictions of fear and safety, and estimated the probability of panic. After completing the predictions, the subject entered the test room. The trial ended with the subject leaving the room to rate the levels of fear and safety that had been experienced, and whether he/she had panicked or came close to panicking. Each subject received a minimum of nine trials.

A panic probability score greater than 50 was defined as a prediction of panic. By this criterion the overprediction of panic occurred on 19.11% of trials, underprediction on 6.10% of trials, and correct match on 74.80% of trials. Using the two-point criterion, 60.16% of trials

were overpredictions of fear, 24.80% were underpredictions of fear, and 15.04% were correct matches between predicted and reported fear. Thus, biases toward the overprediction of fear and panic were found. It was reported that the bias toward overprediction of panic diminished over trials. It is likely that the bias toward the overprediction of fear also declined with trials.

Turning to consider the effects of safety information, it was found that 10 (76.92%) of the 13 subjects in the control group experienced at least one panic. In comparison, only one (7.69%) of the subjects in the safety group reported a panic. This difference was significant ($p < .001$). Interestingly, the groups did not differ in their predictions of panic or in their predictions and reports of fear and safety. The question arises as to the locus of these effects. Were these selective effects due to the presence or absence of safety information provided prior to the exposure task? It may be that the results simply arose from the differences in the feared stimuli. In the safety condition the test room was illuminated, and in the control condition the room was darkened. If illuminated enclosed spaces tend to be less fear-evoking than darkened ones, then the results may have been due to these stimulus differences instead of the amount of safety information provided at the beginning of the experiment. If the findings of Rachman et al. (1988a) can be replicated and their meaning clarified, they may provide some valuable insight into the informational basis of the bias toward overprediction. The implications of these results will be considered in Chapter 5.

In the second experiment by Rachman et al. (1988a), the predict-report paradigm was also used. Twenty claustrophobic subjects made ratings of predicted and reported levels of fear, panic, and safety. The severity of reported panic was assessed on a continuous 0-100 scale rather than by the dichotomous (yes/no) measure. On each trial the subject entered the test room for a period of 2 to 4 minutes. The exposure duration was randomly determined by the experimenter. The authors defined a panic as a score of 61 or more on the panic severity scale. This cutoff was 1 SD above the mean panic severity that was obtained by pooling the responses of all subjects across all trials. According to the two-point criterion, subjects overpredicted panic on 65.00% of trials, underpredicted panic on 17.14% of trials, and correctly predicted panic on 17.86% of trials. Fear was overpredicted on 57.14% of trials, underpredicted on 25.00% of

trials, and correctly predicted on 17.86% of trials. Thus, biases toward overprediction of fear and panic were found. Predictions of panic tended to decrease after an overprediction, increase after an underprediction, and remain constant after a correct match. The same pattern was found for predicted fear. Reported fear and reported panic tended to decline or remain unchanged, regardless of the accuracy of the predictions on the previous trial. These results suggest that underpredictions of fear or panic tended to be followed by overpredictions or by correct matches.

Summary. Table 2.3 presents a summary of the findings of the panic studies. It shows that although subjects were often accurate in their predictions, biases toward the overprediction of fear and panic were observed. A comparison of the prediction indices reveals that the bias toward the overprediction of panic was similar to, if not somewhat greater than the bias toward the overprediction of fear.

Table 2.3. Percentage of trials classified as overpredictions, underpredictions, or correct matches for each panic study.

		Fear Prediction			
Study		Over-prediction	Under-prediction	Correct Match	Prediction Index *
Rachman et al. (1988a)	Expt. 1	60.16	24.80	15.04	0.42
	Expt. 2	57.14	25.00	17.86	0.39
Rachman et al. (1988b)		62.22	27.11	10.67	0.39
				Mean	0.40

		Panic Prediction			
Study		Over-prediction	Under-prediction	Correct Match	Prediction Index
Rachman et al. (1988a)	Expt. 1	19.11	6.10	74.80	0.52
	Expt. 2	65.00	17.14	17.86	0.58
Rachman & Levitt (1985)		15.12	6.59	78.29	0.39
				Mean	0.50

* Prediction Index = (OP - UP)/(OP + UP), where OP = the percentage of trials classified as overpredictions, and UP = the percentage of trials classified as underpredictions.

Pain Prediction

Several studies have found that people tend to overpredict the intensity of pain that they will experience from a potentially painful stimulus (e.g., Arntz & Lousberg, 1990; Arntz & van den Hout, 1988; Spanos, Cross, & Watson, 1987). Predictions and reports of pain also have been found to show match/mismatch patterns similar to those of fear (Arntz & Lousberg, 1990; Arntz & van den Hout, 1988; Arntz, van Eck, & Heijmans, 1990b; Rachman & Lopatka, 1988). These findings suggest that the investigation of pain prediction may shed light on the determinants of the overprediction of fear.

In an early investigation, Kleinknecht and Bernstein (1978) found that dental patients tended to overpredict the painfulness of dental treatment. Wardle (1984) examined this effect in further detail by interviewing 51 dental patients before and after a tooth extraction. Before treatment, each patient rated his/her level of state anxiety and predicted the level of pain that would be experienced during the injection of local anesthetic, and during the tooth extraction. After treatment, subjects rated the levels of pain they had experienced. Predicted pain was greater than reported pain for ratings of injections (effect size = 1.05, $p < .01$) and tooth extractions (effect size = 0.57, $p < .01$). The percentage of subjects who overpredicted their pain increased with pre-treatment anxiety level. Overpredictions of injection pain, for example, were made by 85.71% of highly anxious patients but only 46.67% of non-anxious patients. These results raise the possibility of a causal link between state anxiety and the magnitude of the bias toward overprediction.

Kent (1984) investigated predictions and reports of dental pain as a function of (i) the type of dental procedure (checkup, filling, etc.) and (ii) a trait measure of dental anxiety, the Dental Anxiety Scale (Corah, 1969). Kent compared the predictions and reports of the dental pain of 24 patients with high dental anxiety and 21 patients with low dental anxiety. The high anxiety group experienced less pain than the low anxiety group for procedures requiring local anesthetic (e.g., fillings, extractions), but there were no between-group differences in reported pain for the other dental procedures (e.g., cleaning, checkups). Subjects with low dental anxiety tended to be accurate in their predictions, regardless of the type of dental procedure. Subjects with high

dental anxiety tended to overpredict their levels of pain for procedures that required local anesthetic but not for the less painful procedures.

Subjects were also asked to estimate the number of times they would experience any of the following pain levels if they were to make 100 visits to the dentist: no pain, slight pain, moderate pain, and severe pain. The high and low anxiety groups differed only on their ratings of severe pain. The subjective probability of experiencing severe pain was rated as significantly higher by the high anxiety group compared with the low anxiety group.

Kent's (1984) findings suggest that the overprediction of pain is greatest when procedures are painful and patients are anxious. The association between the level of dental anxiety and the overprediction of pain was later replicated by Arntz et al. (1990b). Kent (1984, 1985) offered two hypotheses for the occurrence of overprediction. According to the first hypothesis, overprediction occurs because people more readily recall episodes of severe pain than episodes in which they experienced little or no pain. That is, overprediction arises from the selective recall of highly painful experiences. The second, related hypothesis proposed that pain expectations are schema-driven. Schemata are information structures that influence the encoding, storage, and retrieval of information (Segal, 1988; see Chapters 4 and 5 for details). The patient with a high level of dental fear is assumed to have a schema in which dental procedures are represented as highly painful. This schema could have been acquired from direct experience, vicarious learning, or other forms of information transmission (Bandura, 1986). According to this model, the schema forms the basis of pain predictions, and thus is the source of the bias toward overprediction. Such a schema may persist unchanged because dental experiences are infrequent and are processed in a schema-congruent manner. Thus it is assumed that high-pain schemata do not accommodate to information about episodes of low pain.

If the overprediction of pain is due to schema-congruent processing, then other biases should also be evident, such as the tendency to recall more pain than was actually experienced. Kent (1985) tested this in a study of 10 patients with high dental anxiety and 17 patients with low dental anxiety. Patients made predictions and reports of dental pain and, three months later, were asked to recall the level of pain they had experienced. High-anxiety patients not only

overpredicted their pain levels, but also recalled having more pain than they had actually experienced. Low anxious patients were more accurate in their predictions and recollections. These findings were replicated by Arntz et al. (1990b) and partially replicated by Rachman and Eyrl (1990). The results of all three studies are consistent with the notion that schemata for aversive stimuli are sources of distorted predictions and recollections of pain, and that these structures are resistant to modification by corrective information. The schema hypothesis and/or the selective recall hypothesis may be extended to account for the overprediction of fear. These possibilities are explored in Chapters 4 and 5.

Covariation Bias

Tomarken, Mineka, and Cook (1989) recently reported a series of studies that demonstrated a cognitive distortion known as the covariation bias. Taking a sample of university students with a wide range of levels of spider or snake fears, Tomarken et al. (1989) presented subjects with trials in which a fear-relevant (snake or spider) or fear-irrelevant (mushroom or flower) slide was presented. Each slide was followed by one of three consequences: a tone, electric shock, or nothing. Although there was no systematic relationship between the type of slide and type of outcome, subjects tended to overestimate the contingency between feared slides and shock. This was evident even when the tone and shock were matched in salience, and when the base rate of shock was varied. The bias was greatest in highly fearful subjects, and all subjects were accurate in all their covariation estimates for fear-irrelevant stimuli.

The overestimation of the contingency between feared stimuli and aversive consequences is a direct and powerful way to confirm or maintain fear. That is, distorted judgments of this sort would "validate" the individual's appraisal of the feared stimulus as threatening (Tomarken et al., 1989). Rachman and Bichard (1988) argued that the bias toward the overprediction of fear represents a bias toward caution. This also can be said about the covariation bias:

> The long-run cost to an organism that would be incurred by mistakenly treating a threatening stimulus or situation as nonthreatening is greater than the cost that would be incurred by mistakenly treating a safe stimulus or situation as threatening. Thus, fear may often be associated with a "conservative" bias to perceive, remember, or interpret fear-relevant stimuli as more threatening than they may actually be. (Tomarken et al., 1989, p. 391)

Are the covariation and overprediction biases related? Mineka and Tomarken (1989) argued that the covariation bias is a product of schema-driven processing, where the individual's expectancies about the relationships among stimuli and outcomes influence the perceived contingencies. Extending this view, it is possible that the overprediction and covariation biases are both a result of schema-congruent processing. Schema representations that exaggerate the aversive consequences of encounters with given types of stimuli could lead to the overprediction of fear and, equivalently, the overestimation of the contingency between these stimuli and high levels of fear. In other words, the covariation and overprediction biases may be variants of processing that exaggerates, in a schema-congruent manner, the aversive consequences of encounters with particular stimuli. Thus, further study of the covariation bias is likely to shed light on the nature of the bias toward overprediction, since they may be a result of the same underlying processes.

Are Fear Expectations Self-Confirming?

Theorists such as Kirsch (1985, 1990) and Reiss (1980, 1987; Reiss & McNally, 1985) have argued that fear expectations have "self-fulfilling" or self-confirming effects. According to this view, "the expectancy for anxiety or panic is capable of generating those responses" (Southworth & Kirsch, 1988, p. 118). Although such effects have not been investigated in the predict-report studies, the existence of self-confirming effects may pose an important complication for any theory of overprediction. Thus it is necessary to address the question of evidence for the self-confirming effects of fear expectations.

In a controversial article, Kirsch (1985) argued that if fear is a function of fear expectations, then expectancy modification procedures should influence fear. Kirsch claimed that the large number of studies demonstrating the fear-reducing properties of placebos provides evidence for this assertion. Kirsch's claim is open to several criticisms. First, it is based on the logical fallacy of affirming the consequent. Second, Kirsch's review of the literature was based on several errors of omission and commission, and the evidence of self-confirming effects is hardly compelling. Wilkins (1986) pointed out that many experiments cited by Kirsch did not employ measures to validate the presence of the relevant expectations. In the experiments that did assess

expectations, the effects may have been due to experimental demand. Even when expectancies were correlated with fear reduction, "it appears that expectancies have been effects of prior improvement and have represented estimates [correlates], rather than causes, of future performance" (Wilkins, 1986, p. 1387).

Southworth and Kirsch (1988) attempted to garner evidence for the self-confirming effects of expectations in fear reduction. Thirty-two agoraphobic patients, diagnosed according to DSM-III criteria, were assigned to a high-expectancy exposure group ($n = 10$), a low-expectancy exposure group ($n = 10$), or a waiting-list control group ($n = 12$). Subjects in both exposure groups received 10 trials of in vivo exposure over a 2-3 week period. In each trial the subject walked continuously away from his/her home until becoming "unduly" anxious. Subjects in the low-expectancy group were told that the exposure trials were intended for assessment purposes and did not constitute treatment. Subjects in the high-expectancy group were told that the trials were part of a treatment that was effective in reducing fear and avoidance. Before each trial, the subject predicted the duration of exposure and the amount of fear that would be experienced. When the subject returned home, he/she recorded the duration of the exposure and rated the level of fear that had been experienced.

In comparison to the waiting-list control group, both treatment groups improved in mobility and reported less anxiety at posttest. The subjects in the high-expectancy group displayed greater, and more rapid increases in mobility than the low-expectancy group. By the end of the 10 sessions, subjects in the high expectancy group could spend approximately twice as long away from home as the low expectancy group. Both groups reported comparable reductions in fear, though the high-expectancy group had received more exposure.

Southworth and Kirsch (1988) concluded that their results provided evidence for the causal role of expectations in fear and mobility. When their pretest and posttest means are statistically compared, however, a different interpretation emerges. These analyses were not reported by the authors, but are calculated here from the descriptive statistics they reported. Pretreatment expectations of fear and mobility were recorded after each exposure group had received their particular instructions. Contrary to the view that fear expectations are self-confirming, the

high-expectancy group predicted more fear than the low-expectancy group at pretest [$t(18) = 2.45$, $p < .05$]. As mentioned earlier, the groups displayed comparable reductions in reported fear, despite differences in instructional set and expectations. These results do not support the view that fear expectations play a causal role in fear reduction.

Pretest mobility expectations did not differ between the high- and low-expectancy groups [$t(18) = 1.15$, $p > .05$]. Posttest expectations of mobility also did not differ between groups [$t(18) = 1.45$, $p > .05$]. Thus, the groups did not differ in their mobility predictions, although the high-expectancy group actually spent more time away from home. These results are contrary to the view that expectations were causally related to mobility. In all, this study offers no evidence that expectations have a causal influence on fear and mobility. The only significant difference between these small groups was in reported mobility. Although this study had low statistical power, it remains possible that the effect on mobility was a chance result.

It is possible that fear expectations are the product, not the cause of any "self-confirming" process (Wilkins, 1985). That is, expectations regarding the nature of the threatening stimulus may produce fear expectations and anticipatory anxiety. Anticipatory anxiety, in turn, may be "transferred over" to influence reported fear, as suggested by Zillmann (1983; see Chapter 5). Thus, in contrast to the view of Kirsch (1985, 1990), fear predictions may be correlates, not causes of fear reports. This possibility will be examined in later chapters.

Summary and Conclusions

Most of the studies reviewed in this chapter are subject to methodological criticisms. Despite these limitations, a pattern of results has emerged consistently across studies that used a variety of samples, tasks, and procedures of analysis.

Overprediction. Subjects and patients tend to overpredict the frequency and intensity of fear, panic, and pain (Kent, 1984, 1985; McMillan & Rachman, 1988; Rachman, 1983; Rachman & Arntz, 1991; Rachman et al., 1988a, 1988b; Rachman & Levitt, 1985; Rachman & Lopatka, 1986a, 1986b, 1986c; Wardle, 1984). Anxious subjects and patients tend to overpredict the likelihood of personally threatening events (Beck et al., 1974; Butler & Mathews, 1983, 1987; Hibbert, 1984; Lucock & Salkovskis, 1988; Mathews & Shaw, 1977). There also is evidence for a possibly related bias, the overestimation of the association between fear-relevant stimuli (spiders, snakes) and aversive consequences (electric shocks) (Tomarken et al., 1989).

A summary of the results for the overprediction of fear and panic is presented in Table 2.4. The overprediction of fear is not limited to conditions of informational impoverishment. It occurs even when the subject has a good deal of information about the fear-evoking stimulus. For example, the table shows that snake phobic subjects tended to overpredict their fears even when the snake was viewed at the time of prediction and subjects were aware of the requirements of the approach task (Rachman & Lopatka, 1986a). Similarly, patients with panic disorder tended to overpredict the likelihood of panicking when they entered familiar environments, such as supermarkets or department stores (Rachman et al., 1988b).

In a sequence of predict-report trials, overprediction is most likely to occur during the first few trials (Rachman & Lopatka, 1986a; Rachman et al., 1988b). This can be seen by comparing the effect sizes across trials for the multiple-trial studies reported in Table 2.4. With successive trials this bias gives way to predictive accuracy. The results suggest that the bias toward overprediction takes precedence over the preference for accurate predictions, at least early in the sequence of predict-report trials. This may be because the bias toward overprediction enhances the likelihood of successfully avoiding aversive stimuli (Rachman, 1988, 1990), and so increases the probability of avoiding fear, at least in the short term.

Table 2.4. Summary: Magnitude of the bias toward overprediction, as measured by (i) the frequency of trials in which overpredictions occurred relative to the frequency of trials in which underpredictions occurred, and (ii) the magnitude of the difference between mean predicted and reported fear.

(i) Frequency *

Study		Sample	Prediction Index (Fear)	Prediction Index (Panic)
Rachman et al. (1988a)	Expt. 1	Claustrophobics	0.42	0.52
	Expt. 2	Claustrophobics	0.39	0.58
Rachman et al. (1988b)		Panic patients	0.39	
Rachman & Levitt (1985)		Claustrophobics		0.39
Rachman & Lopatka (1986a)		Snake phobics	0.34	
Rachman & Lopatka (1986b)		Snake phobics	0.31	
Rachman & Lopatka (1986c)		Snake & spider phobics	0.60	
		Mean	0.41	0.50

(ii) Magnitude *

Study	Sample	Effect size (Fear)	
McMillan & Rachman (1988)	Paratroopers	0.40	
Rachman (1983)	Paratroopers	0.35	
Rachman et al. (1988b)	Panic patients	0.34 (trial 1)	
			0.53 (trial 2)
			0.20 (trial 3)
			0.01 (trial 4)
Rachman & Lopatka (1986a)	Snake phobics	0.95 (trial 1)	
			0.39 (trial 2)
			0.22 (trial 3)
			0.21 (trial 4)
	Mean**	0.51	

* Some studies did not provide sufficient information to compute prediction indices and effect sizes.

** For studies with multiple predict-report trials only the first trial was included in calculating the mean. Each study received equal weighting in calculating the means, and there was no adjustment for differences in sample size. The means are intended only as guides to the overall magnitude of overprediction since they are computed across studies using different populations, tasks, and fears.

It is useful to distinguish between (i) overpredictions that occur during isolated predict-report trials, or on the first trial of a sequence of trials, and (ii) overprediction that arises after the first trial in a sequence of trials. The second type of overprediction appears to have a simple explanation. If subjects base their fear predictions on the level of fear experienced in the previous trial, and fail to consider that fear habituates across trials, then overprediction will occur. This account assumes that the feared stimulus remains constant over trials. This is not always the case (e.g., the snake may increase its level of activity), and fluctuations in the stimulus can provide other sources of overprediction (see below). Nevertheless, the most challenging question for further research is why overprediction is usually greatest on the first trial of a predict-report sequence.

Asymmetry 1: Prediction-prediction sequences. Overprediction is especially likely to occur in particular prediction sequences. The magnitude of predicted fear usually increases after an underprediction, decreases after an overprediction, and remains constant after a correct match (Rachman, 1988; Rachman & Lopatka, 1986a, 1986b, 1986c). This raises the possibility that underpredictions are a source of overpredictions. Although sequential overpredictions are common, sequential underpredictions are rare; a single underprediction is usually sufficient to increase the magnitude of subsequent fear predictions (Rachman & Bichard, 1988). This suggests that a single underprediction may instigate a sequence of overpredictions. If this is the case, then underpredictions can be regarded as proximal causes of the bias toward overprediction, and the determinants of underpredictions can be regarded as distal causes of this bias. These hypotheses are based on the sequential pattern of under- and overpredictions, and are in need of experimental investigation.

Asymmetry 2: Sequences of prediction and report. Although fear reports appear to influence fear predictions, there is little evidence for a converse effect. That is, reported fear has been found to decline with successive exposure trials despite the accuracy of fear predictions on preceding trials (Rachman & Lopatka, 1986a, 1986b, 1986c). The same pattern has been observed in the prediction of panic (Rachman & Levitt, 1985; Rachman et al., 1988a, 1988b). Thus, the overprediction bias appears to have little effect on the fear or panic reported in

subsequent trials. Overprediction seems to play a more important role in promoting avoidance behaviour that, of course, limits the opportunity for exposure in the first place (Rachman, 1988, 1990). The conjecture that the overprediction of fear/panic promotes avoidance is plausible (Craske & Barlow, 1988; Rachman & Lopatka, 1986b), but has yet to be subject to an experimental evaluation.

Safety information. There is suggestive evidence that safety information provided prior to exposure has a greater influence on panic reports than panic predictions (Rachman et al., 1988a). The implications of this interesting result will be taken up in Chapter 5.

Concordance and discordance. The overprediction of fear can occur with other predictive biases (Table 2.1, p. 13), although this is not always the case. McMillan and Rachman (1988) found that two clusters of paratroopers tended to overpredict danger and fear, whereas a third cluster overpredicted their fears despite accurately predicting the dangerousness of the fear-evoking situation. The question arises about the extent that the overprediction of fear is concordant or discordant with other predictive biases, such as the underprediction of safety.

Individual differences. As implied in the preceding paragraph, there is evidence of individual differences in the tendency to overpredict. McMillan and Rachman (1988) found groups differences in the tendency to overpredict danger. They also found that their group of "courageous" paratroopers displayed a smaller bias toward overprediction (0.44 SD units) than the "fearless" or "overconfident" groups of paratroopers (respectively, 1.06 and 1.03 SD units). There is also evidence that the magnitude of the overprediction of pain increases with state anxiety and a trait measure of dental anxiety (Kent, 1984, 1985; Wardle, 1984). Since the match/mismatch patterns for pain are similar to those of fear (Arntz & Lousberg, 1990; Arntz & van den Hout, 1988; Rachman & Eyrl, 1989), it may be that the overprediction of fear also increases with state anxiety, trait anxiety, and other anxiety variables, such as phobia severity. The question arises as to the nature of the relationship between anxiety/fearfulness and overprediction. Severely phobic individuals may tend to overpredict the amount of fear that will be experienced when any phobia-related stimulus is encountered, despite the level of fear evoked. Thus, the magnitude of the bias toward overprediction in these individuals may be generally

greater than that of mildly phobic people, despite the threat value of the phobia-relevant stimulus. If this is the case, then trait anxiety, or a trait measure that is specific to the fear in question, may be an important statistical predictor of overprediction.

Another possibility is that state anxiety (e.g., in the form of anticipatory anxiety) may be a predictor of overprediction. Yet, an exception to this conjecture has already been found. McMillan and Rachman (1988) reported that the magnitude of overprediction of their "fearless" paratroopers tended to be greater than that of the "courageous" paratroopers, who were fearful but successfully completed the feared tasks.

The work of Kent (1984) suggests that the magnitude of overprediction is probably influenced by the interactions between the properties of the stimulus and the trait (or state) characteristics of the individual. Kent (1984) found that patients with low dental anxiety tended to be accurate in their pain predictions, regardless of the type of dental procedure that they were about to undergo. Patients with high dental anxiety tended to overpredict their pain levels for highly painful procedures (i.e., fillings and extractions) but not for milder procedures (cleaning and checkups). The same type of interaction may apply to the overprediction of fear. The role of other individual difference variables in the bias toward overprediction (e.g., neuroticism; Eysenck, 1967) awaits further investigation.

Memory bias. Overprediction of pain is associated with the recall of more pain than was actually experienced (Arntz et al., 1990b; Kent, 1985; Rachman & Eyrl, 1989). Kent (1985) suggested that the overprediction and overrecall of pain are the product of schema-driven processing. The overprediction of fear also may be related to the overrecall of fear. The demonstration of this would provide evidence for the role of schema-driven processing in the overprediction of fear.

CHAPTER 3. REGRESSION TOWARD THE MEAN

The bias toward the overprediction of fear is a well-documented phenomenon. Yet, little is known about the means by which it arises. The basis of overprediction is of interest in its own right and, more generally, is relevant in understanding the nature of fear expectancies and the relationship between cognition and fear. A theoretical basis of overprediction also may have clinical relevance, particularly in the development of strategies to reduce anticipatory anxiety and avoidance, which are known to play an important role in fear and its reduction (Foa & Emmelkamp, 1983; Marks, 1987).

A model of the overprediction of fear and related phenomena has yet to be developed, although promising efforts in this direction have recently appeared in the literature (Arntz & Lousberg, 1990; Kent, 1985; Rachman, 1990; Rachman & Bichard, 1988). The purpose of this, and the next two chapters is to consider a number of theoretical perspectives on the overprediction of fear. The present chapter is devoted to what might be the simplest explanation--that overprediction represents a regression toward the mean.

Recently, Arntz, van den Hout, Lousberg, and Schouten (1990a) addressed the issue of statistical regression in the pattern of changes in predictions from trial t to $t+1$ that typically follow overpredictions, underpredictions, or correct matches on trial t. Although this work is important in understanding the nature of the relationship between match/mismatch and the prediction of fear, it does not shed light on the question of whether the bias toward overprediction is a regression effect.

Regression toward the mean has been defined as a phenomenon and as an explanation (Nesselroade, Stigler, & Baltes, 1980). Following Nesselroade et al. (1980), regression toward the mean will be regarded here as a phenomenon (i.e., a description) rather than an explanation. Regression is typically defined by considering the situation where two parallel forms of a test are administered in succession to the same group of individuals. When subjects are selected because their scores deviate from the mean of the first test, their scores will tend to deviate less from the mean of the second test. Thus, regression toward the mean is said to occur. The more extreme the obtained score on the first test, the greater the regression on the second test.

This can be expressed in terms of the least-squares regression equation. For tests 1 and 2, let the standardized scores be z_1 and z_2, respectively. Given any value of z_1, the best linear (least squares) prediction of z_2 is one that is usually nearer the mean of zero than is z_1; i.e., $|z_2'| < |z_1|$ is generally true, where z_2' is the score predicted from the regression equation, $z_2' = r_{12} \cdot z_1$, and r_{12} is the correlation between the two tests (Hays, 1981). Regression toward the mean will occur when two conditions are satisfied: (i) $|r_{12}| < 1$, and (ii) subjects are selected because their scores on z_1 deviate from zero, the mean of z_1.

Explanations of Regression

In their review of the literature on this subject, Nesselroade et al. (1980) found that regression is often accounted for by the statement that it is due to the lack of perfect correlation between two sets of scores (i.e., $|r_{12}| < 1$). As the authors note, this is merely a restatement of the phenomenon, and begs the question of why there is a lack of perfect correlation to begin with. There appears to be two main accounts of regression.

The first explanation is couched in classical test theory (Cronbach, 1949), which states that an individual's obtained score on a given measure is composed of two independent components; a "true" score plus or minus a random measurement score ("error"). The obtained score is used to estimate the true score. When two parallel forms of a test are administered in succession, it is assumed that errors are uncorrelated across testing occasions, and that the error scores randomly fluctuate about a mean of zero. It is also assumed that high observed scores have large positive error components, and the low scores have large negative errors (Cronbach, 1949). Since measurement errors are assumed to be randomly distributed about a mean of zero, an obtained score with a large error on the first test administration will, on average, have a smaller magnitude of error on the second administration. Thus, an individual with a high score on the first testing occasion will have a lower score on the second occasion. The converse pattern applies for low scores obtained on the first occasion. According to this interpretation, regression is not in the true scores but is a result of changes in the error component.

A second class of explanations considers regression in a broader perspective (e.g., Clarke, Clarke, & Brown, 1959; Furby, 1973). Furby's (1973) position is representative of this type of explanation. She noted that while errors of measurement are commonly assumed to be the sole source of regression effects, the latter are also obtained with measures that have relatively small errors of measurement [e.g., Galton's (1885a, 1885b) measures of seed diameter and human height]. Furby (1973) argued that regression effects can arise from influences on the true score of a given variable.

> The farther a score is from the mean, the more extreme it is. The more extreme a score, the rarer it is and the more likely it is to have been the result of a very rare combination of factors. If I now compare an extreme score, x, for example, with a score for the same person on another variable, y, it is highly unlikely that this person also will have the necessary rare combination of factors determining y as well. It is unlikely for any person to have an extreme score on y, including an extreme score on x. (Furby, 1973, p. 174)

Although apparently unrecognized by Furby, her account echoed Galton's (1885a) original conjectures about the causes of the regression in human offspring.

> The mean filial regression towards mediocrity was directly proportional to the parental deviation from it. ... This law tells heavily against the full hereditary transmission of any rare and valuable gift, as only a few of many children would resemble their mid-parentage [defined as the two parents' mean score on the variable of interest]. The more exceptional the gift, the more exceptional will be the good fortune of a parent who has a son who equals, and still more if he has a son who surpasses him. The law is even-handed; it levies the same heavy succession-tax on the transmission of badness as well as of goodness. If it discourages the extravagant expectations of gifted parents that their children will inherit all their powers, it no less discountenances extravagant fears that they will inherit all their weaknesses and diseases. (Galton, 1885a, pp. 507-508)

Furby (1973) argued that rare combinations of events are temporally unstable. Individuals exposed at one time to rare combinations of events will tend not to be so exposed at a later time, and so the true scores on the two occasions will be differentially influenced by these rare factors, with the result being regression toward the mean. Furby also noted that regression effects could arise from errors of measurement. This explanation is the same as that developed from classical

test theory.

> When we have unreliable measures, exactly the same reasoning applies to "errors of measurement" as applies to "factors determining" x and y. ... Those subjects with a large positive error contributing to their scores on x are likely to have higher x scores on average that those subjects with negligible or large negative error contributing to their scores. However, it is highly unlikely that these subjects will also have large positive error in their y scores (since error in x is uncorrelated with error in y). Therefore, their y scores tend to be lower (closer to the mean) than their x scores. (The analogous but opposite statement is true for large negative error in x.) (Furby, 1973, p. 175)

From a review of the work on this topic appearing after Furby's (1973) article, the present author was unable to find a significant advance over Furby's general explanation of regression. Although it can be argued that rare events contribute to the error of measurement rather than the true score, it remains that regression effects can be due to psychologically important factors. Rather than dismiss regression as a statistical artifact (as did Arntz et al., 1990a), it seems more accurate to regard regression effects as the result of genuine causal influences, even if the contributing factors are considered to be "nuisance variables" for the purposes of the investigation (Clarke et al., 1959; Nesselroade et al., 1980).

Application to the Overprediction of Fear

It may be argued that there are two ways in which overprediction could be a regression effect. In these accounts, fear predictions and fear reports are treated as if they are parallel forms of the same "test." According to the first explanation, the bias toward overprediction will occur if subjects are all selected on the basis of extreme fear predictions. That is, their extreme scores on the measure of predicted fear will regress when they are retested by making their rating of reported fear. This account is untenable, since none of the subjects in the overprediction studies were selected this way.

The second explanation begins by considering the way that subjects were selected for the overprediction experiments described in Chapter 2. In each of these studies, subjects were selected because of extreme scores on some screening measure. For example, the subjects in the study by Rachman and Lopatka (1986a) consisted of university students who indicated extreme

fears of snakes on a fear survey inventory. In other studies, subjects were patients with high fear levels, as defined by clinical or psychometric criteria (e.g., Rachman et al., 1988b). Since subjects were selected because of extreme scores on fear screening measures, it could be argued that their scores regressed (i.e., became less extreme) when they made their fear predictions for a given experimental task. Could it be that this regression continued when subjects made their fear reports? If so, then the bias toward overprediction would be the result of sequential regression.

Nesselroade et al. (1980) provided a mathematical proof that sequential regression does not usually occur. In descriptive terms, their explanation can be applied to overprediction in the following manner. Subjects were selected on the basis of extreme scores on the screening instrument, and so their fear predictions may have regressed. Yet, subjects were not further selected because of extreme fear predictions, and so there is no reason why the errors in their obtained scores would further regress when they made their fear reports. In other words, after the fear prediction is made the regression effect is "spent," and subjects do not regress further when they make their fear reports (Nesselroade et al., 1980).

Classical test theory also predicts that successive regressions do not occur, since the errors of measurement are assumed to be uncorrelated. Thus, large error scores are associated with extreme obtained scores on the fear screening measure. The assumption of uncorrelated errors implies that the errors will be randomly distributed about zero for both the fear predictions and fear reports. Therefore, there will be a regression from the screening test to the fear prediction, and an absence of sequential regression from the fear prediction to fear report.

The arguments against a regression interpretation of overprediction can be supplemented by empirical evidence. The regression explanation holds that subjects with high fear predictions will tend to overpredict, and those with low fear predictions will tend to underpredict. This can be tested by examining the results of McMillan and Rachman (1988), who obtained predictions and reports of fear for a parachute jump completed by 105 trainee paratroopers. As mentioned when this study was reviewed in Chapter 2, the recruits also completed a battery of questionnaires, including ratings of self-efficacy for parachuting under various weather conditions, predictions and reports for various aspects of the jump (e.g., dangerousness), a fear survey questionnaire,

and measures of hypochondriasis and anxiety-related bodily sensations. A cluster analysis was performed on the responses to all variables, which resulted in a three-cluster solution. The clusters were interpreted as representing courageous, fearless, and overconfident groups of paratroopers. The cluster analysis can be used as a means of selecting groups of paratroopers who made relatively high, moderate, and low fear predictions. This can be seen in Table 3.1, which shows the descriptive statistics for the fear predictions and reports of each cluster. The table also shows the effect sizes for the differences between the means of the predicted and reported fear. The equation used to compute the effect sizes is given at the bottom of Table 3.1. If the overprediction of fear is a regression phenomenon, then it is expected that the group with the greatest fear predictions (i.e., the overconfident group) would be the only group to overpredict, and that the group with the lowest fear predictions (the fearless group) would tend to underpredict.

The table clearly shows that overprediction was not limited to subjects who made high fear predictions. Indeed, the magnitude of overprediction of the fearless group was as high as that of the overconfident group, and higher than that of the courageous group. Thus, a bias toward overprediction was evident in all clusters. These results are inconsistent with a regression interpretation of overprediction.

Table 3.1. Means and SDs of predicted and reported fear for the final parachute jump for each of three clusters of novice paratroopers. (From McMillan & Rachman, 1988.)

Cluster	n	Fear Prediction		Fear Report		Effect Size*
		M	SD	M	SD	(SD units)
Fearless	27	35.0	21.1	14.4	17.9	1.06
Courageous	70	52.6	22.6	41.5	27.4	0.44
Overconfident	8	64.3	24.4	50.7	1.9	1.03
Total	105	49.1	23.2	38.7	29.2	0.40

* Effect size = $(M_P - M_R)/S_{pooled}$, where M_P = mean of fear predictions, M_R = mean of fear reports value, and S_{pooled} is the arithmetic mean of the SDs of predicted and reported fear.

In summary, the proposition that the overprediction of fear is a form of regression toward the mean represents a description, not an explanation. This is because regression itself is a phenomenon in need of explanation (Furby, 1973; Nesselroade et al., 1980). In this chapter it has been shown that the conditions in which overprediction occurs are not the same as those in which regression is found. Thus, it is concluded that the overprediction of fear is not a form of regression.

CHAPTER 4. THE APPLICATION OF CONTEMPORARY THEORIES OF EMOTION TO THE OVERPREDICTION OF FEAR

The purpose of the present chapter is to review two theories of emotion that appear to be promising in their potential to contribute to the understanding of the overprediction of fear. These are the theories of Lazarus (1966, 1991) and Beck (1976; Beck & Emery, 1985), which are largely concerned with the role of expectations in emotion. Theories that do not have this focus were deliberately omitted from this review (e.g., Eysenck, 1967, 1970; Lang, 1979, 1984, 1986, 1988). Other major theories that do emphasize expectancies (e.g., Bandura, 1977, 1986; Rescorla, 1978, 1988) were omitted since they appear to have little to contribute over the theories of Lazarus and Beck in accounting for the overprediction of fear. Thus, the present review is deliberately selective. It is also intentionally focused on the aspects of the theories of Lazarus and Beck that are most useful in accounting for the overprediction of fear, although it is recognized that these theories are far broader in scope.

Lazarus' Appraisal Theory

Lazarus (1966, 1991; Lazarus & Folkman, 1984) developed one of the most widely known theories of emotion. Central to this model is the concept of appraisal, which refers to the evaluation of the meaning and significance of a stimulus in terms of one's well-being (Lazarus, 1991). Two types of appraisal are involved in the evaluation of threatening stimuli. Primary appraisal involves an evaluation of the threat cues in order to estimate the amount of danger that is present. Secondary appraisal involves an assessment of the personal and environmental resources for dealing with the stressor and for dealing with the arousal it produces.

According to this theory, the magnitude of the fear response depends on (i) the threat value of the stimulus, (ii) the extent to which coping resources are perceived to be inadequate or of doubtful efficacy, and (iii) the efficacy of coping responses that have already been implemented to alter the threat (e.g., escape) or alter one's reaction to it (e.g., denial). Primary and secondary appraisals can be modified by continued reappraisal of the success of coping efforts and reappraisal of the impact of the event on the individual.

Despite its complexity, this theory has had difficulty accounting for so-called irrational

fears (Barlow, 1988). That is, conditions such as simple phobias, where fear is evoked by stimuli that the individual "knows" to be harmless. To circumvent this theoretical difficulty, Lazarus (1991) proposed that "appraisals" may be unconscious. Thus, appraisals need not be cool, conscious, and deliberate computations; they can be rapid, automatic, and need not be rational.

Application to overprediction. In extending this theory to the overprediction of fear, assume that the fear prediction is made at time t, before encountering the threatening stimulus. Let the fear report be made at some later time, $t + 1$, when the threatening stimulus is actually encountered. From Lazarus' theory it appears that fear predictions are the result of the threat predicted for time $t + 1$ (primary appraisal) and the coping resources predicted to be available at time $t + 1$ (secondary appraisal). As mentioned earlier, the theory holds that the fear report is, in part, determined by primary and secondary appraisals made at time $t + 1$. These are appraisals of the threat value of the stimulus at time $t + 1$, and of the coping resources available at time $t + 1$. The fear report is also influenced by the coping responses that have been implemented and in effect at time $t + 1$. The elements of predicted and reported fear can be expressed algebraically in order to make explicit the application of Lazarus' theory to the overprediction of fear.

$$\text{est. } R = f_1\{PA_t\} - f_2\{SA_t\} \qquad (1)$$

$$R = f_3\{PA_{t+1}\} - f_4\{SA_{t+1}\} - f_5\{CR_{t+1}\} \qquad (2)$$

Where est. R = Predicted fear

R = Reported fear

PA_t = Primary appraisal, made at time t, of the threat expected at time $t + 1$.

PA_{t+1} = Primary appraisal, made at time $t + 1$, of the perceived threat at time $t + 1$.

SA_t = Secondary appraisal, made at time t, of the coping resources expected to be available at time $t + 1$.

SA_{t+1} = Secondary appraisal, made at time $t + 1$, of the coping resources perceived to be available at time $t + 1$.

CR_{t+1} = Coping responses in effect at time $t + 1$.

f_1 to f_5 = Unknown functions.

The existence of the bias toward overprediction implies that, on average, the following is true.

$$\text{est. } R > R \qquad (3)$$

Substituting (1) and (2) into (3) produces expression (4).

$$f_1\{PA_t\} - f_2\{SA_t\} > f_3\{PA_{t+1}\} - f_4\{SA_{t+1}\} - f_5\{CR_{t+1}\} \qquad (4)$$

Thus, Lazarus' appraisal theory can be used to derive an expression for the overprediction of fear that is based on appraisals and coping responses. Unfortunately, expression (4) contains so many free parameters that it does not lead to specific experimental predictions about the role of each component in the overprediction of fear. Although this expression does not provide a very satisfactory account of overprediction, it is a source of hypotheses of further investigation. For example, if overprediction occurs when coping responses are not implemented ($CR_{t+1} = 0$), as may have been the case in many of the overprediction studies reviewed in Chapter 2, then the overprediction of fear may be due to the overprediction of the threat value of the stimulus ($PA_t > PA_{t+1}$) and/or the underprediction of the amount or efficacy of coping resources ($SA_t < SA_{t+1}$).

Beck's Cognitive Model

Beck (1976, 1985; Beck & Emery, 1985) proposed that fear is a complex biopsychosocial response with important evolutionary, biological, affective, and cognitive components. He argued that most basic emotions are innate, survival-oriented responses to an environment that has changed greatly over the course of evolution. Despite this biological flavour, the model is essentially cognitive in nature.

> The crucial element in anxiety states... is a cognitive process that may take the form of an automatic thought or image that appears rapidly, as if by reflex, after the initial [threat] stimulus ... [and is] followed by a wave of anxiety. (Beck & Emery, 1985, p. 5)

Schemata. A key construct in Beck's model is the schema. Schemata are data structures stored in long-term memory. They contain propositional information that may be thought of as rules, assumptions, or formulae (Beck & Emery, 1985). Schemata are not simply the repositories of different kinds of information, but play an active role in organizing the constant influx of information from environmental and internal sources. When a schema is activated it influences the subsequent selection of stimuli to be attended to, facilitates the recall of relevant material from memory, and determines the overall significance of these types of information to the individual. Thus, schema-congruent (top-down) processing can influence the person's appraisal of a given situation.

Central to Beck's theory of anxiety are the danger schemata, which are information structures containing the rules, beliefs, and assumptions for designating objects as dangerous. These structures may represent exaggerated estimates of the aversive consequences of events (Foa & Kozak, 1985). In situations of presumed danger, the relevant danger schema is activated, which filters out schema-irrelevant information in favour of perception, cognition, and recall of data that are relevant to the danger. The danger schema interacts with environmental and internal stimuli to yield the final interpretation of the stimulus.

> When a threat is perceived the relevant cognitive schemas [sic] are activated; these are used to evaluate and assign a meaning to the event. ... There occur a series of adjustments to "fit" appropriate schemas to a specific threat. One's final interpretation is the result of the interaction between the event and the schemas. (Beck & Emery, 1985, pp. 55-56)

In this model, fears are not necessarily the product of effortful, conscious processing. Beck (1985, 1988; Beck & Emery, 1985) emphasizes the automatic (preattentive) processing of information. This assumption circumvents the problem of irrational fears, since the individual need not be aware of the automatic thoughts. Thus, the individual may experience fear in situations he/she "knows" to be harmless. Beck and Emery (1985) proposed that anxiety disorders are characterized by the overactivity ("hypervalence") of a danger schema (or group of danger schemata) relative to other schemata. When a schema is overactive, it does not deactivate when appropriate. When danger schemata are overactive, the individual indiscriminately interprets a wide range of stimuli as threatening (Beck & Emery, 1985).

Cognitive distortions. Beck (1971, 1976) incorporated Lazarus' (1966) concepts of primary and secondary appraisal into his cognitive model. Thus, the individual's level of fear is a function of appraisals of danger and coping resources, and a function of coping responses that are in effect at the time. In the case of irrational fear, Beck argued that the appraisals of danger are exaggerated, and the appraisals of coping are underestimated. These distortions are said to be the product of schema-driven processing.

Several types of distortions in information processing are said to arise from schema hypervalence. When the danger schema is hypervalent, there is a selective abstraction (filtering) of incoming information so that the fearful individual will "see only danger in a situation but none of the safety factors" (Beck & Emery, 1985, p. 55). As part of this, the individual is said to magnify or overemphasize the dangerousness of the situation, and minimize the presence or availability of safety. Several studies provide support for this claim by finding that anxious people selectively attend to threat cues, whereas nonanxious people do not show this bias (e.g., MacLeod, Mathews, & Tata, 1986; Mathews & MacLeod, 1985). Similarly, it has been shown that anxious individuals are also more likely to interpret ambiguous stimuli as threatening (e.g., Butler & Mathews, 1983; Eysenck, Mogg, May, Richards, & Mathews, 1991).

Another cognitive distortion is the tendency to catastrophize (Ellis, 1962), which is said to occur when the individual exaggerates the probability of highly aversive outcomes.

> When an anxious individual considers a problematic situation, he may be drawn to consider the most negative consequences. Although it may be adaptive under some circumstances to anticipate the "worst possible case," the patient with clinical anxiety is fixated on ideas of extreme outcomes and therefore becomes over-prepared to deal with physical or social threats. Although it is conceivable that this extreme anticipation ("catastrophizing") might occasionally be adaptive in providing a "preview" of a possible outcome, this mobilization thwarts realistic problem solving in most situations. (Beck, 1985, p. 192)

Related to the tendency to catastrophize, Beck (1985) argued that the cognitive processing of the fearful individual is characterized by dichotomous thinking; the fearful individual tends to regard possible dangers in absolute, extreme terms (e.g., the belief that an air flight will either be safe or will end in total disaster). Beck and Emery (1985) further claimed that "when the individual is away from the 'danger,' he is generally able to view it realistically" (p. 34). Although anxious individuals may tend to engage in dichotomous thinking, the evidence for the bias toward overprediction runs counter to the claim that fear appraisals are generally realistic when the individual is away from the danger. That is, the tendency to overpredict appears to occur even when the individual is safely removed from the feared stimulus (Rachman & Bichard, 1988).

Application to overprediction. Beck's model does not offer an explicit explanation of the bias toward the overprediction of fear. However, like the theory of Lazarus, it provides some potentially useful leads. Beck's model suggests that fear predictions and fear reports are the product of danger schemata. One possibility is that fear predictions and fear reports are based on different schemata, and that overprediction is the reflection of these differences. However, it is not clear what these differences might be.

The concept of schema-driven processing may provide a more useful basis for conceptualizing the overprediction of fear. When an individual is in a potentially threatening situation, the danger schema(ta) are activated, and information is processed in a schema-congruent manner. In this way safety information is filtered out, and danger information is emphasized (Beck, 1985). It seems likely that this filtering/enhancement process is influenced

by the salience of information. That is, highly salient safety information may be more difficult to filter out than low-salience safety information (Nisbett & Ross, 1980). Conversely, it may be more difficult to enhance danger information when it is of low salience.

If this argument holds, then Beck's model may be able to account for the overprediction of fear. When an individual makes a fear prediction, the salience of the relevant stimulus information is probably not the same as that obtained for the fear report. If the safety information about the feared situation is of low salience when the fear prediction is made, and of high salience when the fear report is made, then the bias toward overprediction will emerge. While this account is plausible under some circumstances, it may not be applicable to others. This extension of Beck's model appears to have difficulty accounting for overprediction in conditions where the person can see the feared object (e.g., a snake or spider) and is aware of the requirements of the approach task (e.g., Rachman & Lopatka, 1986a).

Another possible explanation of overprediction arises from Beck's formulation of cognitive distortions. It may be that overprediction arises because fear predictions are influenced by thoughts of catastrophe (i.e., the overprediction of danger and underprediction of safety). When the person enters the fear-evoking situation to make his/her fear report, the individual's attention is probably diverted away from catastrophic thoughts, and toward the feared stimulus. Thus, the overprediction of fear may arise because thoughts of calamity have a greater impact on fear predictions than fear reports.

Conclusions

In this chapter the theories of Lazarus and Beck were reviewed and an attempt was made to derive explanations of the overprediction of fear. Each model offers fragments for a theory of overprediction. Three ideas appear to be particularly useful: (i) Overprediction may arise from the overprediction of the danger elements of the stimulus, and the underprediction of the safety elements. (ii) Related to this, thoughts of catastrophic consequences may have a greater impact on fear predictions than fear reports. (iii) These processes may be schema-driven.

These ideas will be taken up in the following chapter, which attempts to develop a model of the overprediction of fear.

CHAPTER 5. THE STIMULUS ESTIMATION MODEL

The stimulus estimation model was developed to provide a conceptual framework or heuristic for understanding the overprediction of fear and related phenomena. It was intended to account for overprediction under a variety of conditions, including the presence of this bias in isolated trials or on the first trial of a predict-report sequence. The model has not been described or tested previously, although some of its elements are drawn from other models (Beck, 1985; Beck & Emery, 1985; Kent, 1984, 1985; Lazarus, 1966, 1991; Rachman & Bichard, 1988). The model has two levels of explanation: (i) An algebraic statement of the components of fear predictions and fear reports, and their relationship to overprediction. (ii) A set of cognitive mechanisms that can generate the algebraic relations. The present chapter will be confined largely to the application of the model to the overprediction of fear. The extension to related phenomena will be deferred until Chapter 9.

The purpose of the algebraic expression is to make explicit what might otherwise be intuitive. The model begins with the assumption that a fear response, R, is a function of a perceived stimulus, S.

$$R = \underline{f}_1\{S\} \qquad (1)$$

Where $\underline{f}_1$ is an unknown function that determines the level of fear that a given stimulus will evoke.

The response, R, can be the level of reported fear, or physiological or behavioural responses, such as arousal level or escape behaviour (Gray, 1987; Lang, 1968). The stimulus, S, is defined by the perceptual qualities of the feared object or situation (e.g., size, shape, and activity level of a feared animal) and more molar, interpretive properties such as the perceived dangerousness, safety, and controllability of the stimulus (Barlow, 1988; Rachman, 1990; Rescorla, 1988). The assumption in expression (1) is basic to the major, modern psychological theories of fear, such as neoconditioning (Rescorla, 1988) and cognitive formulations (Foa &

Kozak, 1986; Lang, 1986). The stimulus properties that are relevant to expression (1) are those that have been associated with R. In claustrophobia, for example, a crowded, humid, enclosed space from which escape is blocked constitutes a complex of stimulus features that are likely to be associated with high levels of fear (Booth, 1990). Some properties may be more important that others in forging the link between S and R. Pursuing the example, in claustrophobia the physical restriction and threat to air supply that characterizes small, enclosed spaces are particularly important in evoking fear (Rachman, 1990).

Since individuals tend to prefer accurate predictions (Mineka & Hendersen, 1985), the next step in developing the model was to consider what the person needs to determine in order to make an accurate fear prediction. Clearly, an individual needs to know at least something about the stimulus to predict the amount of fear that is likely to be experienced. Thus, the key assumption of the stimulus estimation model is that to estimate R accurately, it is necessary for the individual to estimate S. Accordingly, the task of deriving a fear prediction can be seen as a two-stage process: (i) estimate S, then (ii) estimate the R that is likely to be elicited by the predicted S. These steps can be expressed as follows.

$$\text{est. R} = \underline{f}_2\{\text{est. S}\} \qquad (2)$$

Where est. R is the predicted level of fear, est. S is the prediction of the fear-relevant properties of the stimulus, and $\underline{f}_2$ is an unknown function. Note that this model assumes that people have some form of knowledge about the relationship between S and R. This knowledge may be acquired through direct experience or by other means (Bandura, 1986; Rachman, 1990). Since $\underline{f}_1$ need not be equal to $\underline{f}_2$, the individual need not have an accurate knowledge of the relationship between R and S.

The bias toward the overprediction of fear implies that, on average, the following is true.

$$\text{est. } R > R \qquad (3)$$

Substituting (1) and (2) into (3), the algebraic aspect of the stimulus estimation model can be expressed as follows.

$$\underline{f}_2\{\text{est. } S\} > \underline{f}_1\{S\} \qquad (4)$$

Although expression (4) is straightforward, it has several interesting implications. According to this expression, there are two sufficient conditions for the overprediction of fear to occur. It may arise from the overprediction of the aversiveness of the stimulus (est. S > S). That is, the overprediction of the danger properties of S or, conversely, the underprediction of the safety properties associated with S.[1] According to expression (4) this can occur regardless of whether $\underline{f}_1 = \underline{f}_2$ or $\underline{f}_1 \neq \underline{f}_2$.

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[1] For the present purposes, the danger and safety features of the perceived stimulus are defined, respectively, as those which increase and decrease reported fear. These features are defined in detail in Chapter 7.

Strictly speaking, est. S > S applies to the danger or threat elements of est. S and S. In terms of the model, safety information can be defined as the inverse or arithmetic opposite of threat information. Hence, the gist of the heuristic est. S > S is retained, since the underprediction of safety can be expressed in terms of the overprediction of some threatening aspect of the stimulus. This definition of safety can be justified by a set of analyses of the data collected for Experiment 3 (Chapter 8). In that study, snake-fearful subjects performed a task in which they were asked to touch the inside of a container that held a live, harmless snake. Subjects made predictions and reports of the dangerousness of the snake, the amount of safety in the situation, and the activity level, length, and controllability of the animal. The last three variables have been shown in previous research to influence snake fear, and thus can be construed as threat related (see Chapter 8 for details). If safety cues can be defined as the arithmetic opposite of some form of danger, then danger and safety ratings should load on the same factor. To test this, the predictions of danger, safety, activity level, length, and controllability were submitted to a principal component analysis. According to the scree test a single factor was obtained, accounting for 35.07% of the variance. The same analysis was performed for the subjects' reports of danger, safety, etc. Again, the scree test indicated a single factor solution, accounting for 36.55% of the variance. For each variable, the loadings are as follows. The first number in parentheses refers to the loading for the predictions, the second loading refers to that of the reports: danger (.79, .67), safety (-.78, -.79), control (-.28, -.70), activity level (.58, .38), and length (.31, .34). Danger and safety were the replicated factor markers (Tabachnick & Fidell, 1989), suggesting that each factor reflects a bipolar danger-safety dimension. These results support the definition of safety as the arithmetic opposite of some form of danger.

The overprediction of fear also will occur if $\underline{f}_2 > \underline{f}_1$. That is, the individual's estimation of relationship between R and S is exaggerated, such that a given S is determined to elicit more fear, R, than is actually the case. For example, consider an agoraphobic who is about to venture from the safety of home to a nearby shopping mall. Let S be the distance from the house to the mall. Assume that S ranges from 0 to 200 m, where larger distances indicate a greater distance from the house. Let R be the magnitude of reported fear (on a 0 - 100 scale). For the sake of the example, assume that a simple psychophysical relationship holds between R and S:

$$R = 0.4\{S\}$$

That is, $\underline{f}_1 = 0.4$. Thus, when the subject is at the starting point (at home), the reported fear is 0. The reported fear is 20 at a distance of 50 m, 40 at a distance of 100 m, and 80 at a distance of 200 m. If $\underline{f}_2 > \underline{f}_1$, then the subject will tend to overpredict his/her level of fear, even when there is complete and accurate knowledge of the stimulus (i.e., when est. S = S). For example, if $\underline{f}_2 = 0.5$ then the subject will predict a fear of 25 at a distance of 50 m, and 50 at 100 m, and 100 at 200 m. Thus a bias toward overprediction will occur.[2]

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[2] Notice that if, for example, $\underline{f}_1 = 0.6$ and $\underline{f}_2 = 0.8$, then a bias toward overprediction will occur until a ceiling in predicted fear is reached. That is, at a distance of 167 m, predicted and reported fear will be at a maximum, 100. This is the result of using rating scales that are limited in their ranges.

Empirical Support

The stimulus estimation model, as stated so far, proposes two means by which overprediction can occur. These are sufficient but not necessary conditions for overprediction, and can be evaluated by two types of experimental prediction: (i) If est. S > S, then the overprediction of fear will be associated with the overprediction of at least some danger elements of the stimulus and/or the underprediction of some safety elements. (ii) If $\underline{f}_2 > \underline{f}_1$, and the subject has full and accurate knowledge of the fear-evoking stimulus (i.e., est. S = S), then subjects will tend to overpredict their fear, and a function, $\underline{f}_0$, exists (e.g., a regression weighting) such that the magnitude of overprediction can be statistically predicted by $\underline{f}_2\{S\} - \underline{f}_1\{S\} = \underline{f}_0\{S\}$.

Concerning the first experimental prediction, the assumption that est. S > S is supported by the studies showing that anxious people tend to overpredict the probability of aversive events (Beck et al., 1974; Butler & Mathews, 1983, 1987; Lucock & Salkovskis, 1988). The link between predictive biases in estimating the stimulus and the overprediction of fear has yet to be examined in detail. McMillan and Rachman (1988) examined the predictions and reports of the dangerousness of a parachute jump for three clusters of trainee paratroopers. For the entire sample it was found that there was no difference between predictions and reports of dangerousness, although subjects tended to overpredict their fears (see Table 2.1, p. 13, for details). Unfortunately, other stimulus properties associated with the jump were not assessed in that study. Also, there may have been important interactions between the overprediction of fear and the subject's performance in executing the jump. (The relationship between overprediction and performance is taken up in Chapter 9.) Other studies of overprediction have not assessed in any detail (if at all) the predictions and reports of the feared stimuli. Thus, prediction (i) remains to be adequately evaluated.

The second prediction gains limited, indirect support from the original predict-report studies, where it was found that subjects tended to overpredict their fears when est S. ≈ S. That is, subjects tended to overpredict their fears even when they could see the feared stimulus, such

as a snake or spider, and were aware of the requirements of the approach task (Rachman & Lopatka, 1986a, 1986b, 1986c). The relative magnitudes of the psychophysical functions, $\underline{f}_1$ and $\underline{f}_2$, remain to be determined. It also remains to seen whether a value of $\underline{f}_0$ can be found to account for a significant proportion of the variance in estimating the magnitude of overprediction. Regression analyses would be useful in this regard where, for a given subject, $\underline{f}_0$ could be estimated by obtaining the magnitudes of overprediction for a range of threat values of S.

To conclude, there is limited but encouraging support for the stimulus estimation model, as stated by equation (4). Stringent tests of the model cannot be made on the basis of available research. That is, there was only a limited assessment of the feared stimulus in the study by McMillan and Rachman (1988). In the predict-report studies of Rachman and Lopatka (1986a, 1986b, 1986c) it was not established that est. S = S, and there was no direct comparison of $\underline{f}_1$ and $\underline{f}_2$. An aim of this dissertation is to evaluate empirically aspects of expression (4).

Cognitive Mechanisms

Equation (4) suggests two questions regarding the underlying mechanisms of overprediction: (i) How does est. S get to be greater than S? (ii) How does $\underline{f}_2$ become larger than $\underline{f}_1$? The present section will consider several candidate mechanisms. These can be regarded as components or submodels within the stimulus estimation model. Each component is presented as a sufficient but not necessary element of the model.

In developing the submodels, it is useful to consider the informational basis of fear predictions and fear reports. It is likely that fear predictions are based on various sources of information, such as fearful past experiences (episodic memories), general knowledge about the feared stimulus (semantic memories), and environmental information about the likely nature of the feared stimulus that is about to be encountered (contextual information). Fear reports are also influenced by various sources of information, such as environmental information about the nature of the stimulus (e.g., whether a spider appears to be of a poisonous variety) and about the availability of escape routes (Barlow, 1988; Rachman, 1990). Fear reports are also thought to be

the product of past encounters with aversive stimuli (e.g., traumatic conditioning, observational learning), and other types of past experiences (Bandura, 1986). Overprediction may arise if fear predictions and fear reports are based on different types or amounts of information. Differences in information utilization may arise at the stages of acquisition, retrieval, and other stages in the processing of fear-relevant information.

Modes of Fear Acquisition

There are three main pathways in the acquisition of fear: Conditioning (e.g., traumatic or multiple subtraumatic events; Eysenck & Rachman, 1965), vicarious learning (e.g., observational learning; Bandura, 1969, 1977, 1986), and learning via verbal information about sources of threat (Rachman, 1978, 1990, 1991). The third pathway is of particular interest. "Verbal information" refers to verbal descriptions about the threat-related aspects of a given class of stimuli. These can be obtained through the media (e.g., newspaper or television reports) or from verbal statements the individual receives from others. For example, a child can acquire a fear of harmless dogs if the parents inform him/her that dogs are generally aggressive (Hekmat, 1987).

In comparison to conditioning and vicarious learning, the provision of fear-relevant verbal information provides a particularly potent means of acquiring exaggerated representations of threatening stimuli. Conditioning and vicarious learning experiences are tied to actual fear-evoking stimuli. The provision of fear-relevant verbal information is not bound by this reality constraint. Although (mis)information is known to influence the magnitude of reported fear (Rachman, 1978; Sanderson, Rapee, & Barlow, 1989; Wolpe, 1981), it may be a particularly potent source of the prediction, and overprediction, of fear.

To illustrate the role of verbal information, consider an individual who has little, if any, direct exposure to snakes, and lives in a region where snakes are not typically found. (This scenario probably applies to many urban settings.) Also assume that any snakes found in a nearby region are usually small (i.e., < 1 m), nonpoisonous, and timorous. If the individual receives misinformation that the snakes of that region are typically large (e.g., > 2 m), poisonous, and aggressive, then he/she probably will expect to experience a very high degree of fear. This prediction would be based on the expectation that if a snake is encountered, it will be large,

poisonous, and aggressive (i.e., est. S). Since the snakes of that region are small, nonpoisonous, and timorous (i.e., S < est. S), the degree of predicted fear will be greater than the level of fear that is reported when a snake is encountered, with the result being the overprediction of fear. If fear predictions serve to promote avoidance behaviour (Rachman, 1988, 1990; Rachman & Bichard, 1988), then the individual will have a reduced opportunity to acquire corrective information, and so will continue to overpredict his/her level of fear.

Empirical support. There has yet to be a test of the hypothesis that the verbal pathway to fear acquisition is a major source of overprediction. Yet, a consideration of the differences between diagnostic groups in the mode of fear acquisition and magnitude of overprediction reveals some support for the hypothesis. Phobias and other anxiety disorders differ in their modes of acquisition (Öst, 1987; Öst & Hugdahl, 1981, 1983, 1985). If the tendency to overpredict one's fear depends on the extent to which the fear was acquired by verbal information, then there should be differences between disorders in the tendency to overpredict. For example, it has been found that in comparison to panic disorder, a greater proportion of animal phobias appear to be acquired by verbal information (Kleinknecht, 1982; Murray & Foote, 1979; Öst, 1987; Öst & Hugdahl, 1983). If the tendency to overpredict is greatest when fears are informationally acquired, then its magnitude or frequency is expected to be greater in simple phobia relative to panic disorder. This prediction can be tested by comparing the mean magnitude of overprediction of snake phobics (Rachman & Lopatka, 1986a) with that of panic patients (Rachman et al., 1988b) when each group was exposed to their respective fear stimuli. The snake phobics were exposed to a live, harmless snake, and the panic patients were exposed to an individually-tailored fear stimulus (e.g., a supermarket; see Chapter 2 for details). The means and SDs of predicted and reported fear are presented in Table 5.1. Although the groups were exposed to different types of stimuli, they did not differ in their mean levels of reported fear [$t(62) < 1.00$, $p > .1$]. The fear predictions of the snake phobics were significantly greater than those of the panic patients [$t(62) = 2.86$, $p < .01$]. The snake phobics overpredicted by 0.95 SD units, whereas the panic patients overpredicted their fears by only 0.34 SD units. These results are consistent with the view that the overprediction of fear increases with the extent that fears are

acquired by verbal information, and encourage further investigation of this hypothesis. Since the group differences could have been due to factors other than the mode of fear acquisition, a stronger test would be to induce fears by various means in groups of subjects. A fear of a given stimulus could be conditioned in one group of subjects, and verbally induced in a second group. The magnitude of overprediction could then be compared across groups.

Table 5.1. Fear predictions and reports for the first exposure trial of snake phobics (Rachman & Lopatka, 1986a) and panic patients (Rachman et al., 1988b).

Sample	n	Fear Prediction		Fear Report		Overprediction Effect Size*
		M	SD	M	SD	
Snake Phobics	44	78.30	9.13	62.17	24.94	0.95
Panic Patients	20	66.95	22.74	58.75	25.34	0.34

* Defined as $(M_{prediction} - M_{report})/S_{pooled}$, where $S_{pooled} = (SD_{prediction} + SD_{report})/2$

Utilization of Environmental Information

As mentioned earlier, it has been found that fearful subjects tend to overpredict their fears even when they can see the feared stimulus and are aware of the requirements of the approach task (e.g., Rachman & Lopatka, 1986a). Although this may be a result of $f_2 > f_1$, it also raises the possibility that some fear-relevant information is not attended to or utilized in the prediction process. For example, safety information available at the time the fear prediction is made may have a greater influence on reported fear than predicted fear, with the result being a bias toward overprediction. This will be called the differential-weighting model. It can be stated as two assumptions: (i) Safety information available in the environment has a greater effect on reported fear than on predicted fear. (ii) This arises because environmental safety information influences S to a greater extent than est. S (i.e., est. S > S).

Safety information consists of the cues that signal the reduction, minimization, or postponement of feared events (Rachman, 1984). Safety cues have been present in all the previous studies of overprediction. For example, in the predict-report studies of spider and

snake phobics (Rachman & Lopatka, 1986a, 1986b, 1986c) the presence of the experimenter and the confinement of the feared animal to a glass container were likely to serve as potent safety cues since they set limits to the nature and duration of exposure to the animal (Barlow, 1988; Rachman, 1990).

Empirical support. The differential weighting model receives some support from the results of a study of 26 claustrophobics reported by Rachman et al. (1988a). A predict-report paradigm was used where subjects entered a small, dark room for two minutes. At the beginning of each trial the subject made predictions of fear and safety, and estimated the probability of panic. The subject viewed the test room before making the first prediction. A group of 13 subjects was given safety information concerning the availability and rate of consumption of oxygen in the room. They were told that a candle would be lit and placed in the test room, and that the burning of the candle indicated that the room contained sufficient oxygen. The 13 subjects in the control group were given safety-irrelevant information and the candle was not lit. After completing each set of predictions, the subject entered the test room. The trial ended with the subject leaving the test room to rate the levels of fear and safety that had been experienced, and whether he/she had panicked or come close to panicking. Each subject received a minimum of nine trials.

It was found that 10 (76.92%) of the 13 subjects in the control group experienced at least one panic. In comparison, only one (7.69%) of the subjects in the safety group reported a panic. This difference was significant ($p < .001$). Interestingly, the groups did not differ in their predictions of panic or in their predictions and reports of fear or safety. Although this study is not without its limitations (see Chapter 2), the results are consistent with the conclusion that the provision of safety information had highly selective effects, influencing reported panic but not predicted panic. The means and SDs for predicted and reported fear were not given in the article, and so it is not known whether there was a trend for safety information to influence reported fear as well. In all, the results of this study offer some support for the differential-weighting model.

Retrieval

The selective recall of fear-relevant information also may contribute to overprediction. This possibility was first proposed by Kent (1984) to account for the overprediction of pain. Commenting on the correlation between dental anxiety and the overprediction of pain (see Chapter 2), Kent (1984) suggested that people with high dental anxiety more readily recall occasions when they experienced severe dental pain compared with the occasions in which they experienced little or no pain. Thus, it was proposed that the prediction of pain is influenced by the selective recall of painful dental visits, with a bias toward overprediction being the result. This will be called the selective recall model, and is introduced here as a candidate cognitive mechanism to underlie the expression, est. S > S.

Rachman (1990; Rachman & Bichard, 1988) extended Kent's (1984, 1985) selective recall model by incorporating the availability heuristic. An individual is said to use this heuristic when the probability of a given outcome is estimated by the ease with which instances or examples of similar events can be brought to mind (Tversky & Kahneman, 1973). Availability is often a useful guide for assessing frequency or probability because instances of common events are usually more easily retrieved than instances of infrequent events (Tversky & Kahneman, 1973, 1974). Yet, availability can yield biased estimates because it is affected by factors unrelated to frequency of occurrence, such as the vividness, recency, and emotion-arousing properties of events (Nisbett & Ross, 1980; Nisbett & Temoshok, 1976; Tversky & Kahneman, 1973). With the inclusion of this heuristic into the selective recall model, Rachman and Bichard (1988) provided the following account of the overprediction of fear.

> When a person has to predict how fearful he/she will be in an uncertain situation, vivid experiences of fear/aversive events will be readily accessible and will be given greater weight than memories of pallid events. The excessive weight attached to vivid memories of aversive events will tend to distort the person's predictions of fear.
>
> By extension, if predictions of fear are distorted by the excessive weight given to vivid experiences of fear, then people who have a large store of fearful memories should make more distortions. Highly fearful people will tend to overpredict fear more often and more strongly than nonfearful people . . . Fearful people may begin to overpredict fear and panic because they vividly recall a first experience of intense fear in a particular situation and fail to recall or attend to all the previous (or subsequent) occasions of little or no fear in that situation. Overpredictions will persist as people continue to attend to the occurrences of fear or panic and disregard the nonoccurrences. (Rachman & Bichard, 1988, p. 309)

The model holds that the individual selectively recalls memories of relevant but highly fearful situations, and then generalizes the level of fear experienced in those episodes to the task of predicting the level of fear that is likely to be experienced on future occasions. The selective recall model does not state that fear predictions are based exclusively on the recall of past experiences. It is likely that fear predictions are also influenced by information that is present in the environment at the time the prediction is made. Yet, the selective recall model does not state how this contextual information is used in the process of forming fear predictions.

The finding that reported fear tends to decline (habituate) over a series of predict-report trials, regardless of the accuracy of predicted fear (Rachman & Levitt, 1985; Rachman & Lopatka, 1986a, 1986b, 1986c) suggests that predictions and reports differ to some extent in their determinants. When people do not have complete information about the situation for which they are making a fear prediction, they are obliged to draw on earlier relevant experiences. This is obviously not a requirement for making fear reports, since the fear-evoking stimulus is present. Thus, an implicit assumption of the selective recall model is that the recall of fearful experiences has a greater influence on fear predictions than fear reports.

The model holds that overprediction will be most likely to occur when there is uncertainty about the precise nature of the feared stimulus (Rachman & Bichard, 1988). This is because the selective recall was said to depend on the availability heuristic. The latter, in turn, appears to be most likely to be used in conditions of uncertainty (Kahneman, Slovic, & Tversky, 1982). It has been shown that overprediction occurs even when the person has a good deal of information about the feared stimulus (Rachman & Lopatka, 1986a, 1986b, 1986c; Rachman et al., 1988a, 1988b). This raises the question of whether the selective recall model accounts for overprediction under some conditions but not others.

A further issue concerns the recency of past experiences. Since the availability of memories for events is said to be influenced by how long ago the events occurred (Tversky & Kahneman, 1973), it may be that the bias toward overprediction is influenced by the recency of fear-relevant events. For example, if a person has had a recent, mildly fearful experience, this may have a greater influence on subsequent fear predictions than a memory of an extremely

frightening experience that happened years ago. This possibility is consistent with the finding that subjects become increasingly accurate with successive predict-report trials (Rachman & Lopatka, 1986a).

In summary, the selective recall model can be stated as follows:

1. For person p, a given class of feared stimuli generally evokes fear of intensity less than or equal to R. Thus, p's reported fear tends to be less than or equal to R.

2. In forming a fear prediction, p selectively recalls experiences in which a fear of intensity $R + \partial R$ was experienced. Thus, the level of predicted fear is $R + \partial R$.

3. Following from (1) and (2), the overprediction of fear arises because $(R + \partial R) > R$.

Empirical support. The selective recall model has yet to be empirically evaluated.

Relationship between Selective Recall and Differential-Weighting

The selective recall and differential-weighting models can account for est. S > S, and so supplement the algebraic expression of the stimulus estimation model by providing another level of explanation. The selective recall model states that est. S > S arises because est. S is increased relative to S by the selective recall of memories of highly fearful experiences. The differential-weighting model holds that est. S > S occurs because environmental safety information reduces S relative to est. S. These models offer independent but complementary accounts of the overprediction of fear. The failure to use some or all environmental safety information in the formation of fear predictions may arise because of an over-reliance on the selective recall of fearful past experiences. As we will see later, selective recall and differential-weighting may be different manifestations of the same process; viz. schema-congruent (top-down) processing.

The link between selective recall and differential-weighting is plausible but not essential. Selective recall may be a source of overprediction without necessarily implying that environmental information is differentially weighted in the process of forming fear predictions. That is, the recall of fear-relevant memories may have a strong influence on fear predictions. Once the individual enters the feared situation, his/her attention is probably drawn away from thoughts of previous experiences, and toward the feared stimulus. Thus, reported fear is likely to

be strongly determined by the exposure situation, and less influenced by the recollection of previous fearful experiences. Differential-weighting of environmental information is not necessary to this account since the selective recall model does not preclude the possibility of environmental safety information having equivalent effects on predicted and reported fear.

It also can be shown that the selective recall mechanism is not necessary to the differential-weighting model. The utilization of safety information in the feared situation, and the under-utilization of safety information when forming fear predictions, has survival value, and may be a controlled process (see below). The individual may under-utilize safety information when forming fear predictions in order to enhance danger expectations as a means of motivating avoidance behaviour, thus reducing the likelihood of encountering aversive stimuli. This strategy is of little use when the feared stimulus has been encountered, since it would result in an unnecessarily high level of reported fear. Indeed, the opposite strategy of fully attending to safety information while in the feared situation would be more appropriate since it would enhance the likelihood of identifying escape routes or other safety resources.

The Danger Schema

A schema is an organized collection of past reactions and experience that forms a cohesive and persistent body of knowledge capable of guiding subsequent perception, appraisals, and recollections (Bartlett, 1932; Beck & Emery, 1985; Mandler, 1984; Segal, 1988). Kent (1984, 1985) argued that pain expectations are schema-driven. He proposed that patients with high levels of dental fear have schemata in which dental procedures are represented as highly painful. According to this hypothesis, the schema forms the basis of pain predictions, and so is the source of the bias toward overprediction. Such a schema may persist unchanged because dental experiences are infrequent and are processed in a schema-congruent manner. Thus, a high-pain schemata would be resistant to accommodation to information about episodes of low pain.

The similarity between the predict-report findings for pain and fear (Rachman & Arntz, 1991; Rachman & Bichard, 1988) suggests that fear predictions also may be schema-driven. The relevant schema, called the danger schema, is defined as a knowledge structure that represents prototypic information about stimuli and responses associated with a given class of

feared events (Beck & Emery, 1985; Williams et al., 1988). Schemata may be narrow in their range of representation (e.g., representing information pertaining only to spiders) or broader in their ambit (e.g., representing "danger" stimuli in general). The breadth of the danger schema is of theoretical interest, but not essential to the present discussion. To illustrate the notion of a danger schema, the dog phobic is assumed to have a representation of typical encounters with dogs, including the size and ferocity of the animal, the typical environments in which dogs are found, and the typical consequences of encountering one (Landau, 1980). The danger schema of the phobic individual represents the object of the phobia as being associated with high levels of fear (Beck & Emery, 1985; Foa & Kozak, 1985; see Chapter 4). The schema need not be veridical or representative in the information it contains about a given class of stimuli.

The concept of the danger schema can be incorporated into the stimulus estimation model by proposing that the individual uses the relevant danger schema to determine est. S, and hence to form his/her fear prediction (est. R). Reliance on the schema is especially likely when there is a lack of other sources of information about the nature of the stimulus for which the fear prediction is being made. As suggested earlier, the overprediction of the threatening qualities of the stimulus may arise because the danger schema of a fearful individual is biased to represent the average or typical fear-evoking stimulus to be more aversive than is actually the case.

A danger schema may be the cognitive structure that underlies the cognitive processes implicated in the selective recall and/or differential weighting models. That is, if fear predictions are based on information stored in the danger schema, selective recall could arise because danger schemata represent fearful experiences as worse than they really were (Beck & Emery, 1985; Foa & Kozak, 1985, 1986). Similarly, the use of environmental information in shaping fear predictions may be schema-driven. Information that is incongruent with the danger schema (e.g., safety information) may be filtered out (deemphasized) during processing, and so has less of an effect on fear predictions than schema-congruent (danger-relevant) information. Filtering may be greatest when safety information is of low salience, which may be generally the case when fear predictions are made. When the individual is in a feared situation, the safety information may be more salient, and so less likely to be filtered out (see Chapter 4 for details). Thus, the

differential-weighting model is consistent with the view that processing is driven by a danger schema.

If fear predictions are based, to some extent, on a danger schema, then what is the basis of fear reports? There is insufficient evidence to answer this question at the present time. As described in Chapter 4, it may be that fear predictions and fear reports are both derived from a danger schema, but draw on this structure in different ways or to a different degree. Alternatively, fear predictions may be based on a danger schema, whereas fear reports may be largely the product of a different mechanism, such as one based on conditioned associations. This is consistent with Martin and Levey's (1985) argument that fear processing reflects a combination of conditioning and cognitive mechanisms.

Empirical support. If overprediction is a result of schema-congruent processing, then other schema-congruent biases should be evident. Thus, Kent (1985) deduced that the overprediction of pain should be associated with distortions in recall, such that patients remember more pain than they actually experienced. Kent (1985) tested this in a study of 10 patients with high dental anxiety and 17 patients with low dental anxiety. Patients made predictions and reports of dental pain and, three months later, were asked to recall the level of pain they had experienced. High-anxiety patients overestimated their pain levels and recalled more pain than they had actually experienced. Low-anxiety patients tended to be accurate in their predictions and recollections. These findings were replicated by Arntz, van Eck, and Heijmans (1990b) and partially replicated by Rachman and Eyrl (1989). The results of these studies are consistent with the notion that pain schemata are sources of distorted predictions and recollections of pain, and that these structures are resistant to modification by corrective information. Given the similarity between the findings for pain and fear, it seems likely that the recall bias found for pain also will be found for fear. This prediction awaits future investigation. Thus, although the danger schema appears to be a generally useful concept, its value in accounting for the overprediction of fear has yet to be demonstrated.

Controlled Processes

The preceding sections offered several explanations of how danger may be overpredicted

and safety can be underpredicted. In other words, these accounts serve to illustrate how the inequality, est. S > S, can arise. A further question is how $\underline{f}_2$ can be larger than $\underline{f}_1$. In considering this, it is useful to consider the distinction between automatic and controlled processes (Hasher & Zacks, 1979; Schneider, Dumais, & Shiffrin, 1984; Schneider & Fisk, 1984; Schneider & Shiffrin, 1977; Shiffrin & Schneider, 1977). Controlled and automatic processes can be regarded as opposite ends of a processing continuum defined by the extent that a process does or does not require attention (Logan, 1988; Williams et al., 1988). The distinction between automatic and controlled processes made here in order to highlight the range of processes that can unlie the overprediction bias.

An automatic process involves a relatively unmodifiable sequence of operations that are activated, without the need for attention or conscious effort, in response to a particular internal or external stimulus. A controlled process is a temporary sequence of operations activated under the control of, and maintained through, the attention of the individual. In contrast to automatic processes, controlled processes are deliberately and consciously initiated, and strategically modifiable (Schneider et al., 1984). The selective recall of high-fear memories is probably an automatic process. Differential weighting of environmental information is also probably automatic, although it may be a controlled process, as suggested earlier.

It may be that the increase in $\underline{f}_2$ relative to $\underline{f}_1$ is a controlled process[3] intended to (i) minimize the likelihood of encountering an aversive stimulus by motivating avoidance behaviour, and (ii) when feared stimuli are not avoided (as in exposure treatments), to protect the individual from the aversive experience of an underprediction (Rachman & Arntz, 1991). Concerning the latter, studies of pain prediction have found that compared with an overprediction or correct match of a pain stimulus of a given intensity, the underprediction of a painful stimulus of the same intensity is followed by greater physiological arousal and subjective anxiety, and a greater tendency to engage in escape and avoidance behaviour (Arntz, 1991). This suggests that when matched for levels of reported pain, underpredictions are inherently more aversive than overpredictions or matches, and so the individual may be motivated to avoid underpredictions by overpredicting his/her level of pain. The same pattern may apply to fear (cf. Chapter 2).

The strategy of increasing f_2 relative to f_1 bears some resemblance to a strategy known as defensive pessimism (Norem & Cantor, 1986a, 1986b). Defensive pessimism occurs when the individual sets an unrealistically low expectation of a positive outcome in a situation where there may be either a positive or negative outcome. Norem and Cantor (1986b) argued that people do this to prepare themselves for potential failure, and to motivate themselves to find ways of minimizing or avoiding aversive events. For example, an individual may unrealistically expect to fail an exam given the amount of preparation that he/she has invested. This pessimistic expectation then motivates the individual to increase study activity, and so reduces the risk of failure and increases the chance of success.

If the inflation of f_2 relative to f_1 is the product of a controlled process (i.e., a deliberate strategy) that motivates avoidance and lessens the impact of aversive stimuli, then this poses an important complication to the view that organisms prefer predictable to unpredictable events (Mineka & Hendersen, 1985). In view of the evidence for the overprediction bias (Chapter 2), it may be more accurate to say that people (and other organisms?) would rather make overpredictions or correct predictions than underpredictions.

Empirical support. The possibility of controlled processes that increase f_2 relative to f_1 has yet to be investigated. Yet, there is empirical support for the similar, and possibly related strategy of defensive pessimism (Norem & Cantor, 1986a, 1986b), which lends credence to the possibility of such a process operating in the overprediction of fear.

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[3] $f_2 > f_1$ also may be due to an automatic process. The form that this would take is not entirely clear, although transient changes in f_1 relative to f_2 may arise from the tranfer of arousal (see Chapter 6), which can influence the overprediction bias.

Sequential Predict-Report Trials

The discussion so far has been concerned with the overprediction of fear on isolated predict-report trials or on the first trial of a predict-report sequence. The present section considers the presence of overprediction in the midst of a sequence of predict-report trials. During a sequence of trials it has been found that the bias toward the overprediction of fear gradually gives way to predictive accuracy (Rachman, 1988; Rachman & Lopatka, 1986a). According to the stimulus estimation model, this occurs because the subject gradually acquires more experience with the stimulus. Over successive trials the subject gains information about the feared stimulus and learns that certain of its properties remain constant, and so est. S becomes increasingly similar to S. When fear is accurately predicted, the model holds that est. S = S. Under these conditions, the task of forming fear predictions reduces to one of simply basing est. R on the level of fear experienced on the previous trial (i.e., {est. R on trial t} = {R on trial t - 1}). It is expected that this strategy will be used only if the subject believes that the stimulus remains reasonably constant from trial to trial (i.e., $S_t \approx S_{t-1}$). Stimulus constancy was generally the case in the overprediction studies conducted by Rachman and coworkers (Chapter 2).

In conditions where the stimulus remains constant over trials, the bias toward overprediction may persist because subjects fail to consider fully the effects of habituation on their levels of reported fear. That is, if habituation occurs, then, $R_t > R_{t+1}$. If est. R_{t+1} is based on R_t (i.e., est. $R_{t+1} \approx R_t$), then est. $R_{t+1} > R_{t+1}$ if habituation is not fully considered when the individual makes his/her fear prediction.

These conjectures have yet to be evaluated empirically, although examination of the data reported by Rachman and Lopatka (1986a) lends some support. Here, subjects tended to overpredict their fears, yet the mean of the difference between the mean fear prediction on trial t and the mean fear report on trial t - 1 was essentially zero. That is, smaller than one point on the 0-100 scale used to measure predicted and reported fear (M = -0.60, SD = 1.86, n = 9 trials). This result is consistent with the hypothesis that fear predictions were based on the level of fear

reported on the previous trial.

Anticipatory Anxiety

As mentioned in Chapter 2, Kirsch (1985, 1990) argued that fear predictions are self-confirming. That is, the expectancy of experiencing fear of a given intensity has a self-fulfilling effect. The studies bearing on this claim were reviewed in Chapter 2, and it was concluded that there was insufficient evidence at the present time for it to be sustained. Nevertheless, this possibility is not implausible, and warrants further consideration since it poses a possible complication to any model of the overprediction of fear.

It is surprising that the literature on the self-confirming effects of fear has paid little attention to the possible role of anticipatory anxiety. It seems likely that predictions about the feared stimulus promote anticipatory anxiety. That is, the more threatening one expects a stimulus to be, the greater the anticipatory anxiety. The individual's level of anticipatory anxiety may influence his/her fear predictions. It also may contribute to the amount of fear reported when the feared stimulus is encountered. That is, there may be an effect analogous to Zillmann's (1978) excitation transfer phenomenon.

Zillmann (1978, 1979) argued that residual arousal from one situation (e.g., physical exercise) can influence the affective state in a later situation (e.g., aggression). In other words, the sympathetic excitation from one situation is "transferred over" to a second situation to intensify the emotional experience in the latter context. Excitation transfer is said to arise because sympathetic activity does not terminate abruptly, but dissipates slowly. It has been found to occur only under conditions where the individual fails to recognize that a portion of his/her sympathetic activation is not due to the present situation, but is a residue of a previously arousing experience (Leventhal & Tomarken, 1986; Zillmann, 1983). Thus, the individual mistakenly attributes all the arousal experienced in the second context to the emotional stimuli presented there. The possible self-confirming effects of fear expectations may be due to such a process.

If anticipatory anxiety influences fear predictions and fear reports, then it will influence the bias toward overprediction only if anticipatory anxiety does not influence predicted and reported

fear to the same extent. For instance, it is possible that anticipatory anxiety has a greater effect on predicted fear than on reported fear, which would produce a positive correlation between overprediction and state anxiety. The algebraic expression of the stimulus estimation model can be used to derive predictions about the role of anticipatory anxiety in the overprediction of fear. To reiterate, expressions (1) to (4) represent the original model. Expressions (5) to (10) represent the derivations that incorporate anticipatory anxiety into the model.

$$R = \underline{f}_1\{S\} \tag{1}$$

Where R = the fear response (e.g., reported fear).

$$\text{est. } R = \underline{f}_2\{\text{est. } S\} \tag{2}$$

Where est. R = the predicted level of fear, and est. S = the predicted stimulus, and $\underline{f}_2$ is an unknown function.

The bias toward the overprediction of fear implies that, on average, the following is true.

$$\text{est. } R > R \tag{3}$$

Substituting (1) and (2) into (3), the model of overprediction can be expressed as follows.

$$\underline{f}_2\{\text{est. } S\} > \underline{f}_1\{S\} \tag{4}$$

Now, let R_A be the individual's level of anticipatory anxiety at the time the fear prediction is made. If anticipatory anxiety influences predicted and reported fear, then expressions (5) and (6) will follow.

$$R = \underline{f}_1\{S\} + \underline{h}_1\{R_A\} \quad (5)$$

$$\text{est. } R = \underline{f}_2\{\text{est. } S\} + \underline{h}_2\{R_A\} \quad (6)$$

Where $\underline{h}_1$ and $\underline{h}_2$ are unknown functions.

Given expression (1), it follows that anticipatory anxiety is a function of the stimulus the individual expects to encounter. That is,

$$R_A = \underline{f}_3\{\text{est. } S\} \quad (7)$$

Where $\underline{f}_3$ is an unknown function.

Substituting (7) into (5) and (6) yields the following.

$$R = \underline{f}_1\{S\} + \underline{h}_1\{\underline{f}_3\{\text{est. } S\}\} = \underline{f}_1\{S\} + \underline{k}_1\{\text{est. } S\} \quad (8)$$

$$\text{est. } R = \underline{f}_2\{\text{est. } S\} + \underline{h}_2\{\underline{f}_3\{\text{est. } S\}\} = \underline{f}_2\{\text{est. } S\} + \underline{k}_2\{\text{est. } S\} = \underline{k}_3\{\text{est. } S\}$$

(9)

Where $\underline{k}_1$, $\underline{k}_2$, and $\underline{k}_3$ are unknown functions.

Given that the bias toward overprediction occurs (i.e., est. R > R) then, on average, expression (10) is true.

$$\underline{k}_3\{\text{est. S}\} > \underline{f}_1\{\text{S}\} + \underline{k}_1\{\text{est. S}\} \qquad (10)$$

As (10) shows, even when anticipatory anxiety is included in the model, the overprediction of fear essentially remains a function of the stimulus and the predicted stimulus. In other words, if anticipatory anxiety plays a role in the overprediction of fear, then it is hypothesized to be a mediating variable that exerts its influence on the overprediction of fear as a result of the overprediction of the danger properties and underprediction of the safety properties of the stimulus. If anticipatory anxiety does not influence the overprediction of fear, then expression (10) reduces to expression (4). The role of anticipatory anxiety will be examined in Chapter 8.

Evaluating the Stimulus Estimation Model

The stimulus estimation model is best regarded as a framework or heuristic for conceptualizing the overprediction of fear and related phenomena. As such, it can incorporate cognitive mechanisms such as the selective recall and differential-weighting models. The component models are presented as sufficient but not necessary causes of overprediction. For example, in the stimulus estimation model the overestimation of S may arise from selective retrieval. However, the overestimation of S also can arise from the encoding of misinformation about S. Safety information may be under-utilized during the prediction process, as the differential-weighting model proposes. Yet, this to is not a necessary component of the stimulus estimation model. It may be that environmental information has an equal effect on predicted and reported fear, and that other factors are responsible for overprediction. Some of these cognitive mechanisms will be evaluated in later chapters.

Explanation versus Description

Is the stimulus estimation model an explanation of overprediction, or simply a description? Although the inclusion of cognitive mechanisms makes for a stronger case for the former, it will be argued that even the algebraic form of the model represents an explanation and not merely a description. As noted by Johnson-Laird (1983) and others, explanations come in various guises: (i) causal - which lays out the necessary and sufficient antecedent conditions for a phenomenon; (ii) ontogenetic - where the focus is on articulating the previously occurring events that led to the

event whose explanation is sought; (iii) reductive - where the phenomenon under scrutiny is recast into simpler or more fundamental terms; and (iv) constructive - where one is concerned with the elaboration of more general principles or laws that lay out the relationship between the event to be explained and other events.

Generally, one distinguishes between an explanation and a description on the grounds that the latter is restricted to observations, whereas the former articulates the relationships among observations. The algebraic form of the model is explanatory in the reductive and constructive senses. That is, it decomposes the overprediction of fear into several elements (e.g., f_1, f_2, est. S, and S), specifies the relationships among the elements, and relates the overprediction of fear to anticipatory anxiety (and to other phenomena; see Chapter 9). The cognitive mechanisms of the model contribute to the causal and ontogenetic explanations. At this early stage, it is not possible to offer a complete explanation of overprediction, since it is not possible to delineate the necessary and sufficient conditions for its occurrence.

Summary of the Model: Assumptions and Predictions

To prime the reader for the experiments described in the chapters to come, the following section will outline the basic assumptions of the stimulus estimation model, and the main experimental predictions that flow from it.

Main Assumptions

1. The algebraic statement of the model [expressions (1) to (4)].

2. Candidate cognitive mechanisms: (i) selective recall, (ii) differential-weighting; (iii) the danger schema(ta); and (iv) fear acquisition via verbal information.

Empirical Predictions

1. est. S > S. Subjects tend to overpredict the danger features and underpredict the safety features of threat-relevant stimuli.

2. If {est. S > S} then {est. R > R}. The magnitude of the overprediction of fear can be predicted by the magnitude of the overprediction of the danger features of the stimulus, and the magnitude of the underprediction of the safety features.

3. $f_2 > f_1$. When est. S = S, the overprediction of fear will still occur, and can be

expressed as $\underline{f}_0\{S\}$, where $\underline{f}_0\{S\} = \underline{f}_2\{S\} - \underline{f}_1\{S\}$. (This could be evaluated by regression analyses.)

4. Selective recall. If the recall of fear-relevant memories is enhanced (e.g., by priming; see Chapter 6), then the magnitude of overprediction will increase.

5. Differential weighting. The provision of safety information at the time the fear prediction is made will decrease fear reports relative to fear predictions.

6. Mode of fear acquisition. People who acquire their fears by verbal information will show a greater amount of overprediction than those who acquire their fears by other means.

7. Danger schema. The overprediction of fear will be associated with the recollection of fears as being more intense than they actually were.

8. Sequential trials. (i) When the fear stimulus remains constant from trial to trial, then fear predictions are (largely) based on the fear report of the previous trial. (ii) When the fear stimulus is held constant, the overprediction of fear arising in the midst of a sequence of predict-report trials occurs to the extent that subjects fail to recognize that their fears habituate over trials.

9. Anticipatory anxiety. The overprediction of the danger features and underprediction of the safety features of the stimulus influence anticipatory anxiety. Anticipatory anxiety, in turn, may influence the magnitude of the overprediction of fear.

Due to the large number of predictions derived from the model, this dissertation will focus on only a subset of them. In the following chapters, three experiments will be described. These tested predictions 1, 2, 4, 5, and 9. The first four predictions were selected because they are central to the model. Prediction 9 was investigated since it was easily incorporated into the design used in Experiment 3.

CHAPTER 6. EXPERIMENT 1

The purpose of the first experiment was to evaluate the selective recall component of the stimulus estimation model. The selective recall model proposes that the overprediction of fear is due to the greater availability (i.e., enhanced access from memory) of memories of highly fearful experiences compared with memories of experiences in which there was little or no fear. Since these memories are used to form fear predictions, the bias toward overprediction arises. As summarized in Chapter 5, the selective recall model is based on the following assumptions.

1. For person p, a given class of feared stimuli generally evokes fear of intensity less than or equal to R. Thus, p's reported fear tends to be less than or equal to R.

2. In forming a fear prediction, p selectively recalls experiences in which a fear of intensity $R + \partial R$ was experienced. Thus, the level of predicted fear is $R + \partial R$.

3. Following from (1) and (2), the overprediction of fear arises because $(R + \partial R) > R$.

This model can be stated in strong and weak forms, depending on the strength of the implicit assumption about the effect of selective recall on reported fear. The strong version of the model states that the selective recall of high-fear memories affects predicted fear, but does not influence reported fear. The weak version of this model simply proposes that selective recall has a greater influence on fear predictions than fear reports.

According to the model, the overprediction of fear is most likely to occur in situations where the person is highly uncertain about the nature of the feared stimulus, but knows that a feared stimulus of a given type (e.g., a spider) may be encountered (see Chapter 5). It has been shown that the bias toward overprediction occurs even when the person has a good deal of information about the feared stimulus (see Chapter 2). Thus, the question arises as to whether the strong and weak versions of the selective recall model apply mainly to situations where the person has little information about the feared stimulus. To provide an adequate test of this model, it was therefore necessary to create a situation in which there was much uncertainty about the feared stimulus at the time the subject made his/her fear prediction. Thus, one necessary feature of the present study was the presence of uncertainty about the feared stimulus.

Priming

A further requirement for testing the model is a method for manipulating the availability of memories for fearful experiences. It has been argued that priming (Neely, 1976, 1977) is the most appropriate method for achieving this (Gabrielcik & Fazio, 1984). Here, "priming" refers to a task that is intended to produce an effect on the subject's performance on a subsequent task. Thus, a priming effect refers to the influence of performing one task on the subsequent performance on the same or similar task (Tulving, 1983). If overprediction is a result of the greater availability of high-fear memories relative to low-fear memories, then a priming task can be used to test this. The availability of highly fearful memories can be increased by having subjects deliberately recall fear-relevant memories, and decreased by recalling fear-irrelevant memories. Previous studies have shown that similar manipulations to be successful in facilitating availability of memories for particular events, and hence increasing the subjective probability of occurrence of similar events (Carroll, 1978; Gregory, Cialdini, & Carpenter, 1982; Johnson & Tversky, 1983; Slovic, Fischhoff, & Lichtenstein, 1982). For example, Johnson and Tversky (1983) found that subjects who read a detailed newspaper account of the death of an individual displayed increases in the estimated risk for a variety of causes of death. Reading a happy newspaper story was found to have an opposite effect on mortality ratings.

When a predict-report task such as that used in previous studies (Chapter 2) is preceded by a priming task, the strong version of the selective recall model makes the following experimental predictions about the effects of fear-relevant priming relative to fear-irrelevant priming.

1. Fear predictions. Fear predictions following fear-relevant priming will be greater than those following fear-irrelevant priming.

2. Fear reports. Priming will have no effect on the level of reported fear.

3. Overprediction. The magnitude of overprediction following fear-relevant priming will be greater than that following fear-irrelevant priming.

The weak version of the selective recall model, which is not as specific as the strong version, only makes the first and third experimental predictions. Note that these experimental predictions concern the magnitude of fear predictions, fear reports, and prediction - report difference scores.

The use of frequency analysis (e.g., according to the two-point criterion) was deliberately eschewed. The rationale for this is presented in Appendix 1.

To supplement the analysis of these predictions, measures of mood and worry were obtained. Measures of mood-state were obtained for exploratory purposes, to investigate further the effects of priming on overprediction. A measure of worry about the experiment was obtained because this variable can be construed as a form of self-induced priming, where the subject rehearses possible aversive events that may take place (Borkovec, Robinson, Pruzinsky, & DePree, 1983; Mathews, 1990). Thus, a measure of worry could serve as a useful covariate to increase the power of the analyses.

Method

Subjects

One hundred and twelve undergraduate university students participated for course credit. Subjects were selected from a pool of over 1,500 students who completed an abbreviated version of the Fear Survey Schedule III (Wolpe & Lang, 1964). Respondents who stated that they were "much," or "very much" afraid of spiders were selected for participation. The final sample consisted of 100 subjects (90% female), with a mean age of 19 years 4 months (SD = 1 year 4 months).

Measures

All ratings were made on visual analogue (VA) scales. Each VA scale consisted of a 100 mm line divided into 5 mm gradations and labeled in increments of 10 mm. The lines were 100 mm long since this length has been found to produce the smallest error of measurement (Seymour, Simpson, Charlton, & Phillips, 1985). VA scales were anchored such that 0 indicated the minimum quantity of the attribute in question, and 100 indicated the maximum. Each mood and fear variable was measured by a single VA scale. This was because such a scale required little time to complete compared with multi-item fear scales, and so reduced the likelihood of the scales giving rise to priming effects. This was deemed important, given the goals of the study.

Spider fear. To match the mean fear levels of experimental groups at the beginning of the experiment, each subject's level of spider fear was measured by a VA scale. The scale was

accompanied by instructions to "place a vertical slash at the appropriate point on the line to indicate how frightened you would be right now if, from a distance of 12 inches, you saw a spider that was 2 inches wide and slowly moving." (Emphasis in original.)

Mood-state. To assess the effects of priming on mood-state, subjects made VA ratings of their current levels of happiness, sadness, anger, and anxiety. These scales were preceded by instructions to "place a vertical slash at the appropriate point on each line to indicate how you are feeling right now" (emphasis in original).

Worry. To assess spider-related worry, the subject was instructed to "place a vertical slash at the appropriate point on the line to indicate your response: What percentage of the last hour have you spent worrying about this experiment?" (emphasis in original). This measure is similar to a previously validated measure of worry (Borkovec et al., 1983; Meyer, Miller, Metzger, & Borkovec, 1990).

The remaining measures were used in the priming tasks and the predict-report task, and are presented in their respective sections.

Priming Tasks

Fear-relevant priming. This task required the subject to recall a highly fearful experience with a spider. The written instructions were as follows. "Describe, as vividly as possible, a memorable, highly fearful experience you have had with a spider, where the peak intensity of your fear was 85 or higher on a 0 to 100 scale (0 = no fear, 100 = terrifying fear). Describe this experience in the space provided below, giving details about what happened, where you were, what the spider looked like, and your reactions."

After giving a written description of the experience, the subject answered several probe questions, which called for descriptions of the spider (e.g., size, colour, and activity level) and the subject's cognitions, physiological reactions, and behavioural responses during the episode. These probes were included because they have been found to facilitate the access of episodic memories (Cook, Melamed, Cuthbert, McNeil, & Lang, 1989; Lang, 1977, 1979, 1988; Lang, Kozak, Miller, Levin, & McLean, 1980; Lang, Levin, Miller, & Kozak, 1983; Robinson & Reading, 1985), and so were likely to enhance the effects of priming.

The next section of the task required subjects to complete a VA measure of the peak amount of fear that they recalled experiencing (0 = no fear, 100 = terrifying fear). A VA rating was also made of the vividness of the recollection (0 = extremely unclear, 100 = extremely vivid).

Fear-irrelevant priming. This task required the subject to recall a fear-irrelevant memory. An attempt was made to match this task with the fear-relevant task in all relevant aspects, apart from the content of the two types of recollection. The written instructions were as follows. "Describe, as vividly as possible, a memorable experience you have had. This should be an event where you did not have any unpleasant emotions, such as fear, anger, or sadness, and should not be related to spiders [emphases in original]. It can be any event that stands out in memory, such as meeting an interesting person, going on a trip, or watching a good movie. It could even be a commonplace event such as enjoying a good meal. Describe this experience in the space provided below, giving details about what happened, where you were, what the scene looked like, and your reactions."

The subject gave a written description of the experience and then completed several probe questions, which called for descriptions of the event (e.g., colours, sounds, shapes) and the subject's cognitions, physiological reactions, and behavioural responses during the episode. The vividness of the recollection was measured on a VA scale (0 = extremely unclear, 100 = extremely vivid).

The duration required for subjects to complete the priming tasks was recorded in order to examine the comparability of the tasks. Subjects were told that they should take 10-15 min to complete. In the pilot studies, the tasks were found to be of approximately equal duration.

Predict-Report Task

The bias toward overprediction is not always observed (Rachman & Levitt, 1985). Since this bias may increase with the amount of uncertainty about the feared stimulus (cf. Kent, 1984, 1985), the predict-report task was designed to enhance this factor. A second reason for this is that the reliance on the availability heuristic is thought to be maximized under uncertainty (Tversky & Kahneman, 1973, 1974). Thus, the predict-report task, to be described below, was intended to enhance the amount of uncertainty regarding the feared stimulus.

Predictions Questionnaire. The predict-report task consisted of a Predictions Questionnaire followed by an approach task. The former was prefaced by the following written instructions. "You will now be asked to make some fear predictions for a task that involves approaching a glass bowl covered by a cloth, which you can see at the end of the room. The bowl will either be empty, or will contain a slow-moving spider that is two inches wide. There is a 50% chance that the bowl will contain the spider. The task consists of going up to the bowl, removing the cloth, and touching the bottom of the inside of the bowl (or as close to this as you can get to doing this). Again, there is a 50% chance that the bowl will either be empty or contain the spider."

After reading the instructions the subject made a series of predictions on VA scales. The fear ratings were anchored such that 0 = no fear at all, and 100 = terrifying fear. These scales are presented below. All emphases were in the originals.

1. "Predict the level of fear that you will experience as you are about to lift the cloth" [Fear Prediction 1 (FP1)].

2. "Predict the level of fear that you will experience when you touch the bottom of the bowl." [Fear Prediction 2, given a 50% probability of encountering the spider ($FP2._{50\%}$).]

3. "Half of the subjects in this experiment will find the spider in the bowl. What do you think the chances are that you will find the spider in the bowl?" (Subjective probability of encountering a spider; 0 = not at all likely, 100 = extremely likely).

4. "If you knew that the spider was in the bowl, predict the level of fear you will experience when you touch the bottom of the bowl." [Fear Prediction 2, given a 100% probability of encountering the spider ($FP2._{100\%}$).]

5. "If you knew that the spider was not in the bowl, predict the level of fear you will experience when you touch the bottom of the bowl." [Fear Prediction 2, given a 0% probability of encountering the spider ($FP2._{0\%}$).]

Approach task. After completing the predictions, the subject was given verbal and written instructions about how to complete the approach task. From a starting point 3 m from the

covered bowl, the subject walked up to it and made a rating of reported fear [Fear Report 1 (FR1)]. He/she then removed the cover and touched the base of the inside of the bowl. After removing his/her hand, the subject rated the level of fear that had been experienced while touching the bottom of the bowl [Fear Report 2 (FR2)].

A spider was never present in the bowl. This was for several reasons. First, the presence of a spider is likely to increase the unwanted (error) variance of the fear reports, since the spider may sporadically move about in its container, thus increasing fear for some subjects but not for others. Moreover, there are individual differences in what constitutes a fearful spider (Watts & Sharrock, 1984, 1985). These differences are likely to interact with the qualities of the spider selected for presentation, thus providing a further source of error variance in the fear reports. Although the inclusion of a spider-present condition would have provided an internal replication of the test of the selective recall model (i.e., a test of the experimental predictions within each of the spider-present and spider-absent conditions), the increase in sample size of high-fear subjects required for the inclusion of this condition was impractical, given the available subject pool.

Design and Procedure

The independent variable was the priming condition (fear-relevant vs. fear-irrelevant). One group of subjects received fear-relevant priming and a second group received fear-irrelevant priming. A no-priming control group could have been added to the present design, although this was not necessary to provide a strong test of the selective recall model. To add a third group would have required a larger sample of spider-fearful subjects. Alternatively, the inclusion of a third group could have been made at the expense of the sample size of each group. This would have sacrificed power. If the aim had been to investigate the processes involved in priming, then a control group would have been appropriate. Such a goal represents a departure from the more specific aim of testing predictions derived from the selective recall model. Thus, the most powerful, efficient means of testing the selective recall model was to compare a group in which the access of fear-relevant memories was facilitated (fear-relevant priming) with a group in which this access is inhibited or not facilitated (fear-irrelevant priming).

The main dependent variables were the four fear predictions (FP1, $FP2_{.0\%}$, $FP2_{.50\%}$, and

FP2.$_{100\%}$) and the two fear reports (FR1 and FR2). Each subject was tested individually in a single experimental session by one experimenter (the author), and all instructions and ratings were presented in booklet form. Except for the approach task, where verbal and written instructions were presented, the experiment simply required the subject to work through the test booklet. The instructions and ratings were completed in the following sequence.

1. Consent form.
2. Ratings of spider fear, worry, and mood-state (happy, sad, angry, anxious).
3. Priming task (fear-relevant or fear-irrelevant).
4. Rating of mood state (retest).
5. Predict-report task.
6. Debriefing.

The protocols for the experimenter and subjects are presented in Appendices 2 and 3, respectively.

Results and Discussion

Selection and Characteristics of Sample

Three subjects in the fear-relevant condition were excluded from the analyses because they were unable to recall a fearful experience with a spider. A subject from the fear-irrelevant group was also excluded because she misread the instructions and initially recalled a fear-relevant memory before changing to recall a fear-irrelevant memory. From the remaining 108 subjects, a sample of 100 was selected ($n = 50$ per group) such that the mean pre-priming level of spider fear was matched between groups, and so that there were no univariate or multivariate outliers on the dependent variables examined in this experiment.[1]

Hotelling's T^2 test was conducted to compare the groups on their pre-priming levels of spider fear, worry, and mood-state (state anxiety, happiness, sadness, and anger). The result of this test was not significant [Hotelling $F(6, 93) < 1.00$, $p > .1$], indicating that the groups did not differ on these variables before priming. None of the corresponding univariate tests were significant ($p > .1$). The pre-priming means, SDs, and results of the corresponding univariate tests are presented in Table 6.1.

Table 6.1. Group characteristics prior to the experimental manipulations.

Variable *		Priming Group: Fear-relevant ($n = 50$) M	SD	Fear-irrelevant ($n = 50$) M	SD	$F(1, 98)$	p
Spider fear		64.60	22.46	63.32	19.87	< 1.00	> .1
Worry		25.62	20.01	30.64	24.74	1.15	> .1
Mood-state:	Happiness	58.14	16.32	58.60	20.59	< 1.00	> .1
	Sadness	27.14	20.39	26.28	24.86	< 1.00	> .1
	Anger	8.96	13.07	13.68	21.39	< 1.00	> .1
	Anxiety	49.58	22.29	50.44	21.80	< 1.00	> .1

* All variables were measured on 0-100 visual analogue scales.

[1] Throughout this dissertation, univariate outliers were defined as $|z| > 3.00$ ($p < .001$). Multivariate outliers were defined by Mahalanobis' D^2, with a critical alpha of .001 (Tabachnick & Fidell, 1989).

Experimenter Effects

It was not expected that there would be any significant effect due to possible experimenter bias, since most of the experiment simply required the subject to work through a test booklet. Nonetheless, the possibility of bias was investigated. A subset of the testing sessions was rated by an observer in order to assess the experimenter's adherence to the protocol. There was no evidence of a departure from the protocol or that the subjects' responses in the rated sessions differed from those of the unrated sessions. The results are presented in Appendix 5. A set of further analyses, also presented in the appendix, revealed no evidence of experimenter bias.

Covariates

It was necessary to ensure that the groups were matched on levels of worry about the experiment since this variable can be construed as a form of self-induced priming taking place prior to the experiment, where the subject dwells on the types of fear-evoking events that might take place during the experiment (cf. Borkovec et al., 1983; Mathews, 1990; Meyer et al., 1990). As Table 6.1 shows, the groups did not significantly differ on this variable. Inspection of the means and SDs of Table 6.1 shows that the groups had almost identical scores on spider fear and the pre-priming mood variables. The greatest (albeit nonsignificant) difference between the groups was on worry (effect size = .22 SD units). This suggests that worry may be the most useful of these variables as a covariate to increase the power of the subsequent analyses. Theoretically, worry is an appropriate covariate since it appears to represent a process of self-induced priming (Borkovec et al., 1983; Mathews, 1990). However, unless stated otherwise, the addition of the covariates (including worry) did not alter the pattern of results obtained in the following sections. In later sections, covariate analyses will be presented only if they are methodologically required (as in the analysis of difference scores; see Appendix 1), or if the addition of covariates altered the interpretation of the results.

Characteristics of the Priming Tasks

Hotelling's T^2 test was used to compare the groups on the duration of the priming tasks and the vividness of the memories recalled during those tasks. The overall test was significant [Hotelling F (2, 97) = 6.05, $p < .003$], and so was followed by a t-test for each dependent

variable. As Table 6.2 shows, the tasks did not differ in duration, although the fear-irrelevant memories were significantly more vivid than the fear-relevant memories. Since the memories in both tasks seemed to have been recalled with a high degree of vividness (Table 6.2), it is unlikely that the group differences in vividness would have limited the evaluation of the selective recall model.

Table 6.2. Duration and vividness of each priming task, and the significance of the differences between the tasks on these variables.

Dependent Variable	Priming Condition: Fear-relevant M	Fear-relevant SD	Fear-irrelevant M	Fear-irrelevant SD	$F(1, 98)$	p
Duration (min)	9.94	2.55	10.44	2.77	< 1.00	> .1
Vividness of memory	78.08	17.34	88.06	10.33	12.25	< .001

The mean (and SD) of the peak levels of fear recalled in the fear-relevant condition was 86.22 (10.40), which shows that subjects were successful in recalling highly fearful experiences. All subjects in the fear-relevant condition recalled being startled by the spider, which was either on or near them. These subjects also recalled having numerous fear-related bodily sensations during the events they described. Sensations included palpitations (94% of subjects), muscular tension (72%), and trembling, sweating, or hot flashes (58%). The subjects recalled that they dealt with the situation by killing or removing the spider (22%), by having it killed or removed by somebody else (40%), or by fleeing from the room or place in which it was found (34%). A typical fear-relevant memory is as follows.

> I was in my dorm room and had just returned from the bathroom. I got ready for bed and pulled the sheets back on the bed. I was just about to get in when I saw some long brown legs in one corner of the sheet. I poked the sheet with a ruler and the spider jumped out. It was about two inches wide, brown, and hairy. I screamed and ran outside my room. A friend of mine heard me scream, so I told her what had happened. She killed the spider. Before I went to bed I had to check everywhere in the room to make sure that there were no more spiders.

The memories recalled in the fear-irrelevant condition consisted of pleasant events, as the following summary suggests: Being on holiday (24% of subjects), meeting a spouse or partner for the first time (12%), meeting with friends (24%), attending a party (10%), sporting event (as spectator or participant) (12%), family dinner (e.g., Thanksgiving) (8%), other (10%). An example of a fear-irrelevant recollection is as follows.

> I went to Europe to travel to different countries there. I didn't plan my route as I wanted to travel ex tempore. I ended up in Portugal, at the southeast end of the country. The view was magnificent. The shore was rocky and very steep. I could see miles and miles ahead. It was one of the most beautiful scenes I've ever experienced. My reaction that moment was one of freedom.

Effects of Priming on Mood

Following the recommendations of Cronbach and Furby (1970), and Rogosa, Brandt, and Zimowski (1982) regarding the analysis of difference scores, the effects of priming on mood-state were tested by an analysis of covariance, with the pre-priming mood ratings as covariates. Four one-way ANCOVAs were performed. The dependent variables were the post-priming mood scores (state anxiety, happiness, sadness, and anger). In each ANCOVA, the covariate consisted of the pre-priming mood score corresponding to each dependent variable. For example, in the analysis using post-priming anxiety as the dependent variable, the covariate was pre-priming anxiety.

Table 6.3 presents the unadjusted and covariate-adjusted means, SDs, and the results of the ANCOVAs. The table shows that the assumption of homogeneity of regression was clearly met in all but one case, as shown by the three nonsignificant interactions between each pair of covariates and the priming factor. The assumption was violated for post-priming anger ($p < .007$), indicating that the covariate had unequal effects across the priming conditions for that affective state. To avoid any difficulty in interpretation associated with the violation of this assumption, the differences between pre- and post-priming anger scores were tested by a two-way between-within ANOVA, where the priming condition was the between-subjects factor, and time of testing (pre vs. post) was the within-subjects factor. Consistent with the means

presented in Table 6.3, the interaction between priming and time of testing was not significant [F (1, 49) < 1.00, p > .1]. Thus, the violation of the assumption of homogeneity of regression did not affect the interpretation of the results. Table 6.3 shows that the covariates were significant for each mood-state. The results for the priming main effects, considered with the post-priming means, show that subjects receiving fear-relevant priming became more anxious and less happy than those who received fear-irrelevant priming (Table 6.3).

Table 6.3. Effects of priming on mood-state.

Post-Priming Mood-State	Priming Condition: Fear-relevant			Fear-irrelevant			Priming Effect F (1, 97)	Signif. of Covariate F (1, 97)	Test of Homog. of Regression F (1, 96) **
	M	Adj. M	SD	M	Adj. M	SD			
Happiness	56.36	56.50	17.36	68.88	68.75	17.75	19.57*	60.54*	2.00
Sadness	21.54	21.26	18.61	21.08	21.36	23.45	< 1.00	95.19*	2.63
Anger	11.68	13.46	12.49	13.38	11.60	20.28	< 1.00	165.90*	7.52 †
Anxiety	55.02	55.32	22.31	42.34	42.04	22.92	15.76*	82.32*	< 1.00

† p < .007.
* p < .0005. Unless indicated otherwise, all other effects were not significant at alpha = .05.
** A nonsignificant result indicates that the assumption of homogeneity of regression was met.

To summarize, subjects in the fear-relevant condition were successful in recalling a highly fearful experience with a spider. Subjects in the fear-irrelevant condition tended to recall pleasant experiences. As a result of these recollections, the subjects in the fear-relevant condition became more anxious and less happy than the subjects in the fear-irrelevant condition.

Tests of the Experimental Predictions

Fear predictions. The first experimental prediction stated that fear predictions following fear-relevant priming would be greater than those following fear-irrelevant priming. This was tested by a one-way MANOVA. The dependent variables were the four fear predictions: FP1, $FP2_{.0\%}$, $FP2_{.50\%}$, and $FP2_{.100\%}$. The independent variable was the priming condition (fear-relevant vs. fear-irrelevant). The priming effect was not significant at the multivariate level [Pillai F (4, 95) < 1.00, p > .1]. As Table 6.4 shows, none of the univariate results were significant. The results show that priming had no effect on predicted fear, thus failing to support

the first experimental prediction.

Table 6.4. Descriptive statistics and ANOVA results for the first experimental prediction.

Dependent Variable*	Priming Condition: Fear-relevant M	Fear-relevant SD	Fear-irrelevant M	Fear-irrelevant SD	$F(1, 98)$	p
FP1	72.34	21.23	67.96	21.53	1.05	>.1
$FP2._{0\%}$	11.66	21.74	7.26	9.80	1.70	>.1
$FP2._{50\%}$	89.08	9.25	87.64	12.36	< 1.00	>.1
$FP2._{100\%}$	87.28	13.77	87.52	11.33	< 1.00	>.1

* FP1 = Prediction of fear just before removing cover. FP2 = Prediction of fear when touching the inside base of the spider container. The percentages correspond to the conditional probability of encountering a spider.

Priming had no effect on another fear-relevant expectation, the subject's rating of the probability that he/she would encounter a spider (subjective probability) [$t(98) < 1.00$, $p > .1$]. The mean rating in the fear-relevant condition was 74.12 ($SD = 17.53$), and the mean rating in the fear-irrelevant condition was 71.54 ($SD = 18.46$). Subjective probability was significantly greater than 50% in both conditions [Fear-relevant condition: $t(49) = 9.63$, $p < .0001$. Fear-irrelevant condition: $t(49) = 8.17$, $p < .0001$]. This shows that despite receiving information that there was a 50% chance of encountering a spider, subjects rated their chances of such an encounter as significantly greater than 50%. This "anxious pessimism" is conceptually consistent with the bias toward overprediction, and is also consistent with the notion that the overprediction of fear arises because subjects overpredict the threatening aspects of the stimulus. Here, the threatening aspect refers to the probability of encountering a spider.

It is of further interest to note that Table 6.4 shows that $FP2._{50\%}$ tended to be no different from $FP2._{100\%}$, instead of being midway between $FP2._{0\%}$ and $FP2._{100\%}$. This could be interpreted as an anchoring effect (Tversky & Kahneman, 1974). Anchoring is said to occur when the value of a previous rating influences a subsequent rating. Thus, if the first rating is a

high number, anchoring occurs when the second rating also tends to be high. Subjects rated $FP2._{50\%}$ after the rating of FP1 was completed. The latter may have served as an "anchor" for the rating of $FP2._{50\%}$. However, the finding that $FP2._{50\%}$ was closer to $FP2._{100\%}$ than $FP2._{0\%}$ is also consistent with the other evidence of the overprediction of fear (see below), and so may be a further indication of the bias toward overprediction rather than an artifact of the order in which the ratings were completed. In terms of the stimulus estimation model, the result may indicate a form of defensive pessimism (i.e., $f_2 > f_1$; see Chapter 4).

Fear reports. The second experimental prediction stated that priming would have no effect on reported fear. This was tested by a one-way MANOVA. The dependent variables were the two fear reports, FR1 and FR2. The independent variable was the priming condition (fear-relevant vs. fear-irrelevant). The priming effect was significant at the multivariate level [Pillai $F(2, 97) = 4.16$, $p < .05$]. Table 6.5 shows the relevant descriptive statistics and univariate analyses. FR1 was significant greater in the fear-relevant condition relative to the fear-irrelevant condition. A trend in the same direction was found for FR2 ($p < .07$). These findings indicate that fear-relevant priming resulted in a greater level of reported fear compared with fear-irrelevant priming. These results fail to support the strong version of the selective recall model.

Table 6.5. Descriptive statistics and ANOVA results for the second experimental prediction.

Dependent Variable*	Priming Condition: Fear-relevant M	Fear-relevant SD	Fear-irrelevant M	Fear-irrelevant SD	$F(1, 98)$	p
FR1	73.40	16.92	61.72	27.28	6.62	< .012
FR2	22.10	25.93	13.63	19.92	3.35	< .07

* FR1 = Report of fear just before removing cover. FR2 = Report of fear when touching the inside base of the container.

As mentioned earlier, worry can be construed as a form of self-induced priming that takes place before the experiment, and so is appropriate as a covariate. When this variable was added as a covariate in the analysis of FR1 and FR2, the assumption of homogeneity of regression was not violated [Pillai $F(2, 95) = 1.94$, $p > .1$], and the covariate was significant [Pillai $F(2, 96) = 3.66$, $p < .05$]. The priming main effect was significant at the multivariate level [Pillai $F(2, 96) = 5.29$, $p < .01$]. Table 6.6 shows that the corresponding ANCOVAs were significant for FR1 and FR2. Thus, when the priming groups were matched on pre-experiment levels of worry, the effects of the priming manipulations were significant for both fear reports.

Table 6.6. Descriptive statistics and ANCOVA results for the second experimental prediction. The covariate was worry.

Dependent Variable	Priming Condition: Fear-relevant Adj. M	Fear-relevant SD	Fear-irrelevant Adj. M	Fear-irrelevant SD	$F(1, 97)$	p
FR1	73.98	16.92	61.14	27.28	8.29	< .005
FR2	22.51	25.93	13.22	19.92	4.06	< .05

Analyses of difference scores. The third experimental prediction stated that the magnitude of overprediction following fear-relevant priming would be greater than that following fear-irrelevant priming. Two one-way ANCOVAs were performed to test this prediction. In both analyses the independent variable was the priming condition (fear-relevant vs. fear-irrelevant). The dependent variable for the first ANCOVA was the difference score, OP1. This variable is defined as FP1 - FR1. The covariate in this analysis was FP1. This method of analyzing difference scores followed the recommendations of Cronbach and Furby (1970) and was done to reduce the measurement error associated with the use of difference scores (see Appendix 1 for details).

For the first analysis the assumption of homogeneity of regression was met [$F(1, 96) = 1.78$, $p > .1$], and the covariate was significant [$F(1, 97) = 25.29$, $p < .0005$]. The priming main

effect was significant [$F(1, 97) = 5.54$, $p < .02$]. The covariate-adjusted and unadjusted means and SDs are shown in Table 6.7. The table shows that OP1 was significantly larger in the fear-irrelevant condition. This result is in the opposite direction to that predicted by the selective recall model.

The dependent variable for the second ANCOVA was OP2, defined as $FP2_{.0\%}$ - FR2. The covariate was $FP2_{.0\%}$. Recall that this variable was the level of predicted fear when the subject places his/her hand into the container, given a 0% probability of a spider being present. The assumption of homogeneity of regression was met [$F(1, 96) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 97) = 10.82$, $p < .001$]. The priming main effect was not significant [$F(1, 97) = 1.93$, $p > .1$], although there was a trend for OP2 to be smaller in the fear-irrelevant condition, compared with the fear-irrelevant condition (effect size = 0.27 SD units). The covariate-adjusted and unadjusted means and SDs are shown in Table 6.7. The pattern of results did not change when the ANCOVAs were repeated with worry or the mood variables were added as covariates.

Table 6.7. ANCOVA results and descriptive statistics for the third experimental prediction. The covariates were FP1 and $FP2_{.0\%}$ for OP1 and OP2, respectively.

Dependent Variable *	Priming Condition						$F(1, 97)$	p
	Fear-relevant			Fear-irrelevant				
	M	Adj. M	SD	M	Adj. M	SD		
OP1	-1.06	-2.09	19.29	6.24	7.27	24.54	5.54	< .02
OP2	-10.44	-11.35	25.73	-6.37	-5.46	17.59	1.93	> .1

* OP1 = Fear Prediction 1 - Fear Report 1.
OP2 = Fear Prediction $2._{0\%}$ - Fear Report 2.

The means in Table 6.7 represent difference scores between predicted and reported fear, and so serve as indicators of the magnitude and direction of any predictive biases. As the table shows, the bias toward overprediction was found for OP1 in the fear-irrelevant condition, since the mean score of this variable was significantly greater than zero [$M = 6.24$, $t(48) = 2.05$, $p <$

.05].[2] OP1 was not different from zero in the fear-relevant condition [$M = -1.06$, $t(48) < 1.00$, $p > .1$]. In both priming conditions, OP2 was significantly smaller than zero, thus indicating that subjects tended to underpredict their second fear report. [Fear-relevant condition: $M = -10.44$, $t(48) = 3.06$, $p < .01$. Fear-irrelevant condition: $M = -6.37$, $t(48) = 2.15$, $p < .05$].

In summary, the results failed to support the predictions made by the selective recall model. In fact, the finding that priming influenced reported fear but not predicted fear is in the opposite direction to that predicted by the model. It is also noted that the experimental manipulations wiped out the bias toward overprediction in all but one condition; OP1 in the fear-irrelevant condition (Table 6.7). In both priming conditions there was a tendency to underpredict for OP2. This result requires further investigation. In the following sections some possible explanations for the priming effects will be considered.

Were the Priming Results Simply Ceiling Effects?

Priming may have had no observable effect on predicted fear because a ceiling had been reached in the ratings of these variables in both priming conditions (i.e., three of the four fear predictions tended toward the high end of the 0-100 scale; see Table 6.4). Because fear reports tended to be in the midrange of the 0-100 scale, these were unlikely to be influenced by a ceiling (or a floor) in the scores. Thus, the finding that priming influenced fear reports but not fear predictions may have been due to a ceiling in fear predictions. If such an effect was present, then the present experiment would not have provided an adequate test of the selective recall model since the "true" effects of priming on predicted fear, and hence overprediction, could not be determined.

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[2] The pattern of results did not change when covariates, FP1 and $FP2_{.0\%}$, were added to the analyses, and so the simpler analyses are reported.

There are several lines of evidence to show that the priming tasks did not have differential effects on predicted fear, and that the results were not ceiling effects. First, the ceiling had not been reached for FP1 or $FP2._{0\%}$, since the ratings for $FP2._{50\%}$ and $FP2._{100\%}$ tended to be higher than those of FP1 and $FP2._{0\%}$ (see Table 6.4). Thus, the absence of priming effects on FP1 and $FP2._{0\%}$ cannot be attributed to a ceiling in scores. The second source of evidence involves a comparison of priming effects between subjects with high versus low levels of spider fear. Ratings of pre-priming spider fear were subjected to a median split (median = 65.50), and high and low fear groups were formed. A two-way MANOVA was then performed. The independent variables were fear group (high vs. low fear of spiders) and priming condition (fear-relevant vs. fear-irrelevant). The dependent variables were the four fear predictions.

The multivariate main effect for fear group was significant [Pillai $\underline{F}(4, 93) = 5.30$, $\underline{p} < .001$]. Univariate effects were analyzed by a two-way ANOVA for each dependent variable. The independent variables were the same as in the multivariate analysis. The main effects for fear group are shown in Table 6.8. The table shows that the low-fear group made lower fear predictions than the high-fear group on three of the four dependent variables. Thus, the median split was generally successful in separating the subjects with high fear predictions from those with low fear predictions. With this division the presence of ceiling effects would be demonstrated by a significant interaction between fear group and priming condition. This interaction was not significant for the multivariate test [Pillai $\underline{F}(4, 93) < 1.00$, $\underline{p} > .1$] or for any of the tests of individual dependent variables (Table 6.8). Thus, there was no evidence that the priming results described in the earlier sections of this chapter were ceiling effects.

Table 6.8. Results of a median split analysis of ceiling effects.

Dependent Variable	Pre-Priming Spider Fear				Fear Group (Spider Fear) Main Effect		Priming x Fear Group Interaction	
	Low		High					
	M	SD	M	SD	F (1, 96)	p	F (1, 96)	p
FP 1	63.32	21.32	76.98	19.35	10.67	< .002	< 1.00	> .1
FP 2.0%	7.82	10.97	11.10	10.17	< 1.00	> .1	1.39	> .1
FP 2.50%	85.50	14.91	91.22	18.73	6.97	< .01	< 1.00	> .1
FP 2.100%	82.40	13.14	92.40	9.71	18.97	< .0005	2.05	> .1

Reliability

It could be argued that the priming results were due to another type of artifact. Chapman and Chapman (1978, 1983) noted that if two measures differ in reliability, then the more reliable measure will tend to differentiate between groups better than the less reliable measure. The rationale for this is as follows. When a given test or measure is administered to a given group of individuals, the following relation holds.

$$S_o^2 = r^{-1} . S_t^2$$

When S_o^2 is the observed variance in test scores, r is the test's reliability, and S_t^2 is the variance of the true score of the given test (Chapman & Chapman, 1978). When two groups are compared on a given test, the smaller the value of S_o^2, the greater the likelihood of demonstrating any true difference between the groups on the test (Cohen, 1988). For a given value of S_t^2 the equation shows that the lower the level of test reliability, the greater the magnitude of S_o^2. Thus, the lower the reliability, the greater the between-group difference that is need to attain statistical significance at a given alpha level.

In the present study, the "tests" or measures were the ratings of predicted and reported fear.

The observed standard deviations, S_Os, are presented in Tables 6.4 and 6.5. The major finding was that the priming groups differed in fear reports but not fear predictions. If the measures of reported fear were more reliable than then measures of predicted fear, then the priming results may have been due to a statistical artifact.

There are several arguments against the claim that the priming results were an artifact of differential reliability. First, the measures of prediction and report were made on the same type of VA scale with the same response format, and so did not differ in method-related variance, which is one source of differential reliability. Second, and more importantly, for a difference in reliabilities to have influenced the present results, it is necessary that this should be manifested through differences in the observed standard deviations, S_Os (cf. Cohen, 1988). If the obtained results were due to differential reliabilities, then it is expected that the SDs for the measures of predicted fear should be greater than those of reported fear (thus making it more difficult for the priming groups to differ in predicted fear relative to reported fear). Inspection of Tables 6.4 and 6.5 shows that this was not so. For the measures of predicted fear, the mean SD was 15.13 (SD of SD = 5.46), which is smaller than the mean SD for reported fear (M = 22.51, SD of SD = 4.91).

Third, given that there were four measures of predicted fear, compared with two measures of reported fear, and the SDs of predicted fear tended to be smaller than those of reported fear, it can be concluded that the present design was biased toward finding priming differences for predicted fear over reported fear. The opposite pattern of results was found, which suggests that priming influenced reported rather than predicted fear, or at least that priming had a greater effect on reported fear than predicted fear. Either way, the results fail to support the conjecture that the priming effects were an artifact of the reliability of the measures.

Experimental Demand

The most common form of experimental demand is for the subject to present him/herself as a "good" participant by complying with the perceived requirements of the experiment (Christensen, 1980). Since the subjects in this experiment were aware that the study was concerned with the fear of spiders, there may have been an experimental demand to make high

predictions and reports of this fear. In particular, the demand characteristics hypothesis states that fear predictions and fear reports would be greatest in the fear-relevant condition, since the recall of fear-relevant memories should enhance any demand to produce high fear ratings in the predict-report task. As the results of the previous sections show, this was not supported. That is, priming influenced reported fear but not predicted fear. This pattern is inconsistent with the experimental demand hypothesis.

Were the Priming Effects Mediated by Mood?

To reiterate the main findings of this study, it was found that relative to fear-irrelevant priming, fear-relevant priming did not influence fear predictions or the subjective probability of encountering a spider, but did produce greater fear reports, higher state anxiety, and lower levels of state happiness. Zillmann's (1983) transfer of excitation theory may be used to explain these findings by proposing that the effects of priming on mood were "transferred over" to influence the level of fear reported in the approach task. That is, the effects of priming on reported fear may have been mediated through the effects on mood, with the relatively greater state anxiety and lower state happiness in the fear-relevant condition producing greater levels of reported fear in the subsequent approach task. As mentioned in Chapter 5, Zillmann (1983) argued that excitation transfer will only occur when the individual is unaware of the link between current arousal and the previous arousing situation. Unfortunately, our subjects were not asked about their arousal attributions after they made their fear reports. Yet, covariance analyses can be used to test the hypothesis that the effects of priming on reported fear were mediated by changes in mood.

A one-way MANCOVA was performed. The dependent variables were FR1 and FR2 and the independent variable was the priming condition (fear-relevant vs. fear-irrelevant). The covariates were the post-priming ratings of state anxiety and state happiness. If the effects of priming on reported fear were due to the effects of mood, then the covariates should be significant. Moreover, if mood mediated the effects of priming on reported fear, then matching the priming groups on post-priming mood (as per covariance analysis) should wipe out the effects of priming on reported fear.

The assumption of homogeneity of regression for the MANCOVA was not violated [Pillai $F(2, 94) < 1.00$, $p > .1$], and the covariates were significant at the multivariate level [Pillai $F(4, 192) = 3.90$, $p < .01$]. State anxiety was a significant predictor (covariate) for FR1 [$t(98) = 3.95$, $p < .0005$]. State anxiety was not a significant predictor for FR2 [$t(98) = 1.06$, $p > .1$]. State happiness was not significant for FR1 [$t(98) < 1.00$, $p > .1$] or FR2 [$t(98) < 1.00$, $p > .1$]. The priming main effect was not significant for the multivariate test [Pillai $F(2, 95) = 1.71$, $p > .1$]. Table 6.9 shows that none of the univariate tests were significant. In all, the results suggest that the effects of priming on reported fear were mediated by state anxiety, at least for FR1. This pattern of results did not change when worry was added as a covariate.

The results are consistent, to some extent, with Zillmann's (1983) theory, and suggest that the effects of priming on reported fear may have been at least partially mediated by state anxiety. State happiness did not have an inhibitory effect on reported fear. This result is at variance with previous findings (Samsom & Rachman, 1989), and may have been because the difference between the priming groups in state happiness was smaller than those induced in previous studies.

Table 6.9. Descriptive statistics and ANCOVA results. Covariates were post-priming ratings of anxiety and happiness.

Dependent Variable	Priming Condition				Priming Main Effect	
	Fear-relevant		Fear-irrelevant			
	Adj. M	SD	Adj. M	SD	$F(1, 96)$	p
FR1	71.04	16.92	64.08	27.28	2.32	>.1
FR2	21.13	25.93	14.60	19.92	1.70	>.1

Conclusions

Relative to fear-irrelevant priming, fear-relevant priming produced greater levels of reported fear but did not influence predicted fear. Hence, the overprediction of fear tended to be greatest after fear-irrelevant priming. These results are contrary to the experimental predictions made by the strong and weak versions of the selective recall model, and could not be attributed to ceiling effects, differential reliability of the measures, or experimental demand.

There was evidence to suggest that the effects of priming on reported fear were mediated partially by state anxiety. Since overprediction was greatest in the fear-irrelevant group, which had the lowest level of post-priming state anxiety, these results do not support the hypothesis that overprediction increases with anxiety (cf. Kent, 1985). On the contrary, the priming results suggest that state anxiety at the time the fear prediction is made has a (later) effect on reported fear, but does not influence predicted fear. In terms of the stimulus estimation model, the results suggest that priming influenced $\underline{f}_1$ but not $\underline{f}_2$.

The finding that subjects overpredicted for OP1 in the fear-irrelevant condition (Table 6.7) is consistent with the previously documented bias toward overprediction (Rachman & Bichard, 1988). Since priming increased reported fear but not predicted fear, OP1 in the fear-relevant condition was no different from zero (Table 6.7). Thus, the bias toward overprediction was wiped out by fear-relevant priming. As mentioned, this may have arisen because priming increased state anxiety which, in turn, increased FR1 but not FP1. As a result, the overprediction bias was reduced. An unexpected result was that subjects in the fear-relevant and fear-irrelevant conditions tended to underpredict for OP2 (i.e., OP2 was smaller than zero; see Table 6.7). It is not clear why this occurred, since state anxiety was not a significant covariate for FR2. It may be that there were other factors at work (arising from the nature of the priming tasks and/or approach task) in reversing the predictive bias from overprediction to underprediction. Further investigation is required on this issue.

The finding that priming did not influence predicted fear is in contrast with previous studies, which have found that priming influences probability estimates for a variety for events (Carroll, 1978; Gregory et al., 1982; Johnson & Tversky, 1983; Slovic et al., 1982). The priming

procedure used in the present study was similar to that used in other studies, and so the discrepancy may have arisen from differences in the types of events there were predicted. The predictions of the present study were about a commonplace experience; viz., fear. Previous studies required probability estimates for events that subjects were unlikely to have had much experience (e.g., serious accidents, sources of mortality). The availability heuristic is most likely to be used under conditions of high uncertainty, and so priming effects are more likely to be found for predictions for unfamiliar events, than common ones such as fear.

The question arises about the effects of stronger forms of priming on predictions and reports of fear. If the effects of priming on reported fear were (partially) the result of changes in state anxiety, then mood induction may be a potent form of priming. Regardless of the intensity of priming, the results of the present study suggest that priming will have a greater influence on fear reports than fear predictions.

In conclusion, the results of Experiment 1 did not support the selective recall model. Although the results provided some useful information, they leave open the question of the source of overprediction. One possibility, as suggested by the selective effects of priming, is that some factors are more likely to influence fear reports than fear predictions. This will be pursued in the following chapter as part of a test of the differential-weighting model.

CHAPTER 7. EXPERIMENT 2

The purpose of the second experiment was to evaluate the differential-weighting model, which represents one of the information processing mechanisms of the stimulus estimation model. The differential-weighting model, which was described in Chapter 5, emphasizes the informational basis of fear predictions and fear reports. Fear predictions are likely to be based on danger and safety information, such as memories of past events,[1] general knowledge, and information about the likely nature of the feared stimulus that is about to be encountered. Similarly, fear reports are determined by information about sources of danger and about the availability of safety (e.g., escape routes) (Barlow, 1988; Marks, 1987; Rachman, 1990). The magnitude of the fear response is also the result of past encounters with aversive stimuli, and other forms of learning (Bandura, 1986; Rachman, 1990).

The differential-weighting model holds that the bias toward overprediction arises because safety information has a greater influence on fear reports than fear predictions. This is consistent with the results of a study by Rachman et al. (1988a), where it was found that safety information had greater influence on panic reports than panic predictions (for details see Chapter 2). The differential-weighting model proposes that this finding reveals a general process that applies to predictions of panic and fear, and is the mechanism of overprediction for a variety of fear-evoking stimuli and conditions, such as those in which the fear prediction is made in the first trial of a series of predict-report trials. Since the concept of safety is an essential element of the model, it will be described in detail in the following section.

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[1] This does not necessarily imply the selective recall of memories of highly fearful experiences.

Safety Information

Safety information pertains to cues that signal the reduction, minimization, or postponement of threatening events (Rachman, 1984). In this way, the addition of safety information can increase the controllability of the feared stimulus and so is associated with lower levels of reported fear (Barlow, 1988). Safety cues have been present in all the previous studies of overprediction. In the studies of spider and snakes fears, for example, the presence of the experimenter is likely to increase the perceived controllability of the stimulus. The confinement of the feared animal to a glass container is also likely to serve as a potent safety cue since it places constraints on the spider's mobility. In the study of claustrophobia reported by Rachman et al. (1988a), the safety information consisted of information about the availability of oxygen in the small test room. All of these cues set limits on the nature and duration of feared events (Barlow, 1988; Rachman, 1990).

The effects of safety information on overprediction can be investigated by varying the instructional set that subjects receive before commencing a predict-report task. In the present study the task was the same as that used in the previous experiment. This was because it proved useful in eliciting adequate levels of predicted and reported fear in Experiment 1, and contained features that were useful for the present aims (see below). In the current study there were two experimental groups, receiving either high or low levels of safety information about a task in which subjects were asked to place their hands into a container that might have had a spider in it. In the low information group, subjects received little information about the nature of the spider that they might observe or about the container in which it could have been housed. Subjects in the high information group were supplied with additional, safety information. The latter was that the spider was timid and rarely moved, and details about the nature of the container (i.e., the container was transparent, was large enough to place one's hand into without touching the spider, and the container was one that the spider had never escaped from).

Previous studies have shown that information describing the timorous and torpid qualities of spiders is likely to reduce the extent that they are viewed as harmful or threatening (Barlow, 1988; Bennett-Levy & Marteau, 1984; Cornelius & Averill, 1983; Marks, 1987; McNally &

Steketee, 1985; Rachman & Whittal, 1989; Watts & Sharrock, 1984). This is not surprising since a spider with these properties is less likely to crawl onto, and bite the subject. Information about the nature of the container is also a source of safety since it provides spatial limits to the feared encounter (Rachman, 1984), such as information about whether the subject can see if there is a spider present before placing his/her hand in the container. Information regarding the size of the container and the low activity level of the animal implies that subjects can easily avoid touching the spider (if present) when they place their hands into the container.

In the strong version of the differential-weighting model it is predicted that the high and low safety information groups will not differ in predicted fear, whereas the reported fear of the high information group will tend to be lower than that of the low information group. The weak version of the model does not make the claim that safety information has no effect on predicted fear, but holds that the fear reports of the high information group will tend to be lower than those of the low fear group. Both versions of the model make the counter-intuitive experimental prediction that the group with the greatest amount of safety information will display the greatest magnitude of overprediction of fear.

The experimental predictions can be summarized as follows. The first prediction is from the strong version of the model. The remaining predictions are from the strong and weak versions of the model.

1. The fear predictions in the high information group will not differ from those of the low information group.

2. The high information group will have lower fear reports that the low information group.

3. The high information group will display a greater magnitude of overprediction than the low information group.

Method

Subjects

Subjects were selected from a pool of undergraduate university students in the same manner as in the first experiment. The sample of Experiment 2 consisted of 121 students (76.03% female) that had not participated in the first study. Subjects participated for course credit, and had a mean age of 20 years 0 months (SD = 3 years 4 months). The sample represented a wide range of spider fears, ranging from very mild to intense fear (see Results for details).

Measures

Spider fear. To match the fear levels of the experimental groups prior to the experimental manipulations, each subject's general level of spider fear was assessed by a visual analogue (VA) scale. All the VA scales in this experiment were 100 mm lines divided into numbered, 5 mm gradations, and labelled in increments of 10 mm. The spider fear scale was accompanied by instructions to "place a vertical slash at the appropriate point on the line to indicate how frightened you are of spiders." The scale was anchored such that 0 = not frightened at all, and 100 = extremely frightened.

State anxiety. Given the role of state anxiety in the overprediction of fear, as suggested by the findings of the previous experiment, the mean levels of state anxiety of the groups were compared at the beginning of the experiment. State anxiety was measured on the same VA scale used in the previous experiment (0 = no anxiety, 100 = extreme anxiety).

Predict-Report Task

The remaining measures were included in the predict-report task, which consisted of a Predictions Questionnaire followed by an approach task. Two versions of the Predictions Questionnaire were used, differing only in the prefatory instructions. The instructions in the high-information condition contained safety information that was not given in the low-information condition.

Low-information instructions. "You will now be asked to make some predictions concerning a task that involves approaching a glass bowl covered by a cloth. The bowl will either

be empty, or will contain a live, harmless spider. There is a 50% chance that the bowl will contain the spider, and a 50% chance that the bowl will be empty. The task consists of going up to the bowl, removing the cloth, and then placing your hand into the bowl until you touch the inside of the bottom of the bowl (or as close to this as you can go). Again, there is a 50% chance that the bowl will either be empty or contain the spider. You may look into the bowl while you are performing this task."

High-information instructions. In the instructions used in this condition the emphases represent words or phrases that differentiate the high and low information versions. They were not in the original. "You will now be asked to make some predictions concerning a task that involves approaching a transparent glass bowl covered by a cloth, which you can see behind you at the end of the room. (Please turn around and take a look at the bowl.) The middle of the bowl is eight inches wide, and its opening is four inches wide. The bowl will either be empty, or will contain a live, harmless spider. The spider is timid, rarely moves, and has never escaped from the bowl. There is a 50% chance that the bowl will contain the spider, and a 50% chance that the bowl will be empty. The task consists of going up to the bowl, removing the cloth, and then placing your hand into the bowl until you touch the inside of the bottom of the bowl (or as close to this as you can go). Again, there is a 50% chance that the bowl will either be empty or contain the spider. You may look into the bowl while you are performing this task."

In the low-information condition the ratings were completed while the covered bowl was shielded by a partition. In the high-information condition the partition was removed and each subject was requested to view the covered bowl (at a distance of 3 m) before making his or her predictions.

Predictions Questionnaire. The predict-report instructions were followed by a Predictions Questionnaire that consisted of eight VA scales. Anchor points for the VA scales are given in parentheses. All emphases were in the original.

1. "How anxious do you feel right at this moment?" (0 = not anxious at all, 100 = extremely anxious.) (State anxiety after receiving the instructions.)

2. "For half the subjects the spider is in the bowl. What do you think the chances are that

you will be one of the subjects for whom the spider is in the bowl?" (0 = not at all likely, 100 = extremely likely.) The variable measured by this scale will be known as the subjective probability of encountering a spider.

3. "Predict the peak amount of fear that you will experience when you are standing at the bowl just about to lift the cloth." (0 = no fear at all, 100 = terrifying fear.) This item will be called Fear Prediction 1 (FP1).

4. "Predict the peak amount of fear that you will experience when you touch the bottom of the inside of the bowl." (0 = no fear at all, 100 = terrifying fear.) This item will be called Fear Prediction 2 when subjects are informed that there is a 50% chance of encountering a spider ($FP2._{50\%}$).

5. "If you knew that the spider was not in the bowl, predict the peak amount of fear that you will experience when you touch the bottom of the inside of the bowl." ($FP2._{0\%}$)

6. "If you knew that the spider was in the bowl, predict the peak amount of fear that you will experience when you touch the bottom of the inside of the bowl." ($FP2._{100\%}$)

7. "If the spider is in the bowl, how quickly do you think it will move?" (0 = will not move at all, 100 = will move extremely quickly.)

8. "If the spider is in the bowl, how dangerous do you think it will be?" (0 = not dangerous at all, 100 = extremely dangerous.)

To prevent subjects from assuming that some of the preceding items implied that there was a greater than 0.5 probability that the spider would be in the bowl, the Predictions Questionnaire concluded with the following statement: "Remember, there is a 50% chance that the bowl will contain a spider, and a 50% chance that the bowl will be empty."

Approach task. This task was the same as that used in the first experiment. The subject received written and verbal instructions about approaching the bowl and making ratings of reported fear. From a starting point 3 m from the bowl, the subject walked up to the bowl and rated his/her peak level of fear on a 0-100 VA scale (0 = no fear at all, and 100 = terrifying fear) just before removing the cover [Fear Report 1 (FR1)]. The subject then removed the cloth

covering the bowl, touched the inside base of the bowl, and then removed his/her hand from the bowl. The subject then used a second VA scale to rate the peak level of fear than had been experienced while touching the container's inside base [Fear Report 2 (FR2)]. For each subject the bowl was empty.

As mentioned in the previous chapter, there were several reasons for not including a spider-present condition. The presence of a spider was likely to increase the error variance of the fear reports, since the spider may move sporadically, thus increasing fear for some subjects but not for others. Moreover, there are individual differences in what constitutes a fearful spider (Watts & Sharrock, 1984, 1985). These differences are likely to interact with the qualities of the spider selected for presentation, thus providing a further source of error variance in the fear reports. The inclusion of a spider-present condition would have provided an internal replication of the experimental predictions (i.e., a test of the predictions in each of the spider-present and spider-absent conditions. However, the increase in sample size required for this was not feasible.

Design

The independent variable was the information level (low vs. high safety information). This was a between-group factor. Subjects were quasi-randomly assigned to each group, with the constraint that the groups were matched on the mean level of spider fear. The dependent variables were the items in the predictions questionnaire, Fear Reports 1 and 2, spider fear, and state anxiety. Two difference scores also served as dependent variables: OP1 = Fear Prediction 1 - Fear Report 1, and OP2 = Fear Prediction 2.0% - Fear Report 2.

Procedure

All subjects were tested individually by one of two experimenters. One experimenter was the author, and the other was unaware of the experimental predictions of the study. All ratings and instructions were presented in booklet form. Each subject completed the scales and tasks in the following sequence.

1. Consent form.

2. Rating of spider fear (which was used to determine the experimental condition that the subject would be assigned to).

3. Rating of state anxiety prior to receiving the high or low safety information contained in the Predictions Questionnaire.

4. Predictions Questionnaire (high or low information versions). This included a rating of state anxiety after subjects received the high or low safety information.

5. Approach task.

6. Debriefing.

The protocols used by the experimenters and subjects are presented in Appendices 6 and 7, respectively.

Results

Preliminary Analyses

As intended, the sample represented a wide range of levels of spider fear. The sample was approximately normally distributed with respect to this variable, with a grand mean of 52.20 and SD of 26.27. Univariate and multivariate analyses for outliers did not identify any outliers in the two groups. To control for the slightly unequal cell sizes (Table 7.1), the multivariate analyses of variance were based on unique sums of squares (Tabachnick & Fidell, 1989). The groups were matched on level of spider fear [$F(1, 119) < 1.00$, $p > .1$] and did not differ in their levels of state anxiety at the beginning at the experiment [$F(1, 119) = 2.13$, $p > .1$]. The means and SDs of these variables are shown in Table 7.1.

Table 7.1. Group means and SDs of spider fear and state anxiety prior to the experimental manipulations.

Group	n	Spider Fear		State Anxiety	
		M	SD	M	SD
Low Information	62	52.87	25.76	41.89	20.56
High Information	59	51.49	27.00	36.64	18.87

Covariate selection. Subjects were selected to cover a wide range of levels of spider fear, and so this variable could be used as a covariate to increase the power of the remaining analyses. The results of the previous experiment suggested that state anxiety might be a useful covariate. To prevent the following results from being unnecessarily complicated, covariate analyses (using spider fear and/or state anxiety) will not be reported unless they make a difference to the interpretation of the results.

Experimenter effects. There was no evidence of experimenter bias due to knowledge of the aims of the experiment. This is shown by the results presented in Appendix 8.

Effects of Safety Information on Predicted Fear

The first experimental prediction stated that the fear predictions of the high information group would not differ from those of the low information group. This was tested by a one-way MANOVA. The independent variable was the information level (low vs. high). The dependent variables were FP1, $FP2._{0\%}$, $FP2._{50\%}$, and $FP2._{100\%}$. The information main effect was not significant at the multivariate level [Pillai F (4, 116) < 1.00, p > .1]. The corresponding ANOVAs for each dependent variable were nonsignificant. The results of these analyses, and the means and SDs are shown in Table 7.2. As the table shows, there was not even a trend for a group difference in fear predictions. Thus, the first experimental prediction was supported.

Table 7.2. Means and SDs of fear predictions for each information level, and corresponding univariate results.

Dependent Variable*	Information Level				F (1,119)	p
	Low		High			
	M	SD	M	SD		
FP1	57.00	26.80	56.10	25.27	< 1.00	> .1
$FP2._{0\%}$	12.76	18.03	11.12	17.36	< 1.00	> .1
$FP2._{50\%}$	67.71	25.72	67.64	25.09	< 1.00	> .1
$FP2._{100\%}$	65.89	26.99	66.80	25.86	< 1.00	> .1

* FP1 = Prediction of peak fear just before removing cover. FP2 = Prediction of peak fear when touching the inside base of the spider container. The percentages correspond to the conditional probability of encountering a spider.

As in the previous experiment, it was found that the means for $FP2._{50\%}$ were not midway between $FP2._{100\%}$ and $FP2._{0\%}$. Rather, they were no different from those of $FP2._{100\%}$, and approximately two SDs greater than $FP2._{0\%}$ (Table 7.2). Although these results could be interpreted as an anchoring effect (see Chapter 6), they are consistent with the evidence for the bias toward overprediction. It seems likely that one source of overprediction is the failure to

utilize fully stimulus probability informationwhen forming one's fear predictions. These interesting results will be taken up later.

Reported Fear

The second experimental prediction stated that the high information group would report less fear than the low information group. This was tested by a one-way MANOVA. The independent variable was information level (low vs. high), and the dependent variables were FR1 and FR2. The information main effect was significant at the multivariate level [Pillai $F(2, 118) = 3.29$, $p < .05$]. Univariate analyses were conducted for each dependent variable. The results of these analyses, and the means and SDs are shown in Table 7.3. The table shows that the second experimental prediction was supported for FR2 but not FR1. There was a trend in the predicted direction for FR1. For this variable the effect size of the group difference was 0.22 SD units, which in the classification scheme of Cohen (1988) is small, but nontrivial in magnitude. With a larger sample or more sensitive measures this effect may have reached significance at alpha = .05. Nevertheless, it is concluded that the second experimental prediction was supported only for FR2. The significance level of this result did not change appreciably with the inclusion of spider fear and state anxiety as covariates.

Table 7.3. Means and SDs of fear reports for each information level, and corresponding univariate results.

Dependent Variable*	Information Level					
	Low		High		$F(1,119)$	p
	M	SD	M	SD		
FR1	49.95	25.79	44.19	26.94	1.45	>.1
FR2	26.53	29.84	14.29	21.59	6.63	<.011

* FR1 = Report of peak fear just before removing cover. FR2 = Report of peak fear when touching the inside base of the container.

Analyses of Difference Scores

The third experimental prediction stated that the high information group would display a greater magnitude of overprediction than the low information group. This was tested by a pair of one-way ANCOVAs. The independent variable was information level. For the first ANCOVA, the dependent variable was the difference score, OP1. Recall that this was defined as FP1 - FR1. Following the recommendations of Cronbach and Furby (1970), FP1 was used as a covariate in this analysis (see Appendix 1). The assumption of homogeneity of regression for the first ANCOVA was met [$F(1, 117) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 118) = 13.51$, $p < .0005$]. The Information main effect approached significance [$F(1, 118) = 3.95$, $p < .099$]. The covariate-adjusted and unadjusted means, and SDs appear in Table 7.4. OP1 was significantly greater than zero in the low information condition [$t(61) = 4.37$, $p < .0005$] and in the high information condition [$t(58) = 11.08$, $p < .0005$]. Thus, subjects tended to overpredict their fears for OP1. Since subjects tended to overpredict, and the Information main effect was marginally significant , it is concluded that the provision of safety information tended to increase the magnitude of overprediction for OP1. This provides some support for the third experimental prediction of the differential-weighting model.

Table 7.4. ANCOVA results, unadjusted means, covariate-adjusted means, and SDs for the information main effect. The covariate was FP1.

Dependent Variable*	Information Level						$F(1, 118)$	p
	Low			High				
	M	Adj. M	SD	M	Adj. M	SD		
OP1	7.05	6.95	17.48	11.92	12.01	17.68	3.95	< .099

* OP1 = Fear Prediction 1 - Fear Report 1.

For the second ANCOVA, the dependent variable was OP2, which was defined as $FP2_{.0\%}$ - FR2. $FP2_{.0\%}$ was the covariate. Recall that $FP2_{.0\%}$ was the subject's predicted level of fear when touching the bottom of the container, given a 0% probability of a spider being present. As before, information level (low vs. high) was the independent variable. The assumption of homogeneity of regression was not violated [F (1, 117) < 1.00, p > .1], and the covariate was significant [F (1, 118) = 13.07, p < .0005]. The information main effect was significant [F (1, 118) = 6.52, p < .012]. The covariate-adjusted and unadjusted means, and SDs appear in Table 7.5. As the table suggests, OP2 in the high fear information condition was not different from zero [t (58) = 1.45, p > .1], whereas OP2 in the low information condition was significantly smaller than zero [t (61) = 5.32, p < .0005]. Thus, for OP2, subjects tended to underpredict in the low information condition, and tended to be accurate in the high information condition. These results show that the addition of safety information resulted in a smaller amount of underprediction. Strictly speaking, this result is not in the form of the third experimental prediction, which stated that the high information group would display a greater magnitude of overprediction than the low information group. Yet, it is consistent with the gist of the prediction since, arithmetically, an underprediction can be regarded as a negative overprediction.

Table 7.5. ANCOVA results, unadjusted means, covariate-adjusted means, and SDs for the information main effect. The covariate was $FP2_{.0\%}$.

Dependent Variable*	Information Level						F(1, 118)	p
	Low			High				
	M	Adj. M	SD	M	Adj. M	SD		
OP2	-13.77	-14.15	29.26	-3.17	-2.79	21.14	6.52	<.012

* OP2 = Fear Prediction 2 - Fear Report 2.

Further Analyses of the Effects of Safety Information

The results presented so far have generally supported the three experimental predictions of the differential-weighting model: Safety information influenced fear reports but not fear predictions, and the overprediction of fear tended to be greater when more safety information was provided. The selective effect of information on fear reports is inconsistent with the view that the results were due to experimental demand. To gain further insight into the effects of safety information, additional analyses were conducted. The safety information that distinguished the experimental conditions consisted of statements that the spider was timid and slow moving. Thus, it is of interest to know whether this information had any effect on the subjects' predictions of the activity level or dangerousness of the spider that could have been present. Since safety information had no effect on fear predictions, the differential-weighting model would be inconsistent unless it predicts that this information has no effect on other fear-relevant expectations, such as the predicted dangerousness and activity level of the spider. The groups were not expected to differ in the subjective probability of encountering a spider. These experimental predictions will be evaluated in this section.

The results Experiment 1 raise a further question of whether the information effects in the current study were mediated by state anxiety. It may be that safety information influenced state anxiety at the time the fear predictions were made. Any effects on state anxiety may have been "transferred over" to influence fear reports. A similar argument was used to explain the effects on priming in Experiment 1, and was derived from Zillmann's (1983) work on the transfer of affective excitation (see Chapter 6).

A one-way MANCOVA was performed. The independent variable was information level. The dependent variables were the predicted dangerousness and activity level of the spider, the subjective probability of encountering a spider, and the subject's level of state anxiety after he/she had been presented with the information about the spider. The information main effect was not significant at the multivariate level [Pillai $F(4, 116) < 1.00, p > .1$] or at the univariate level (see Table 7.6). The inclusion of covariates in the analyses did not alter this pattern of results.

Table 7.6. Means and SDs of state anxiety and fear-relevant predictions for each information level, and corresponding univariate results.

Dependent Variable	Information Level				$F(1,119)$	p
	Low		High			
	M	SD	M	SD		
State Anxiety	53.24	24.17	48.29	24.09	1.27	>.1
Subjective Probability	60.73	16.58	57.39	17.76	1.14	>.1
Predicted Activity Level	62.24	24.67	56.19	25.52	1.76	>.1
Predicted Dangerousness	19.66	24.17	20.19	22.86	< 1.00	>.1

Table 7.6 shows that safety information had no effect on subjects' predictions about the dangerousness or activity level of the spider. These results are counter-intuitive, since the safety information was directed toward the spider's activity level and dangerousness. Yet the results are consistent with the differential-weighting model, and with the finding that safety information had no effect on fear predictions. The results further indicate that safety information did not influence the subjective probability of encountering a spider, which adds further weight to the conclusion that the effect of information on reported fear was not mediated by differences in the subjects' expectations of encountering a spider.

Subjects tended to rate the subjective probability of encountering a spider as significantly greater than 50%, even though they were informed that there was a 50% probability of encountering a spider [see Table 7.6; Low information: t (61) = 5.10, $p < .001$. High information: t (58) = 3.20, $p < .01$]. This can be taken as further evidence of "anxious pessimism" of which the overprediction of fear is one example.

Discussion

The findings of this experiment revealed a discordance between fear-relevant expectations and fear experience. Subjects tended to overestimate the likelihood of encountering a spider, and the provision of safety information did not alter this bias. Safety information did not influence fear predictions or other fear-relevant expectations, but did influence reported fear and so influenced the bias toward overprediction. Subjects tended to overpredict for OP1 in both information conditions, with the magnitude of this bias being greatest in the high information condition. Yet, subjects tended to be accurate for OP2 in the high information condition, and tended to underpredict in the low information condition. Since the effects of information on over- and underprediction were mediated by the effects on reported fear, the results of this study (and those of Experiment 1) raise the question of whether it is generally the case that the factors that shape the magnitude of overprediction operate by influencing fear reports rather than fear predictions.

When groups differ on some measures but not others, it is important to establish whether this represents a difference in the "true" scores, or whether this is a statistical artifact. If two measures differ in reliability, then the more reliable measure will tend to differentiate between groups better than the less reliable measure (Chapman & Chapman, 1978, 1983). If the reliability of the VA ratings of predicted fear was lower than those of reported fear, then there would be a bias for the groups to differ on fear reports compared with fear predictions. It was argued in the previous experiment that a reliability artifact was unlikely to have been responsible for the priming effects. The same arguments apply to the information effects of present study.

First, the measures of prediction and report were made on the same scales with the same format, and so were unlikely to have differed in method-related variance, which is one source of differential reliability. If the fear prediction scales had a lower reliability than the fear report scales, then it is expected that the SDs of predicted fear should be greater than those of reported fear. Inspection of Tables 7.2 and 7.3 shows that this is not so. For the fear predictions, the mean SD was 23.89 (SD of SD = 3.88), which was smaller than the mean SD for the fear reports (M = 26.04, SD of SD = 3.42). These results fail to support the view that the

information effects were an artifact of the reliability of the measures.

The results of the present study generally support the three experimental predictions made by the differential-weighting model, and support the inclusion of this model as a cognitive component of the stimulus estimation model. That is, the provision of safety information resulted in lower fear reports but did not influence fear predictions. This suggests that the overprediction of fear arises from a process of selective abstraction (i.e., differential utilization) of information in the formation of fear expectations. This process has been implicated in other aspects of emotion-relevant information processing (Beck & Emery, 1985; Beck, Rush, Shaw, & Emery, 1979). The findings raise the question of the role of other sources of information in the bias toward overprediction.

It may be that the overprediction of fear arises from the over-reliance on a danger schema (Beck & Emery, 1985) in the formation of fear predictions, to the neglect or under-utilization of other sources of information, such as safety information available in the environment. The bias toward the overprediction can arise if fear expectations are the result of schema-congruent processing from high-fear schemata. Thus, safety information is neglected and other types of information (e.g., danger information) may be emphasized in the prediction process. If the fear schema is biased to represent typical fear experiences as more threatening than they actually were, then the bias toward overprediction will tend to occur for a variety of fear-evoking stimuli. If the schema is not biased in this way, then overprediction will tend to be greatest for stimuli that evoke low levels of reported fear. The results of the first experiment can be interpreted as indicating that the priming of the danger schema need not increase the magnitude of the bias toward overprediction. The schema may operate in a binary fashion (active/inactive) and is probably activated when the spider-fearful subject enters a situation where he/she expects to encounter a spider (such as one of our experiments). Note that the schema outlined here does not require or imply a mechanism of selective retrieval of high-fear memories, as proposed by the selective recall model.

It is commonly reported in the literature that several exposure trials are required before the bias toward overprediction gives way to predictive accuracy (Rachman, 1988; Rachman &

Arntz, 1991; Rachman & Bichard, 1988). In terms of the differential-weighting model, this is accounted for by proposing that the validity and salience of safety information increases over trials. This may represent a processing strategy consisting of a gradual decrease in reliance on the schema to derive fear predictions, and an increasing emphasis on incoming information about stable stimulus features (including safety cues) in the formation of fear predictions. The powerful effect of underpredictions in producing overpredictions on subsequent trials (Rachman & Bichard, 1988) suggests that the occurrence of an underprediction may serve as a cue to reinstate schema-congruent processing. As such, safety information may be easily invalidated or devalued by the occurrence of an underprediction.

The role of state anxiety in the overprediction of fear remains to be clarified. In Experiment 1 it was found that in comparison to fear-irrelevant priming, fear-relevant priming produced an <u>increase</u> in state anxiety and a <u>smaller</u> bias toward overprediction. It was argued that this arose because priming increased state anxiety, and this influenced fear reports but not fear predictions. In the present experiment, the addition of safety information was followed by lower levels of predicted fear, but this manipulation did not influence state anxiety. These findings are open to several interpretations. The differences in the results of Experiments 1 and 2 may have arisen because there are multiple pathways to fear (Rachman, 1978). That is, fear reports may be influenced by manipulations that increase state anxiety (Zillmann, 1983) and by other types of manipulations (e.g., the provision of safety information). These pathways are just beginning to be understood, and are in need of further investigation (Rachman, 1990). Fear predictions and fear reports may be based on different mechanisms, which are differentially sensitive to safety information and state anxiety. For example, safety information may exert its effects on fear reports but not fear predictions because this information needs to be combined with exposure to the feared situation before it can manifest its effects (cf. Bandura, 1986). If this is the case then it is expected that the information manipulations of the present study would not alter state anxiety prior to the approach task. In comparison, fear-relevant priming may increase state anxiety and, in turn, increase reported fear by the transfer of anxious arousal (Zillmann, 1983).

Considerably more research is required before the differential-weighting model, with or

without the assumption of a danger schema, can be regarded as an adequate component of the stimulus estimation model. A question for further investigation concerns the role of other types of information in the formation of predictions and reports of fear. The present experiment found that safety information had more influence on fear reports than fear predictions. One goal of the experiment described in the following chapter is to attempt to consolidate this finding by replication and extension. Questions remain about the effects of danger information on predictions and reports of fear. Do subjects under-utilize danger and safety information alike when forming their predictions? Alternatively, there may be an asymmetry in information utilization. That is, danger information may play a more important role than safety information in the formation of fear predictions. This possibility is consistent with notion of schema-congruent processing.

A further issue arises from a limitation of the present study. The experimental groups differed in the type and amount of information that was received. It might be objected that the observed effects were due to group differences in the amount of any type of information instead of the amount of safety information that was presented prior to making the fear predictions. This explanation seems implausible, since the provision of danger or threat information can increase fear levels (Barlow, 1988; Miller, 1979; Thompson, 1981). Thus, it seems more likely that the results of present study were due to group differences in the type rather than the amount of information. This issue will be pursued in the following experiment, where groups received information that differed in type (danger vs. safety) rather than amount, and by holding constant the type of information (i.e., that pertaining to safety) and varying the amount (low vs. high salience).

CHAPTER 8. EXPERIMENT 3

The purpose of the third experiment was twofold. First, to replicate and extend the results of Experiment 2. Second, to test the algebraic expression of the stimulus estimation model. In the previous study it was found that the addition of safety information influenced fear reports but not fear predictions. The general design of the present study was similar to that of the previous study. However, instead of spider-fearful subjects, snake-fearful subjects were used. Fear of snakes was used to examine the generality of the previous findings and was chosen because this fear is common, and so an adequate sample size could be readily obtained. The generality of the information effects was investigated by varying the type of information and by using an animal-present condition in place of the animal-absent condition used in Experiments 1 and 2. Related to the question of generality, the effects of information salience were also investigated.

The predict-report task of this experiment was similar to that used in the previous experiments. Each subject was assigned to one of four groups (control, danger, safety, or enhanced safety conditions), differing only in the amount and type of fear-relevant information that was presented before subjects made their fear predictions for an approach task. In the approach task the subject was asked to walk up to a covered glass container, remove the cover, and touch a mark on the inside of the container. Subjects were told that inside the container was a live, harmless snake. Unlike the previous experiments, there was always an animal in the container.

Replication

The first aim was to attempt to replicate the findings of Experiment 2 by comparing the predictions and reports of a control group, receiving little information about the approach task, with a group receiving safety information about the task, which was of the type used in Experiment 2. The following predictions were tested.

1. The fear predictions of the safety information group will not differ from those of the control group.

2. The safety information group will make lower fear reports that the control group.

3. The safety information group will display a greater magnitude of overprediction than the

control group.

Information Salience

In the previous experiment, safety information was added in the form of a short written description of the spider and the container, and the opportunity to view the covered container before completing the predict-report task. The inclusion of this information resulted in lower levels of reported fear, but did not influence predicted fear. Human judgments are known to be more readily influenced by highly salient information, compared with information of low salience (Kahneman et al., 1982; Nisbett & Ross, 1980). This suggests that safety information may have to be highly salient before it influences fear predictions. For the present purposes, the enhancement of the salience of a given stimulus feature is to increase its prominence or obviousness, so that it is more likely to capture attention (Nisbett & Ross, 1980). The salience of a feature is influenced by a variety of factors. One way to increase it is to add information that supports or demonstrates the feature in question. For example, information that a snake is harmless may be conveyed by a written statement (low salience) or by written statement combined with the opportunity to observe the experimenter encountering the animal without aversive consequences (high salience). Written safety information plus the opportunity to observe a model performing the approach task without aversive consequences is known to influence reported fear (Bandura, 1977, 1986), and may have a greater influence on fear predictions than written information alone (Bandura, 1986; Nisbett & Ross, 1980). If safety information has to be highly salient before it influences fear predictions, then the bias toward overprediction can be seen as a result of a tendency to overlook the subtle cues to safety that are often available at the time the fear prediction is made.

Regardless of the saliency of this type of information, the strong and weak versions of the differential-weighting model predict that the addition of even highly salient safety information will have a greater influence on fear reports than fear predictions (Chapter 5). Thus, it is predicted that the provision of highly salient safety information will increase the magnitude of the bias toward overprediction. This will be tested by contrasting a group that receives minimal information about the snake with a group that receives enhanced (high salience) safety

information of the type described above. As in the previous experiment, safety information will be presented just before the subject makes his/her fear predictions. The experimental predictions are as follows.

1. Relative to the control group, the enhanced safety group will have lower levels of predicted fear.

2. The enhanced safety group will make lower fear reports that the control group.

3. The enhanced safety group will display a greater magnitude of overprediction than the control group.

Danger Information

A further aim of this experiment was to compare the effects of danger and safety information. For the present purposes, danger features are defined as those that enhance the extent that a feared stimulus is uncontrollable, and signal the increase or increased likelihood of feared events (Barlow, 1988; Rachman, 1990). As mentioned in the previous chapter, safety features are defined as those which enhance controllability and signal the reduction, minimization, or decreased likelihood of feared events (Rachman, 1984, 1990). The addition of danger features tends to increase reported fear, whereas the addition of safety features tends to decrease reported fear.

Fear predictions may be characterized by a general under-utilization of environmental information. Alternatively, they may be selectively influenced by particular types of information, such as danger information. The information used to form fear predictions may be processed in a schema-congruent fashion. The danger schema for snake-fearful individuals is likely to represent snakes as threatening (cf. Landau, 1980). Consequently, an experimental prediction of the schema version of the differential-weighting model, which entails the concept of schema-congruent processing (Chapter 5), is that the fear predictions of snake-fearful individuals will be influenced by danger information but not by safety information. If fear predictions and fear reports are influenced by schema-congruent processing, it is parsimonious to predict that they are influenced to the same degree. This prediction, along with the other experimental predictions described in this section, will be tested by comparing fear predictions and fear reports

of the control group with those of a group receiving snake-relevant danger information just before they complete their fear predictions.

To summarize, the following predictions were tested about the effects of danger information.

1a. Relative to the control group, the danger information group will have uniformly higher levels of predicted and reported fear.

1b. Alternative to 1a: Relative to the control group, the danger information group will have higher levels of reported fear, but not predicted fear. That is, the group differences in reported fear will be greater than those in predicted fear.

2a. Following from 1a, the control and danger groups will not differ in their magnitudes of overprediction.

2b. Alternative to 2a: Following from 1b, the danger group will display a smaller magnitude of overprediction than the control group.

Evaluating the Algebraic Expression of the Stimulus Estimation Model

Recall that the stimulus estimation model was intended as a theoretical framework that consists of an algebraic expression of overprediction supplemented by a number of candidate cognitive mechanisms. Experiments 1 and 2 focused on two of the cognitive mechanisms; selective recall and differential weighting. An aim of the present study was to evaluate the algebraic expression of the model. To reiterate, the expression is summarized as follows.

Let the fear report, R, be a function of the fear stimulus, S.

$$R = \underline{f}_1\{S\} \qquad (1)$$

Where $\underline{f}_1$ is an unknown function.

The model states that the estimation of the fear report is based on an estimation of the fear stimulus.

$$\text{est. } R = f_2\{\text{est. } S\} \qquad (2)$$

Where est. R = the predicted level of fear, est. S = the predicted stimulus, and f_2 is an unknown function.

The bias toward the overprediction of fear implies that, on average, the following is true.

$$\text{est. } R > R \qquad (3)$$

Substituting (1) and (2) into (3), the model of overprediction can be expressed as follows.

$$f_2\{\text{est. } S\} > f_1\{S\} \qquad (4)$$

Types of predictive bias. Expression (4) leads to a set of predictions about the phenomena that should be subject to predictive biases. The model implies that one source of the overprediction of fear is the overprediction of danger and other aversive properties of the stimulus, and the underprediction of safety associated with the stimulus (Chapter 5). Since movement, size, and uncontrollability have been found to be threat-relevant features for small-animal fears (e.g., McNally & Steketee, 1985), it is predicted that subjects will tend to overpredict the length and activity level of the snake, and to underpredict the perceived controllability of the situation. The overprediction of threat also implies that subjects should tend to underpredict their abilities to confront a threat-relevant stimulus. Thus, it is predicted that subjects will tend to underpredict their abilities to perform the approach task. If subjects overpredict the threatening properties of the stimulus, then it is expected that they will overpredict other aversive stimulus properties, such as the perceived ugliness of the snake. Similarly, it is expected that subjects will tend to overpredict the amount of disgust evoked by the animal.

In summary, it was predicted that subjects would display predictive biases about a large

number of stimulus and response parameters associated with snakes:

1. Fear (overprediction).
2. Danger (overprediction).
3. Safety (underprediction).
4. Controllability (underprediction).
5. Activity level of snake (overprediction).
6. Snake length (overprediction).
7. Perceived ugliness of the animal (overprediction).
8. Disgust (overprediction).
9. Ability of subject to complete the approach task (underprediction).

Structural equation modeling. As described in Chapter 5, the stimulus estimation model offers two hypotheses about the source of the overprediction bias: (i) est. S > S, and (ii) $\underline{f}_2 > \underline{f}_1$. The focus of the present study was on (i). According to this assumption, the overprediction of fear is the result of the overprediction of the danger properties of the stimulus and the underprediction of the safety properties. This can be evaluated by structural equation modeling (Steiger, 1989). Structural equation modeling ("causal modeling") is a method that draws on regression analysis and confirmatory factor analysis (McDonald, 1985). It is used to evaluate models that specify causal relationships among groups of variables. Here, "causal" is used in the statistical sense of the word. To test the significance of a given model, the correlation (or covariance) matrix obtained for the variables of interest is compared to the correlation (covariance) matrix predicted by a given model. If the model provides an adequate explanation of the data, then the predicted and obtained matrices will be very similar to one another. The significance of the model is evaluated by the overall goodness-of-fit of the model to the data, and by testing the significance of each causal pathway. Although correlation does not imply causality, causality implies (non-zero) correlation (Bollen, 1989). Thus, the analysis of correlation matrices by structural equation modeling can be used to test hypotheses about causal relations (Bollen, 1989; McDonald, 1985).

The difference score between predicted and reported fear (est. R - R) served as a dependent ("endogenous") variable, and the differences between predicted and reported stimulus parameters (est. S - S) were the predictor ("exogenous") variables. The present study used a snake as the feared stimulus. Therefore, five properties of the snake and its context were used as stimulus properties: The perceived danger, safety, controllability, activity level, and length of the snake. The difference between the prediction and report of each of these variables served as a predictor variable.

The stimulus estimation model holds that some or all the stimulus variables will be significant statistical predictors of the overprediction of fear. The results of the previous experiment, with the original findings of Rachman et al. (1988a), suggest that the underprediction of safety will be a statistical predictor of the overprediction of fear. The remaining stimulus properties were selected because a number of studies suggest that they are important in determining snake fear (Barlow, 1988; Bennett-Levy & Marteau, 1984; Mineka & Hendersen, 1985; Mineka & Kihlstrom, 1978; McNally & Steketee, 1985; Rachman & Whittal, 1989; Slovic, 1987).

Regarding other candidate predictors, studies by Wardle (1984) and Kent (1984, 1985) have shown that the magnitude of overprediction of pain increases with the subject's level of state anxiety and trait dental anxiety. Given the similarity between fear and pain predictions (Chapter 2), it is likely that state anxiety or some form of trait anxiety contributes to the overprediction of fear. In Chapter 5 it was argued that state anxiety is the most likely of these variables to mediate the overprediction of fear. Hence, the stimulus estimation model was extended to include state anxiety as a mediating variable. Briefly, the model proposes that stimulus predictions influence state anxiety which, in turn, influences the magnitude of the overprediction of fear. These assumptions were examined in the present study by structural equation modeling. The aim was to determine which of these variables was the strongest statistical predictor of overprediction, and to include the best predictor into the structural model. It was hypothesized that state anxiety would be superior to snake fear and trait anxiety as a predictor.

The model to be tested is illustrated in Figure 8.1. Here, the biases in predicting various

stimulus features are hypothesized to define a latent variable, est. S - S, which is a representation of the predictive bias in estimating the entire stimulus. As shown in the figure, this bias is hypothesized to increase both state anxiety and the bias toward the overprediction of fear. State anxiety is hypothesized to increase the magnitude of fear overprediction.

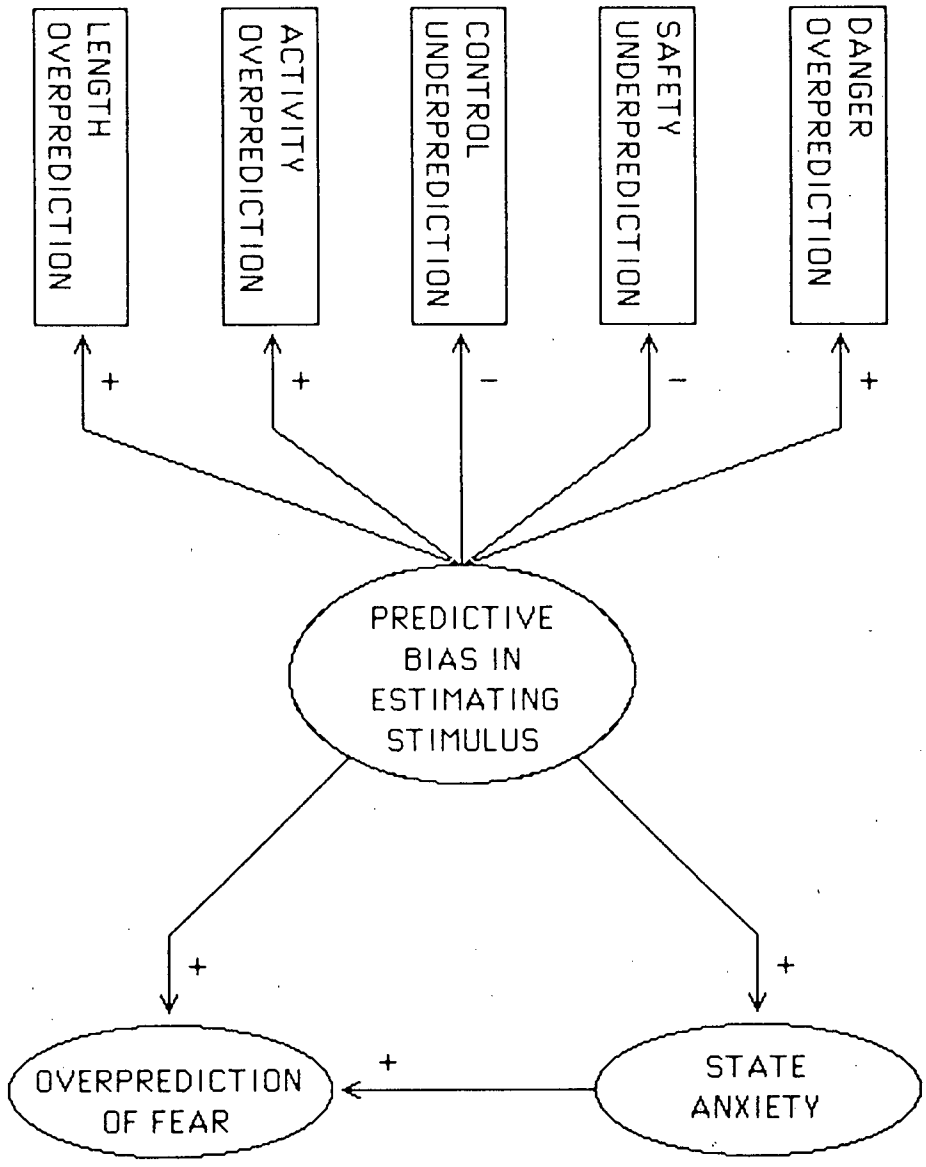

Figure 8.1. Path diagram of hypothesized causal relations.

Summary of Predictions for Experiment 3

Safety Information

1. The fear predictions of the safety information group will not differ from those of the control group.

2. The safety information group will make lower fear reports that the control group.

3. The safety information group will display a greater magnitude of overprediction than the control group.

Safety Information Enhanced by Modeling

1. Relative to the control group, the enhanced safety group will have lower levels of predicted fear.

2. The enhanced safety group will make lower fear reports than the control group.

3. The enhanced safety group will display a greater magnitude of overprediction than the control group.

Danger Information

1a. Relative to the control group, the danger information group will have uniformly higher levels of predicted and reported fear.

1b. Alternative to 1a: Relative to the control group, the danger information group will have higher levels of reported fear, but not predicted fear. That is, the group differences in reported fear will be greater than those in predicted fear.

2a. Following from 1a, the control and danger groups will not differ in their magnitudes of overprediction.

2b. Alternative to 2a: Following from 1b, the danger group will display a smaller magnitude of overprediction than the control group.

Types of Predictive Bias

The following predictive biases will be observed:

1. Fear (overprediction).

2. Danger (overprediction).

3. Safety (underprediction).

4. Controllability (underprediction).
5. Activity level of snake (overprediction).
6. Length of snake (overprediction).
7. Perceived ugliness of the animal (overprediction).
8. Disgust (overprediction).
9. Ability of subject to complete the approach task (underprediction).

Structural Modeling

The predictions summarized in Figure 8.1 will be evaluated.

Method

Subjects

The sample consisted of 240 undergraduate university students who had not participated in the previous experiments. Subjects were selected by their responses to the same fear screening questionnaire that was used previously, and participated for course credit. The sample represented a wide range of fear of snakes, ranging from mild to extreme fear. This provided a sufficient range of fear levels for the structural equation modeling. After the deletion of 16 outliers (see below), the final sample consisted of 224 students. They had a mean age of 20 years 5 months (SD = 3 years 5 months), and 61.70% were female.

Measures

Snake fear. To match the fear levels across the four experimental groups at the beginning of the experiment, each subject's general level of snake fear was assessed by a visual analogue (VA) scale. The VA scales in this experiment were 100 mm lines divided into numbered, 5 mm gradations, and labelled in increments of 10 mm. The snake fear scale was prefaced by instructions to "place a vertical slash at the appropriate point on the line to indicate how frightened you are of snakes." The scale was anchored such that 0 = not frightened at all, and 100 = extremely frightened.

State and trait anxiety. In keeping with the previous experiments, state anxiety was measured by a VA scale (0 = not anxious at all, 100 = extremely anxious). Trait anxiety was assessed by the trait version of the State-Trait Anxiety Inventory (STAI-T; Spielberger, 1983).

Snake Characteristics Questionnaire. This questionnaire was used to check whether the information manipulations used in the experiment were relevant to the subjects' conceptions of the danger and safety associated with snakes. For each of the following word-pairs, subjects were asked to circle the descriptor that would, in general, make any snake more dangerous and less safe: (i) active / inactive; (ii) timid / inquisitive; (iii) predictable / unpredictable; (iv) controllable / uncontrollable. These adjectives were central to the contents of the Predictions Questionnaires (see below).

Predict-Report Task

The remaining measures were included in the predict-report task, which consisted of a Predictions Questionnaire followed by an approach task.

Predictions Questionnaire. Three versions were used, differing only in the information that was presented at the beginning of each questionnaire. The instructions are given below. The emphases in the danger and safety versions represent words or phrases that distinguished the three versions from one another. These emphases were not in the originals.

1. Control version. "You will now be asked to make some predictions about a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task."

2. Safety version. "You will now be asked to make some predictions about a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The snake is very timid: It prefers to hide rather than to explore its environment. It almost never moves about. If the snake does move, it always moves very slowly and is easy to predict and to control. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task."

3. Danger version. "You will now be asked to make some predictions about a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The snake is very inquisitive: It prefers to explore its environment rather than to hide. It almost always moves about. When the snake does move, it always moves very quickly and is difficult to predict and to control. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task."

Following each set of instructions, 11 scales were presented. Nine of these were VA scales. The anchor points for each scale are given in parentheses, and all emphases were in the original. For item 10 (predicted length of snake), subjects indicated the predicted length of the snake in the unit of measurement that they were most familiar with (feet, inches, meters, etc.). For the purposes of the analyses, all responses to item 10 were transformed into cm. The remaining measure (item 5) had a binary (yes/no) response format.

1. "How anxious do you feel right at this moment?" (0 = not anxious at all, 100 = extremely anxious.) (State anxiety after receiving the instructions to the approach task.)

2. "Predict the peak amount of fear that you will experience when you are standing at the container just before you remove the cover." (0 = no fear at all, 100 = terrifying fear.) (Fear Prediction 1.)

3. "Predict the peak amount of fear that you will experience when you put your hand into the container and touch the red mark." (0 = no fear at all, 100 = terrifying fear.) (Fear Prediction 2.)

4. "When you lift the cover and go to touch the red mark, how much control will you have over whether the snake will touch you?" (0 = no control at all, 100 = complete control.)

5. Will you be able to touch the red mark? (yes/no)

6. "How dangerous do you think the snake will be?" (0 = not dangerous at all, 100 = extremely dangerous.)

7. "How ugly do you think the snake will be?" (0 = not ugly at all, 100 = extremely ugly.)

8. "When you lift the cover and go to touch the red mark, how safe do you think you will feel?" (0 = not safe at all, 100 = completely safe.)

9. "How much disgust will you feel when you see the snake?" (0 = no disgust at all, 100 = extreme disgust.)

10. "How long do you think the snake will be?"

11. "When you lift the cover and go to touch the red mark, how fast do you think the snake will move?" (0 = will not move at all; 100 = will move extremely rapidly.)

Approach task. Each subject received written and verbal instructions about the procedure for approaching the container and completing the various fear-relevant reports. From a starting point 3 m from the container, the subject walked up to the container and rated the following items. All but items 3 and 9 were rated on VA scales, and all emphases were in the original. Item 3 was a binary item (yes/no) and item 9 was rated in the same manner as the item assessing predicted length (item 10) of the Predictions Questionnaire.

1. "Rate the peak level of fear you experience just before you remove the cover" (0 = no fear, 100 = terrifying fear). (Fear Report 1)

The subject then removed the cover from the container, and touched the red mark (or as close as he/she could go).

2. "Rate the peak level of fear you experienced when you touched the red mark (or when you were as close to this as you could go)." (0 = no fear, 100 = terrifying fear.) (Fear Report 2)

3. "Were you able to touch the red mark?"

4. "When you lifted the cover and went to touch the red mark, how much control did you have over whether the snake touched you?" (0 = no control at all, 100 = complete control.)

5. "How dangerous was the snake?" (0 = not dangerous at all, 100 = extremely dangerous.)

6. "How ugly was the snake?" (0 = not ugly at all, 100 = extremely ugly.)

7. "When you lifted the cover and went to touch the red mark, how safe did you feel?" (0 = not at all safe, 100 = completely safe.)

8. "How much disgust did you feel when you saw the snake?" (0 = no disgust at all, 100

= extreme disgust.)

9. "How long was the snake?"

10. " When you lifted the cover and went to touch the red mark, how fast did the snake move?" (0 = did not move at all; 100 = moved extremely rapidly.)

Design

The independent variable was information type, which was a between-subject factor with four levels corresponding to the information conditions (control, danger, safety, and enhanced safety). Sixty subjects were assigned to each condition. The conditions differed only in the information presented immediately before the Predictions Questionnaire. In three conditions the subjects received either the control, safety, or danger version of the predict-report questionnaire, and there was a partition between the subject and the covered snake container. In the fourth condition, which was the enhanced safety condition, subjects received the safety version of the predict-report task and, from a distance of 3 m from the container, observed the experimenter modeling the approach task. The experimenter served as a mastery model rather than a coping model.[1] The walls of the container were covered so that the subject could not see the snake during the modeling. This was so that the snake's behaviour did not interfere with the credibility of the safety information. Subjects in the enhanced safety condition completed the Predictions Questionnaire after observing the model.

Predicted and reported fear were the dependent variables for the comparisons among the information conditions. The other ratings obtained in the Predictions Questionnaire and approach task served as dependent variables and predictor variables for the remaining analyses. Trait anxiety, state anxiety, and the subject's level of snake fear at the beginning of the experiment also served as dependent variables.

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[1] In the present context, a mastery model would perform the approach task without showing signs of fear. A coping model would perform the tasks successfully, but would display signs of fear (Bandura, 1986). Coping models are thought to be more effective than mastery models in reducing fear because the former are more similar to the fearful subject (Bandura, 1986). However, mastery modeling was used here because it could be performed with a higher degree of consistency.

Procedure

All subjects were tested individually and all ratings and instructions were presented in booklet form. Three experimenters were used. One was the author, one had some knowledge of the experimental predictions (JZ), and the third was unaware of the aims or predictions of the study (EG).

Each subject completed the experiment in the following sequence.

1. Consent form.
2. Rating of snake fear.
3. State anxiety.
4. STAI-T (Order 1). Half of the subjects completed the measure of trait anxiety, the STAI-T, before completing the Predictions Questionnaire. The remaining subjects completed the STAI-T after completing the approach task. The STAI-T was counterbalanced in order to determine whether this measure produced any priming effects. Such effects would have limited the external validity of the results of the tests of the experimental predictions.
5. Predictions Questionnaire. Subjects in the control, danger, and safety conditions completed all predictions behind a partition so that the covered container could not be seen. In the enhanced safety condition, subjects viewed the covered container, but not the snake, as the experimenter modeled the approach task.
6. Approach task.
7. STAI-T (Order 2).
8. Snake characteristics questionnaire.
9. Debriefing.

The protocols used by the experimenters and subjects are presented in Appendices 9 and 10, respectively.

Results and Discussion

Preliminary Analyses

Screening for outliers. Before testing the main hypotheses, all ratings were examined for univariate and multivariate outliers. This was done separately for each information condition. Using Mahalanobis' D^2 with a critical alpha of .001, as recommended by Tabachnick and Fidell (1989), no multivariate outliers were detected. Sixteen subjects had scores that were univariate outliers ($|z| > 3.00$, $p < .001$) on one or more of the following measures: (i) predicted snake length; (ii) reported snake length; (iii) reported dangerousness of snake; (iv) reported speed of movement of snake. These subjects were omitted from further analyses, leaving a total of 224 subjects.

Order effects. The two fear predictions and two fear reports did not vary as a function of the order of administration of the STAI-T [Pillai $F(4, 219) = 2.23$, $p > .05$], nor did the scores on the STAI-T [$F(1, 222) < 1.00$, $p > .1$]. Thus, it is concluded that the STAI-T did not produce any priming effects on the predictions and reports of fear.

Manipulation check. The experimental manipulations concerned the type of information that was presented to subjects. Based on previous experimental findings and clinical observations (Barlow, 1988; Bennett-Levy & Marteau, 1984; Marks, 1987; McNally & Steketee, 1985; Mineka & Hendersen, 1985; Mineka & Kihlstrom, 1978; Rachman, 1990; Rachman & Whittal, 1989), it was expected that subjects would regard a snake as more dangerous and the situation less safe if the snake was active, inquisitive, unpredictable, and uncontrollable. To determine whether this manipulation was successful, subjects were presented with four pairs of adjectives, and asked to select a word from each pair that would best describe a snake as dangerous and unsafe. As mentioned earlier, the adjective pairs were as follows: (i) active / inactive; (ii) timid / inquisitive; (iii) predictable / unpredictable; (iv) uncontrollable / controllable.

A dangerous snake was regarded as active in 91.52% of cases, inquisitive in 80.80% of cases, unpredictable in 100.00% of cases, and uncontrollable in 99.55% of cases. Subjects were selected for the analysis of the differences among the information conditions only if they regarded a dangerous snake as active, inquisitive, unpredictable, and uncontrollable. A total of

172 subjects (76.79%) met this criterion. The pattern of results did not change when the analyses were rerun using the larger sample of 224 subjects. The results to be reported for the group comparisons, however, were based on the restricted sample (N = 172) since the information manipulations are meaningful only if subjects believed that a dangerous snake is active, inquisitive, unpredictable, and uncontrollable. For the remaining analyses, the full sample (N = 224) was used.

Performance. All 224 subjects were able to lift the cover of the snake container, and 98.21% were able to touch the red mark in the container. Of the sample of 172 subjects, 98.26% were able to touch the mark.

Group characteristics prior to the experimental manipulations. A one-way MANOVA was performed to determine whether the four information groups differed in fear/anxiety levels prior to the experimental manipulations. The independent variable was information condition, and the dependent variables were snake fear, state anxiety prior to the experimental manipulation, and trait anxiety. The groups did not significantly differ at the multivariate level [Pillai $F(9, 504) < 1.00$, $p > .1$] or at the univariate levels [Snake fear, $F(3, 168) < 1.00$; State anxiety, $F(3, 168) = 1.24$; Trait anxiety, $F(3, 168) < 1.00$; all $ps > .1$]. The means and SDs of these variables are presented in Table 8.1. As intended, subjects covered a wide range of snake fear. Since one of the aims was to replicate Experiment 2, it is of relevance to note that the grand mean and SD of the snake fear of the present experiment ($M = 56.37$, $SD = 20.46$) was comparable to the grand mean and SD of spider fear in Experiment 2 ($M = 52.20$, $SD = 26.27$).

Table 8.1. Group means and SDs of snake fear and state anxiety prior to the experimental manipulations, and group means and SDs of trait anxiety.

Information Condition	n	Snake Fear		State Anxiety		Trait Anxiety	
		M	SD	M	SD	M	SD
Control	42	57.83	19.34	36.21	21.92	41.62	6.83
Danger	42	54.67	19.08	40.67	25.00	41.91	10.26
Safety	45	54.47	20.66	36.93	19.50	42.13	9.46
Enhanced Safety	43	58.58	22.64	31.54	21.46	40.70	9.35

Covariates. Subjects were chosen to encompass a wide range of levels of snake fear, and so this variable could be used as a covariate to increase the power of the remaining analyses. Similarly, state or trait anxiety were potentially useful covariates (see Chapter 6). Yet, throughout this experiment the pattern of results did not change with the addition of these covariates singly or in combination. Therefore, the unadjusted results will be presented throughout.

Experimenter effects. As mentioned, three experimenters were used, with different levels of knowledge about the experimental predictions under investigation. There was no evidence of experimenter bias arising from knowledge about the aims of the study. This is shown by the results presented in Appendix 11.

Group Comparisons: Danger, Safety, and Enhanced Safety Information

Safety information. Recall that the experimental predictions were as follows.

1. The fear predictions of the safety information group will not differ from those of the control group.

2. The safety information group will make lower fear reports that the control group.

3. The safety information group will display a greater magnitude of overprediction than the control group.

To test the first two predictions, a one-way MANOVA was performed. The independent variable was information type (control vs. safety information), and the dependent variables were Fear Predictions 1 and 2, and Fear Reports 1 and 2. The information main effect was not significant for the multivariate test [Pillai $F(4, 82) < 1.00$, $p > .1$] or for the univariate tests ($p > .1$ in each case). Thus, support was found for the first but not the second experimental prediction. The means and SDs of the fear predictions and reports are presented in Table 8.2.

Table 8.2. Group means and SDs.

Dependent Variable	Group				$F(1, 85)$	p
	Control		Safety			
	M	SD	M	SD		
Fear Prediction 1	55.02	22.20	53.53	19.89	< 1.00	> .1
Fear Prediction 2	68.86	20.42	66.16	22.62	< 1.00	> .1
Fear Report 1	45.74	22.32	47.87	24.47	< 1.00	> .1
Fear Report 2	41.98	27.22	37.40	28.28	< 1.00	> .1

To test the third experimental prediction, overprediction differences scores were used as the dependent variables. For the first analysis a one-way ANCOVA was performed. The dependent variable was OP1, defined as Fear Prediction 1 - Fear Report 1. The independent variable was information type (control vs. safety), and the covariate was Fear Prediction 1 (Cronbach & Furby, 1970; see Appendix 1). The assumption of the homogeneity of regression was not violated [Pillai $F(1, 83) < 1.00$, $p > .1$], and the covariate was significant [Pillai $F(1, 84) = 10.87$, $p < .001$]. The information main effect was not significant [$F(1, 84) < 1.00$, $p > .1$].

For the second analysis, a one-way ANCOVA was also performed. The dependent variable was OP2, defined as Fear Prediction 2 - Fear Report 2. The independent variable was information type (control vs. safety), and the covariate was Fear Prediction 2. The assumption of the homogeneity of regression was not violated [Pillai $F(1, 83) < 1.00$, $p > .1$], and the covariate was significant [Pillai $F(1, 84) = 11.98$, $p < .001$]. The information main effect was not significant [$F(1, 84) < 1.00$, $p > .1$]. Thus, the third experimental prediction was not supported for either OP1 or OP2. The unadjusted and covariate-adjusted means and SDs of the overprediction scores are presented in Table 8.3.

Table 8.3. Magnitude of overprediction: Group means and SDs. Means are adjusted for the covariate, which was the fear prediction corresponding to each dependent variable.

Dependent Variable	Group						$F(1, 84)$	p
	Control			Safety				
	M	Adj. M	SD	M	Adj. M	SD		
OP 1	9.29	9.05	23.53	5.67	5.90	15.30	< 1.00	> .1
OP 2	26.88	26.29	26.44	28.76	29.35	26.92	< 1.00	> .1

Safety information enhanced by modeling. The experimental predictions were as follows.

1. Relative to the control group, the enhanced safety group will have lower levels of predicted fear.

2. The enhanced safety group will make lower fear reports than the control group.

3. The enhanced safety group will display a greater magnitude of overprediction than the control group.

To test the first two predictions, a one-way MANOVA was performed. The independent variable was information type (control vs. enhanced safety information), and the dependent variables were Fear Predictions 1 and 2, and Fear Reports 1 and 2. The information main effect was not significant for the multivariate test [Pillai $F(4, 80) = 1.44$, $p > .1$] or for the univariate tests ($p > .098$ in each case). Thus, the first two experimental predictions were not supported. The means and SDs of the fear predictions and reports are presented in Table 8.4.

Table 8.4. Group means and SDs.

Dependent Variable	Group				F(1, 83)	p
	Control		Enhanced Safety			
	M	SD	M	SD		
Fear Prediction 1	55.02	22.20	50.58	26.28	< 1.00	> .1
Fear Prediction 2	68.86	20.42	61.51	24.95	2.20	> .1
Fear Report 1	45.74	22.32	36.93	26.17	2.78	> .098
Fear Report 2	41.98	27.22	41.49	32.63	< 1.00	> .1

To test the third prediction, overprediction differences scores, OP1 and OP2, were used as the dependent variables. For the first analysis a one-way ANCOVA was performed, with OP1 as the dependent variable. The independent variable was information type (control vs. enhanced safety), and the covariate was Fear Prediction 1. The assumption of the homogeneity of regression was not violated [Pillai $F(1, 81) = 2.85$, $p > .094$], and the covariate was significant [Pillai $F(1, 82) = 19.41$, $p < .0005$]. The information main effect was not significant [$F(1, 82) = 2.09$, $p > .1$].

For the second analysis a one-way ANCOVA was also performed. The dependent variable was OP2 and the independent variable was information type (control vs. enhanced safety). The covariate was Fear Prediction 2. The assumption of the homogeneity of regression was not violated [Pillai $F(1, 81) < 1.00$, $p > .1$], and the covariate was significant [Pillai $F(1, 82) = 5.87$, $p < .02$]. The information main effect was not significant [$F(1, 82) < 1.00$, $p > .1$]. Thus, the third experimental prediction was not supported for either OP1 or OP2. The unadjusted and covariate-adjusted means and SDs of the overprediction scores are presented in Table 8.5.

Table 8.5. Magnitude of overprediction: Group means and SDs. Means are adjusted for the covariate, which was the fear prediction corresponding to each dependent variable.

Dependent Variable	Group						$F(1, 82)$	p
	Control			Enhanced Safety				
	M	Adj. M	SD	M	Adj. M	SD		
OP 1	9.29	8.44	23.53	13.65	14.50	18.85	2.09	>.1
OP 2	26.88	25.78	26.44	20.02	21.12	26.28	< 1.00	>.1

Danger information. The experimental predictions were as follows.

1a. Relative to the control group, the danger information group will have uniformly higher levels of predicted and reported fear.

1b. Alternative to 1a: Relative to the control group, the danger information group will have higher levels of reported fear, but not predicted fear. That is, the group differences in reported fear will be greater than those in predicted fear.

2a. Following from 1a, the control and danger groups will not differ in their magnitudes of overprediction.

2b. Alternative to 2a: Following from 1b, the danger group will display a smaller magnitude of overprediction than the control group.

Experimental predictions 1a and 1b each have two parts: (i) the common prediction that danger information influences fear reports, and (ii) specific statements about the relative magnitude of the effects of danger information on predicted and reported fear. A repeated measures analysis is appropriate for testing part (ii), where predicted and reported fear are considered as levels of a within-subject factor. First, however, it is necessary to determine whether danger information had any effect on predicted and reported fear. To test this, a one-way MANOVA was performed. The independent variable was information type (control vs. danger information), and the dependent variables were Fear Predictions 1 and 2 and Fear Reports 1 and 2. The information main effect was not significant for the multivariate test [Pillai $F(4, 79) < .1$, $p > .1$] or for the univariate tests ($p > .1$ in each case). The means and SDs of the fear

predictions and reports are presented in Table 8.6.

The results show that the addition of danger information had no effect on predicted or reported fear. These results make the addition of a repeated measures analysis unnecessary since the latter were based on the assumption that danger information had an effect on predicted and reported fear. In all, these results fail to support experimental predictions 1a and 1b.

Table 8.6. Group means and SDs.

Dependent Variable	Group				$F(1, 82)$	p
	Control		Danger			
	M	SD	M	SD		
Fear Prediction 1	55.02	22.20	54.43	22.59	< 1.00	> .1
Fear Prediction 2	68.86	20.42	68.45	20.26	< 1.00	> .1
Fear Report 1	45.74	22.32	45.81	25.90	< 1.00	> .1
Fear Report 2	41.98	27.22	38.60	30.88	< 1.00	> .1

To test experimental predictions 2a and 2b, overprediction differences scores were used as the dependent variables. For the first analysis a one-way ANCOVA was performed. The dependent variable was OP1 and the independent variable was information type (control vs. danger). The covariate was Fear Prediction 1. The assumption of the homogeneity of regression was not violated [Pillai $F(1, 80) = 3.49$, $p > .06$], and the covariate was significant [Pillai $F(1, 81) = 14.63$, $p < .0005$]. The information main effect was not significant [$F(1, 81) < 1.00$, $p > .1$].

For the second analysis a one-way ANCOVA was also performed. The dependent variable was OP2. The independent variable was information type (control vs. danger), and the covariate was Fear Prediction 2. The assumption of the homogeneity of regression was not violated [Pillai $F(1, 80) < 1.00$, $p > .1$], and the covariate was significant [Pillai $F(1, 81) = 6.55$, $p < .012$]. The information main effect was not significant [$F(1, 81) < 1.00$, $p > .1$]. Thus, for OP1 and OP2 experimental prediction 2a was supported over prediction 2b. The unadjusted and covariate-adjusted means and SDs of the overprediction scores are presented in Table 8.7.

Table 8.7. Magnitude of overprediction: Group means and SDs. Means are adjusted for the covariate, which was the fear prediction corresponding to each dependent variable.

Dependent Variable	Group						$F(1, 81)$	p
	Control			Danger				
	M	Adj. M	SD	M	Adj. M	SD		
OP 1	9.29	9.18	23.53	8.62	8.73	19.01	< 1.00	> .1
OP 2	26.88	26.81	26.44	29.86	29.93	27.76	< 1.00	> .1

Were the Information Manipulations Adequate?

To summarize the findings of the previous sections, the results failed to demonstrate any effects of danger, safety, or enhanced safety information on predicted fear, reported fear, or the overprediction of fear. These results uniformly fail to support the differential weighting model, and fail to replicate the findings of the previous experiment, despite very similar information manipulations. The pattern of results did not change when the entire sample ($N = 224$) was used (excluding 16 outliers) instead of the subsample of 172 subjects.

It may be asked whether the information manipulations were adequate to test the differential-weighting model. Although the results of the previous experiment suggested that they should have been, it may have been that the differences in methodology across the experiments outweighed the similarities, and wiped out any information effects. The type of fears (spider vs. snake) also varied across studies, although it is not clear why this should be important. Uncertainty about whether the feared animal would be present was a feature of the previous experiment but not of the present one. This factor may have been important in sharpening the effects of the information manipulations on reported fear, although it is not clear how this could have occurred. It may have been that unlike the animal-absent condition (Experiment 2), the animal-present condition (Experiment 3) was associated with greater error variance, due to sporadic movements of the animal. This may have wiped out any effects of the information manipulations in the present study.

Further analyses were conducted to compare the groups on predictions and reports of the

following variables: The danger, length, activity level, and ugliness of the snake, the amount of disgust evoked by the snake, the perceived safety and controllability of the situation, and the subject's ability to touch the red mark in the container. Thus, eight predictions and eight reports served as the dependent variables. A further set of analyses was conducted using difference scores (prediction - report) for the above-mentioned variables, with the prediction serving as the covariate. The sample of $N = 172$ was used, but yielded the same pattern of results to those obtained from the entire sample of 224 subjects.

The analyses were undertaken for two reasons. First, to assess whether the information manipulation was adequate for the present purposes. If the groups fail to differ on all of these variables, then this would suggest that the manipulations were inadequate. Second, it is necessary to know whether information effects are significant to plan the analyses for remaining hypotheses in this experiment (e.g., structural equation modeling). If there are significant information effects for the variables of interest, then it is necessary to perform the remaining analyses separately for each information condition to avoid the contaminating effects of the information manipulations. If there are no significant information effects, then the analyses can be based on the total sample (i.e., pooled across groups).

The eight predictions and eight reports were compared across information levels by a one-way MANOVA. The independent variable was information type (four levels; control, danger, safety, and enhanced safety). The multivariate main effect was significant [Pillai $F(48, 465) = 2.07$, $p < .0005$]. The univariate results are shown in Table 8.8. To control for excessive Type I error in these exploratory analyses, a Bonferroni-corrected critical alpha of .0063 was adopted. The table shows that only one variable was significant, the predicted activity level of the snake. Tukey comparisons were conducted for this variable. It was found that the danger group had significantly higher scores than the other groups, and the score for the enhanced safety group was significantly lower than that of the control group ($p < .005$ for both comparisons).

Table 8.8. Results of univariate tests for each dependent variable.

Variable		F (3, 168)	p
Predicted ...	Control	< 1.00	> .1
	Ability to Touch Mark	< 1.00	> .1
	Danger	< 1.00	> .1
	Ugliness	< 1.00	> .1
	Safety	< 1.00	> .1
	Disgust	< 1.00	> .1
	Length	4.02	.009
	Activity Level	13.49	.0005*
Reported ...	Control	< 1.00	> .1
	Ability to Touch Mark	< 1.00	> .1
	Danger	2.15	.096
	Ugliness	3.14	.027
	Safety	1.74	> .1
	Disgust	1.32	> .1
	Length	< 1.00	> .1
	Activity Level	2.79	.042

* Significant at the Bonferroni-corrected critical alpha of .0063.

To examine further the effects of information, eight one-way ANCOVAs were performed, where the independent variable was information type (four levels). In each analysis the dependent variable was the difference score, prediction - report, of one of the variables presented in Table 8.8 (e.g., predicted safety - reported safety). In keeping with the analyses of difference scores throughout this dissertation, the prediction variable was used as the covariate to enhance the power of the analyses. The results of these analyses are shown in Table 8.9. A Bonferroni-corrected critical alpha of .0125 was adopted. As the table shows, none of the information effects were significant according to this criterion, with the smallest p value being .022. Thus, the information manipulations failed to have significant effects on the prediction - report difference scores.

Table 8.9. ANCOVA results for each prediction - report difference score.

Prediction - Report Variable	Information Main Effect		Covariate		Homogeneity of Regression	
	$F(3, 167)$	p	$F(1, 167)$	p	$F(3, 164)$	p
Control	< 1.00	> .1	23.83	< .0005	< 1.00	> .1
Ability to Touch Mark	< 1.00	> .1	19.19	< .0005	1.72	> .1
Danger	2.82	.041	294.97	< .0005	3.75	.012*
Ugliness	3.28	.022	55.93	< .0005	2.59	> .05
Safety	2.46	.06	49.21	< .0005	2.38	> .07
Disgust	1.30	> .1	48.05	< .0005	2.27	> .08
Length	< 1.00	> .1	627.72	< .0005	1.10	> .1
Activity Level	2.76	.044	386.46	< .0005	< 1.00	> .1

* Assumption of homogeneity violated (at alpha = .05). The results for the information main effect did not change when the covariate, predicted danger, was deleted from the analysis [$F(3, 168) = 1.26$, $p > .1$].

In summary, 28 variables were examined (i.e., 2 fear predictions, 2 fear reports, the 16 predictions and reports of Table 8.8, and the 8 prediction - report variables of Table 8.9). The information conditions differed on only one variable (predicted activity level). Two interpretations can be made of these results. The first is that the differential-weighting model is incorrect. Alternatively, the information manipulations were too weak to evaluate the model adequately. Given that the information manipulations had almost no demonstrable effects, the second interpretation seems more plausible. It is also in keeping with the conclusions of Experiment 2, and with the structural modeling results to be presented later in this chapter. The lack of information-group effects on the prediction - report difference scores also indicates that the scores on these variables may be pooled across the information groups for the remaining analyses.

Types of Predictive Bias

In the comparisons of the four information groups, the sample consisted of only those subjects who stated that a dangerous snake was active, inquisitive, unpredictable, and uncontrollable. This left a sample of 172. This selection was made in order to use only those subjects who were most likely to respond to the information manipulations. This restriction was not necessary for the following analyses, and so the entire sample of 224 subjects was used. The 16 subjects with outlying scores were not included.

It was deduced from the stimulus estimation model that if subjects tend to overpredict their fears, then they would overpredict a variety of other fear-relevant stimulus and response features, such as the dangerousness, activity level, size, ugliness, and amount of disgust evoked by the snake. It was further predicted that subjects would underpredict their abilities to touch the mark in the container, and would underpredict the safety and controllability of the situation.

To examine these predictions, two sets of analyses were performed. A one-sample Hotelling T^2 test was performed to test the significance of the predict-report differences from zero. The variables used were the prediction - report scores for the variables presented in Table 8.10. The multivariate result was significant [Hotelling F (10, 214) = 65.52, $p < .0005$]. All of the univariate results were significant, and all predictive biases were in the expected direction (Table 8.10). Covariate analyses were not necessary for these analyses since all the difference scores were significantly different from zero. The addition of covariates simply increased the level of significance but did not change the interpretation of the results. Thus, the results described in this section are confined to the simpler, unadjusted analyses.

As Table 8.10 shows, subjects tend to overpredict their fears. They also overpredicted another affective response, disgust. Stimulus properties were also overpredicted (i.e., length, activity level), as were more evaluative properties, such as the dangerousness and ugliness of the snake. Concomitantly, the safety and controllability of the snake were underpredicted, as was the subject's ability to touch the red mark in the container. In all, the results support the stimulus estimation model.

Table 8.10. Mean, SD, and significance of difference from zero of each of the prediction - report differences for the fear-relevant variables.

Prediction - Report Variable	M	SD	t (223)	p **	Effect Size (SD units)
OP1	9.63	19.22	7.50	< .0005	0.50
OP2	26.80	26.98	14.87	< .0005	0.99
Control	-22.67	31.00	10.95	< .0005	-0.73
Danger	13.43	19.11	10.52	< .0005	0.70
Safety	-13.96	32.21	6.49	< .0005	-0.43
Ability to Touch Mark *	-0.09	0.32	4.37	< .0005	-0.28
Length (cm)	15.60	26.45	8.83	< .0005	0.59
Activity Level	37.38	28.67	19.51	< .0005	1.30
Ugliness	25.13	25.79	14.59	< .0005	0.97
Disgust	18.07	25.38	10.65	< .0005	0.71

* For prediction and report: 1 = yes, 0 = no.
** Bonferroni-corrected critical alpha = .01.

Table 8.10 also shows the effect size for each variable, which was defined as $M.SD^{-1}$. The effect sizes are an indication of the magnitude of the predictiive biases. In comparing these values, it must be cautioned that the scales used to assess each variable will influence the effect size. That is, for a given value of M, scales with a greater reliability will tend to yield smaller SDs and hence larger effect sizes. Thus, the comparison of effect sizes should be restricted to variables measured by the same type of scale. VA scales were used for all variables except for the predicted and reported length of the snake, and the subject's predicted and reported ability to touch the red mark. With this caveat in mind, Table 8.10 shows that the effect sizes were generally within the moderate to large range (Cohen, 1988), indicating substantial predictive biases. The bias toward the overprediction of danger tended to be stronger than the bias toward the underprediction of safety (absolute values: 0.70 vs. 0.43). This suggests that different types of information are differentially susceptible to predictive biases. Yet, there are also consistencies among the effect sizes. The effect sizes of the affective variables (i.e., fear and disgust) are of comparable magnitudes to those of the perceptual-evaluative variables (i.e., danger, safety, controllability, ugliness). Respectively, the mean (and SD) of the absolute values of the effect sizes was 0.73 (0.25) for the affective variables and 0.71 (0.22) for the perceptual-evaluative variables. [2]

To examine further the relationship between the overprediction of fear and the other predictive biases, a series of Pearson correlations were computed. Table 8.11 shows the that OP1 was not correlated with any of the other variables, whereas OP2 was significantly correlated with all but two variables. These results are not surprising since all of the prediction - report variables except OP1 pertained to the same situation, viz. placing one's hand into the snake container. OP1 concerned the predictions and reports of fear just before the cover of the container was removed (i.e., before the subject could see the snake). It is noted that there was a trend for OP2 to be correlated with predicted - reported activity level ($p < .02$). There was a nonsignificant correlation between OP2 and the predicted - reported ability to touch the mark inside the container. This may have arisen because the latter was a tripartite measure and so was probably lacking in sensitivity for the correlational analyses. The relationship between the overprediction of fear and the biases involved in predicting the threat-relevant features of the snake will be considered in greater detail in the following section.

Overall, the results reported in the present section support the stimulus estimation model, which states that the overprediction of fear arises from predictive biases in estimating the stimulus (i.e., the overprediction of danger-related features, and underprediction of safety-related features). The results also provide the first demonstration that the overprediction of fear is related to a predictive bias regarding one's behaviour (i.e., underprediction of approach behaviour) and the overprediction of another affective response, disgust.

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[2] The smallest effect size was for the underprediction of the subject's ability to touch the red mark (-0.28). This may have been because the predictions and reports for this variable were binary ("yes" = 1, "no" = 0), yielding a tripartite measure (overprediction = 1, correct match = 0, underprediction = -1). The limited number of values may have reduced the sensitivity of this measure in comparison to the 0-100 VA scales.

Table 8.11. Pearson correlations of OP1 and OP2 with the other fear-relevant variables.

Prediction - Report Variable	OP1		OP2	
	r	p	r	p
Control	-.10	> .05	-.35	< .0005*
Danger	.13	< .025	.18	< .004*
Safety	-.09	> .09	-.45	< .0005*
Ability to Touch Mark	-.09	> .09	-.02	> .1
Length	-.11	> .05	.19	< .002*
Activity Level	.04	> .1	.14	< .02
Ugliness	.03	> .1	.22	< .0005*
Disgust	-.04	> .1	.25	< .0005*

* Significant at Bonferroni-corrected critical alpha of .0125.

Structural Equation Modeling

The purpose of the following analyses was to evaluate the structural model presented in Figure 8.1, which is an application of the stimulus estimation model to the fear of snakes (with the assumptions regarding anticipatory anxiety; see Chapter 5). OP2 was chosen as the measure of the overprediction of fear, since the predicted and reported stimulus features that were obtained corresponded to OP2 but not to OP1. That is, the predictions and reports of safety, danger, and so forth, corresponded to when the snake was viewed by the subject, which is the condition in which OP2 applies. Ratings were not made of the predicted and reported safety, danger, etc. when the subject was standing in front of the covered container, which is the condition in which OP1 applies.

In the evaluation of the model presented in Figure 8.1, two sets of preliminary analyses were conducted. The first was to determine whether the prediction - report difference variables for danger, safety, control, length, and activity level significantly loaded on the same latent variable. The latent variable was defined as the predictive bias in estimating the stimulus (i.e., est. S - S). A maximum-likelihood factor analysis[3] was performed on the five variables, and the first factor was extracted. The loadings for the first maximum-likelihood factor are shown in Table 8.12. The Jöreskog-Sörbom Adjusted Goodness-of-Fit Index (AGFI; Steiger, 1989) was used to evaluate the overall fit of the factor solution to the data. The AGFI ranges from 0 (poor fit) to

1 (perfect fit). The obtained value was 0.94, indicating that the single factor solution provided a good fit to the data. The table shows that all loadings were significantly greater than zero ($p <$ .0031). Thus, the five prediction - report variables were used to define the latent variable used in the structural modeling.

The second analysis was to determine whether state anxiety was the most likely mediating variable (Figure 8.1) or whether other anxiety-relevant variables (e.g., snake fear, trait anxiety) were superior, and hence better tests of the hypothesis that an anxiety-relevant variable mediates between the stimulus biases and the overprediction of fear.

Table 8.12. Factor loadings and standard errors of the five difference scores for the first factor of the maximum likelihood analysis.

Predict - Report Variable	Loading	Std Error of Loading	z	p *
Control	-.35	.09	3.97	< .00005
Danger	.45	.09	4.90	< .00005
Safety	-.67	.11	6.26	< .00005
Length	.37	.09	4.18	< .00005
Activity Level	.24	.09	2.74	< .0031

* Bonferroni-corrected critical alpha = .02.

[3] Maximum likelihood factor analysis was performed in preference to principal component analysis in order to be consistent with the structural equation modeling, which also uses maximum-likelihood factor analyses. The correlation between the factor scores obtained from the principal component and maximum-likelihood methods was very high ($r = .97$).

Previous investigations (e.g., Kent, 1984) have found that subjects with high scores on a trait measure of dental fear tended to make greater overpredictions of dental pain than subjects with low scores on the measure of dental fear. Similarly, Rachman and Bichard (1988) suggested that highly fearful people are more likely to overpredict than people with low levels of fear. Thus, some anxiety variable may mediate the overprediction of fear. This may be state anxiety, trait anxiety, or a measure that is more specific to the stimulus about which the predictions and reports are made. In the present study, the stimulus-specific measure was of the subject's general level of snake fear (i.e., the VA item, "How frightened are you of snakes?"). This variable, along with the measure of state anxiety (recorded just before the fear predictions were made), and trait anxiety was entered into regression analyses to determine which of these variables was the best statistical predictor of the overprediction of fear. The dependent variable was OP2. The results are shown in Table 8.13. As the table shows, only state anxiety was a significant predictor of OP2. The magnitude of the correlation between state anxiety and OP2 ($r = .17$, $p < .009$) indicates that it was statistically significant, but substantively trivial in its ability to predict variance in the overprediction of fear (3% variance accounted for).

Table 8.13. Regression analysis for predicting the magnitude of the overprediction of fear from the anxiety/fear variables.

Variable	Beta	$t(223)$	p
(i) All variables in the equation: Adj. $R^2 = .02$			
Snake fear	.08	1.10	>.1
State anxiety	.13	1.73	.084
Trait anxiety	.04	< 1.00	>.1
(ii) Stepwise regression: Adj. $R^2 = .03$			
State anxiety	.17	2.64	.009

With the preliminary analyses complete, the variables for the structural equation model were OP2, state anxiety, and the stimulus bias (est. S - S). The latter was defined as the first maximum-likelihood factor of the variables presented in Table 8.12. According to the model (Figure 8.1), the magnitude of the predictive bias in estimating the stimulus increases state anxiety. The model further states that the magnitude of the overprediction of fear is increased by state anxiety and by the magnitude of the bias in stimulus estimation. The correlation matrix that served at the input for the structural equation modeling is presented in Table 8.14.

Table 8.14. Matrix of Pearson correlations used as input for the structural equation modeling. All correlations are significant ($p < .009$).

	Stimulus bias	OP2
OP2	.49	
State anxiety	.17	.17

The standardized path coefficients, their standard errors, and significance levels for the structural model are presented in Table 8.15. The overall goodness-of-fit could not be computed since the degrees of freedom for such a simple model were not positive. More important is the significance of the individual pathways. The table shows that all pathways were significant except for the path where state anxiety increases OP2. The model was reestimated with this path deleted. The standardized path coefficients, their standard errors, and significance levels for the revised model are presented in Table 8.16. The AGFI was 0.96, indicating that the overall model provided a good fit to the data. The table shows that the stimulus bias was a significant cause (in the statistical sense) of the overprediction of fear. These results support the stimulus estimation model. The path diagram corresponding to the final model is presented in Figure 8.2.

Table 8.15. Results of structural equation modeling: All pathways included.

Path *	Stdized Path Coefficient	Std Error of Stdized Coeff.	z	p
Stimulus bias --> OP2	.47	.06	7.97	< .00005**
--> State anxiety	.17	.07	2.64	.004**
State Anxiety --> OP2	.09	.06	1.56	.059
ERROR TERMS				
D1 --> OP2	.87	.04		
D2 --> State Anxiety	.99	.05		

* Stimulus bias = Latent variable defining the predictive biases in estimating the stimulus, made up of the first maximum-likelihood factor of the following prediction-report variables: Safety, danger, size, controllability, and activity level of the snake.
** Significant at the Bonferroni-corrected critical alpha of .033.

Table 8.16. Results of structural equation modeling after the deletion of nonsignificant pathways.

Path	Stdized Path Coefficient	Std Error of Stdized Coeff.	z	p
Stimulus bias --> OP2	.49	.06	8.38	< .00005
--> State anxiety	.17	.07	2.64	.004
ERROR TERMS				
D1 --> OP2	.87	.04		
D2 --> State Anxiety	.99	.05		

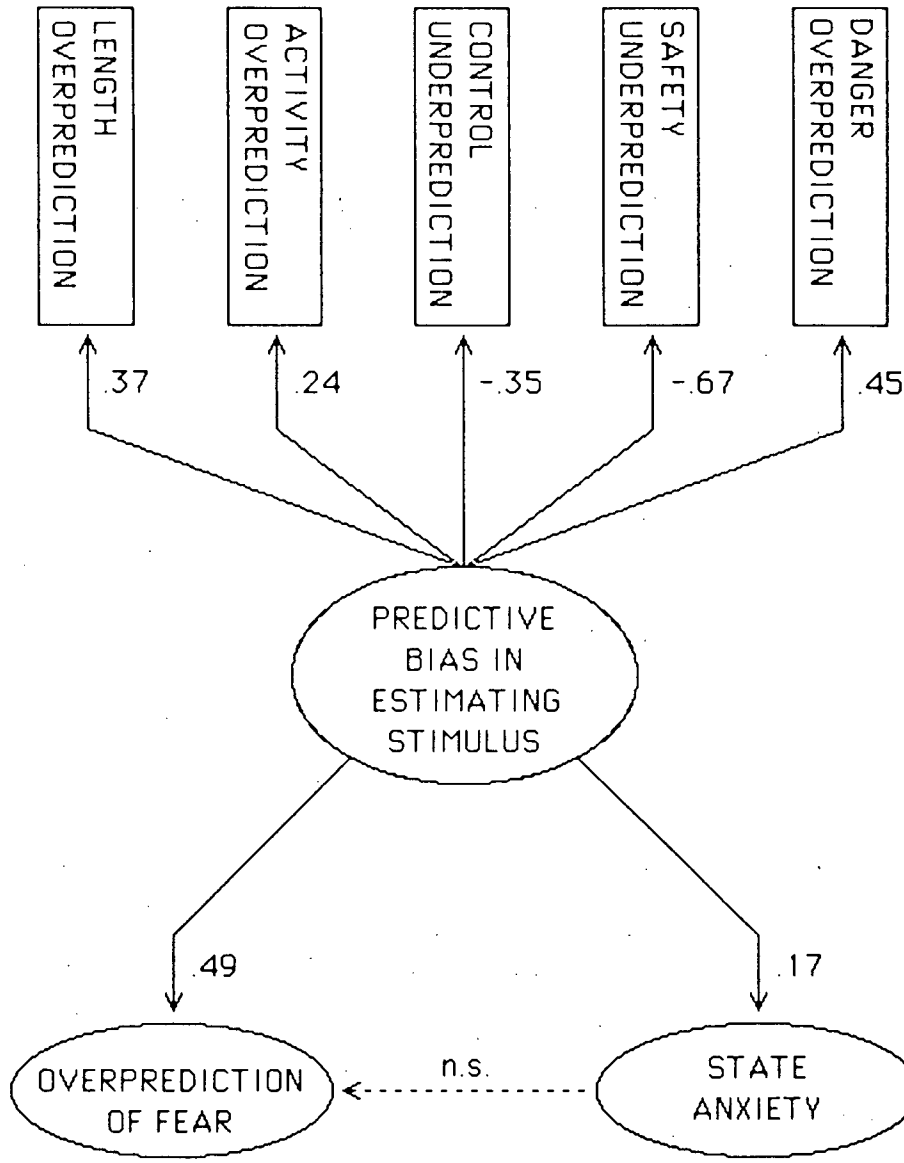

Figure 8.2. Path diagram of obtained solution, showing standardized path coefficients and standard errors.

Conclusions

The information manipulations of this experiment uniformly failed to influence predicted fear, reported fear, and the overprediction of fear. These results did not support the differential weighting model. This may indicate that the model is incorrect, or that the manipulations were inadequate. A very similar information manipulation had significant effects in Experiment 2. Other aspects of the methodology were also similar between the two experiments, such as the nature of the approach task. The type of manipulation used in Experiment 2 may not have been sufficiently powerful to produce consistent effects. Yet, in the information manipulations of the present study there were not even any clear trends in support of the differential-weighting model. It may have been that the uncertainty regarding the feared stimulus in Experiment 2 interacted with the manipulations in safety information, to exert the effects on reported fear. It is not clear why this should occur. It is possible that the sporadic movements of the snake may have increased the error variance in the fear reports in the present study, so as to wipe out the effects of the information manipulations. The effects of environmental information on predictions and reports of fear require further investigation. The use of more potent information manipulations seems warranted, such as information strongly indicating the dangerousness of the feared stimulus (e.g., the opportunity to observe highly fearful models). Thus, the roles of the type of information (e.g., danger vs. safety) and its manner of presentation (e.g., written statement vs. modeling) are subjects for further study.

The remaining analyses demonstrated that the bias toward the overprediction of fear is associated with a variety of other predictive biases, such as the overprediction of danger and the underprediction of safety. With regard to the structural equation modeling, the results generally supported the algebraic expression of the stimulus estimation model. The exception was the failure to support the assumptions about the indirect role of state (anticipatory) anxiety in influencing the overprediction of fear. The results for the final structural model suggest that state anxiety is a correlate rather than a cause of the overprediction of fear. This is consistent with the results of Experiment 2, but contrasts with those of Experiment 1. The role of state anxiety will considered in further detail in the concluding chapter.

Like the results of Experiment 2, the results of the structural modeling are consistent with the differential-weighting model, since the overprediction of fear was associated with the underprediction of safety. Thus, the structural modeling results are consistent with the conclusion that the information manipulations were insufficiently powerful to provide an adequate test of the differential-weighting model.

CHAPTER 9. GENERAL DISCUSSION

Overview of the Stimulus Estimation Model

This model, which was described in detail in Chapter 5, can be stated as an algebraic expression and a number of candidate cognitive mechanisms. According to the expression, $\underline{f}_2\{\text{est. S}\} > \underline{f}_1\{\text{S}\}$, the overprediction of fear can arise when est. S > S and/or when $\underline{f}_2 > \underline{f}_1$. The model proposes a second level of explanation in the form of several candidate cognitive mechanisms that are intended to account for the algebraic relations. According to the first mechanism, the overprediction of fear is most likely to arise when the fear is acquired through verbal information that exaggerates the dangerousness of S, thus producing the bias, est. S > S. A second mechanism, called the selective recall model, states that est. S > S arises from a process of selective recall, where the fearful individual selectively recalls memories of highly threatening events. A third mechanism, the differential-weighting model, proposes that est. S > S arises because safety information available in the environment has a greater influence on S compared with est. S. The three mechanisms are compatible with one another, but each does not necessarily imply any of the others. As described in Chapter 5, it may be that the mechanisms are related through the danger schema. That is, the acquisition of threat-relevant verbal information may play a role in establishing the schema, and the selective recall and differential-weighting models may be schema products.

The model further proposes that the overprediction of fear may arise from a controlled process analogous to defensive pessimism (Norem & Cantor, 1986a, 1986b), where the individual purposely overestimates the relationship between the fear response and the feared stimulus (i.e., $\underline{f}_2 > \underline{f}_1$) in order to limit the likelihood of encountering aversive stimuli, and to motivate oneself to prepare for the encounter with such stimuli.

In an extension of the model, it was argued that if anticipatory anxiety affects the overprediction of fear, then this is the result of the individual's expectations about the feared stimulus. That is, the prediction of the feared stimulus influences the amount of anticipatory anxiety which, in turn, influences the overprediction of fear by the transfer of anxious arousal

(Zillmann, 1983).

Summary of Findings and Evaluation of the Model

The research in this dissertation dealt with some aspects of the model, but left others for future investigation. Two cognitive mechanisms were examined; the selective recall and differential-weighting models. The selective recall model was not supported as a mechanism of fear overprediction (Experiment 1), although it may be implicated in pain overprediction (Kent, 1985). The differential-weighting model received some support (Experiments 2 and 3). The algebraic form of the stimulus estimation model, which states that the overprediction of fear arises because est. S > S, was supported (Experiment 3).

The hypothesis that anticipatory anxiety plays a role in the overprediction of fear was supported in Experiment 1 but not in Experiments 2 and 3. The inconsistency may have been a result of the means of inducing state anxiety. In Experiment 1, state anxiety was influenced by the priming of fear-relevant and fear-irrelevant memories. It was suggested in that study that the effects of priming on reported fear (and hence overprediction) were mediated by changes in state anxiety. The manipulations of Experiments 2 and 3 did not influence state anxiety. The results of Experiment 3 suggested that state anxiety may have been simply a correlate of the factor(s) responsible for the priming effects.

These contradictory findings can be reconciled by hypothesizing that state anxiety influences the overprediction of fear only when the conditions for excitation transfer are fulfilled (Zillmann, 1983). That is, the transfer of arousal occurs only when the individual fails to recognize that his/her current level of arousal is partially due to previous arousing events. The conditions for excitation transfer may have been satisfied in Experiment 1 but not in Experiments 2 and 3. Further studies of priming are required to understand the relationships among priming, excitation transfer, and the overprediction of fear.

In all, the stimulus estimation model emerged as a useful framework or heuristic for conceptualizing and investigating the overprediction of fear. The algebraic form of the model was supported, while the cognitive mechanisms are in need of further evaluation.

Extension to Related Phenomena

In Chapter 2 it was noted that people not only tend to overpredict their fears, but also tend to overpredict the probability of panic, and the intensity of pain. If the stimulus estimation model can account for the overprediction of fear, then it is expected that it also should be able to account for the overprediction of panic and pain. These applications will be considered in the following sections.

Panic Prediction

In previous studies of panic prediction (e.g., Rachman & Levitt, 1985; see Chapter 2), the overprediction of panic has been demonstrated when the subject overestimates that likelihood that a given stimulus will precipitate a panic attack. In extending the stimulus estimation model to the overprediction of panic, it is proposed that this bias will occur when the person overpredicts the likelihood of threatening events (e.g., confinement, scrutiny by others) and/or underpredicts the availability of safety (e.g., escape routes). This may arise from the differential-weighting of danger and safety cues, or from the other mechanisms described in Chapter 5.

The overprediction of the consequences of panic also can be expressed in terms of the stimulus estimation model. Clark (1986) proposed that panic attacks arise from the catastrophic misinterpretation of the consequences of certain bodily sensations. This hypothesis has been supported by the findings of several studies (e.g., Ehlers, Margraf, Roth, Taylor, & Birbaumer, 1988; McNally & Foa, 1987; Taylor, Koch, & Crockett, 1991). The misinterpretations of panic patients are overpredictions of sorts. In terms of the algebraic expression of the stimulus estimation model, the aversive consequence of panic is defined as S, and the predicted aversive consequence of panic is est. S. The catastrophic misinterpretation of the consequences of bodily sensations can be expressed as est. S > S. The mechanisms used to explain est. S > S in Chapter 5 may be extended to account for how people overpredict the consequences of bodily sensations. The transmission of verbal information may be particularly important. For example, a person may learn from the media or from other sources that palpitations are a sign of impending coronary malfunction (Beck & Emery, 1985; Clark, 1986). The discounting of previous experiences could also play a role in producing est. S > S. The interpretation of the

consequences could be processes in a schema-congruent manner. When predicting the consequences of panic, the patient with panic disorder may dismiss as "near misses" or "fortunate escapes" the many times that he/she has panicked without harmful consequences (Beck & Emery, 1985; Seligman, 1988).

Overprediction of Pain

The stimulus estimation model can be applied to pain prediction by proposing that the overprediction of pain arises from a process of defensive pessimism and/or from the overprediction of the probability of invasive or tissue-damaging events. Dental phobics, for example, may overpredict the severity of pain because they overestimate the type of procedure that is required and/or overestimate the likelihood of pain-evoking events. Examples include the overprediction of the probability that a filling or extraction will be required, and the overprediction of the likelihood of the dentist striking a nerve during a dental procedure. The overprediction of these pain-evoking stimuli may arise from the selective recall of painful dental experiences (Kent, 1985), or from failing to attend to safety information. As an example of the latter, dental patients may fail to consider the effects of analgesic medications when predicting their pain levels.

The model can be applied to the overprediction of pain arising from other sources. In the case of pain induced by electric shock (e.g., Arntz & van den Hout, 1988), the differential weighting of contextual information may produce overprediction, where the person attends to the pain cues (e.g., the electrodes and experimental apparatus) and fails to consider safety cues (e.g., safety information that is explicit or implicit in the consent form).

Overprediction in Context

Underpredictions

Although the focus of this dissertation is on the overprediction of fear, an important, related, issue concerns the nature of underpredictions. This is of interest because isolated underpredictions are thought to cause sequences of overpredictions (Chapter 2; Rachman, 1988; Rachman & Arntz, 1991), and so factors that increase the magnitude or frequency of underpredictions indirectly contribute to the subsequent occurrence of the bias toward overprediction. Given that organisms generally prefer predictable to unpredictable events (Mineka & Hendersen, 1985), and that the preference for predictability is complicated by the tendency to overpredict aversive events, it seems likely that naturally occurring underpredictions are rare in comparison to overpredictions and correct predictions. This suggests than chance aversive events and random errors in the prediction process are probably the major determinants of the frequency of underpredictions. The magnitude of underpredicted fear is proportional to the intensity of the fear response to unexpected aversive events. Thus, neuroticism (Eysenck, 1970) or other variables related to the intensity of negative affect can be seen as vulnerability factors in shaping the magnitude of underpredictions. The larger the underprediction, the more likely it is to promote a series of overpredictions (Rachman, 1988, 1990; Rachman & Arntz, 1991; Rachman & Bichard, 1988). The occurrence of an underprediction may serve to inflate est. S relative to S (e.g., an increase in perceived danger due to reappraisal of the stimulus), and/or to increase f_2 relative to f_1. Further investigation of underpredictions as distal causes of the overprediction bias may prove useful in extending the stimulus estimation model.

Approach, Escape, and Avoidance

Given the intimate relationship between the experience of fear and overt behaviour (Gray, 1982; Klein, 1981; Marks, 1987; Mowrer, 1939; Rachman, 1990), discussion of the stimulus estimation model would be incomplete without considering the relationship between fear-relevant expectations and fear-relevant behaviour. Three related forms of fear-relevant behaviour can be identified: approach, escape, and avoidance.

Approach behaviour occurs when the individual deliberately attempts to move toward a

feared stimulus. This, for example, occurs during exposure treatments. Escape behaviour refers to withdrawal or movement away from a fear-evoking stimulus. Avoidance refers to the intentional failure to enter situations in which a fear-evoking stimulus might be found. Although escape and avoidance can be defined as the opposites of approach behaviour, they are distinguished to clarify the present discussion. Stated generally, the fear response, R, can refer to the individual's level of reported fear, or some other form of fear response, such as approach, escape, or avoidance behaviour. The following sections consider the application of the stimulus estimation model to each of these behaviours.

Approach and escape. If approach behaviour is regarded as a form of fear response, then the stimulus estimation model predicts, by generalization of expressions (1) to (4) (Chapter 5), that fearful people will tend to underestimate their approach behaviour, R, where R is defined as the distance the individual moves toward the feared stimulus from some safe point. The underprediction of approach behaviour is hypothesized to occur because people tend to overpredict the danger and underpredict the safety associated with the feared stimulus. Support for this was found in Experiment 3 where subjects tended to underpredict their ability to place their hands into the snake container.

The model further predicts that fearful individuals will tend to overpredict the likelihood that the feared stimulus will necessitate escape behaviour. Similarly, the magnitude of overprediction is probably related to the amount of hesitation ("behavioural inhibition"; Gray, 1982) displayed during approach behaviour. The results of a study by Rachman and Lopatka (1986b) are indirectly related to this prediction. Snake-fearful subjects were asked to approach a live, harmless snake. It was found that the number of hesitations increased when subjects had underpredicted fear on the previous trial. Since overpredictions tend to follow underpredictions (Chapter 2), the results suggest a relationship between the overprediction of fear and the increase in hesitations.

There may be some important interactions between the predictions and reports of fear, and the predictions and reports of approach/escape behaviour. According to the model, the individual bases his/her predictions of fear and approach behaviour on the nature of the feared stimulus.

For example, an individual's predicted distance of approach to a snake might depend on the predicted striking range of the animal. If the person expects that there is a low probability that the snake will have a striking range of 3 m, but a high probability of a striking range of 1 m, then he/she might predict to approach within of 3 m of the animal. The prediction of approach behaviour is also likely to be influenced by the amount of fear that the person predicts and the amount of fear that he/she is prepared to tolerate. The overprediction of fear and the underprediction of fear tolerance may intensify the biases toward the underprediction of approach behaviour and the overprediction of the probability that escape will occur.

Avoidance. How do people predict and select the places or situations that they will avoid because of the possibility of encountering a fear-evoking stimulus? The stimulus estimation model states that the individual will select the situations to avoid on the basis of est. S, the stimulus that is expected to be encountered in a given situation.

$$R = \underline{l}_1 \{\text{est. } S\} \qquad (11)$$

Where R (the fear response) is avoidance behaviour in this case, est. S is the estimated stimulus, and $\underline{l}_1$ is an unknown function.

According to the model, the prediction of avoidance behaviour is also based on est. S:

$$\text{est. } R = \underline{l}_2 \{\text{est. } S\} \qquad (12)$$

Where est. R is predicted avoidance behaviour, and $\underline{l}_2$ is an unknown function.

Recall that the model proposes that fearful individuals tend to overpredict the dangerous properties of the stimulus and underpredict the availability of safety. From expression (11) the model holds that fearful people will display excessive (i.e., unnecessary) avoidance behaviour

(since est. S > S). The model further states that avoidance behaviour will be overpredicted only when $l_2 > l_1$. Since these functions are unknown, the model leads to no specific statement about whether fearful people will overpredict their avoidance. If predicted and actual avoidance are based on est. S, then fearful people may well be accurate in their expectations about the extent that they will attempt to avoid aversive stimuli (i.e., est. R = R).

Rachman (1988; Rachman & Bichard, 1988) proposed that fearful people display excessive avoidance behaviour because they overpredict their fears. The present model holds that the overprediction of fear is not a cause of excessive avoidance. Rather, excessive avoidance and the overprediction of fear are both the result of the overprediction of the danger properties of the stimulus and the underprediction of the availability of safety resources.

Avenues for Further Investigation

The utility of a model can be gauged by its ability to (i) provide an explanation of the phenomena of interest, (ii) to be open to refutation, and (iii) to predict phenomena that have yet to be observed. In the following three sections, the stimulus estimation model will be measured against these standards. Later sections will consider some additional issues arising for the future study of overprediction.

Explanation

The model appears to be a useful heuristic, and it advances the understanding of the overprediction of fear by linking it with other forms of predictive bias. Even so, the model provides only a sketch of an explanation, and is in need of further development and refinement. The role of controlled processes remains to be addressed, as does the role of the verbal mode of fear acquisition in the bias toward overprediction (see below). Some support was found for the differential-weighting model, although this mechanism is in need of further study. Related to this, the question arises about the relationship between danger schemata and the predictions and reports of fear. If fear predictions are the product of a danger schema, are fear reports also (partly?) the product of this schema, or are they entirely due to another mechanism? If such a schema does play a role in overprediction, then how is it maintained or modified? If underpredictions are especially aversive (Rachman & Arntz, 1991), then they may be of

particular significance in altering the danger schema. Other factors that influence the salience of fear experiences also may be of relevance in shaping and maintaining the danger schema, and hence influencing the bias toward overprediction.

Falsification

What kinds of empirical outcomes would be damaging to the model? The model is considered to be a heuristic, so it could be argued that falsification is not a relevant issue, since heuristics can only be more or less useful. This argument best applies to the notion of the danger schema, since the schema concept appears to be unfalsifiable (Brewin, 1988; Segal, 1988). In comparison, the other aspects of the model are amendable to refutation. Beginning with the algebraic expression, the assumption of est. S > S is best evaluated when the danger and safety properties of a fear stimulus can be exhaustively enumerated. This is most easily done with fears of simple stimuli (e.g., spiders, snakes). If subjects overpredict their fears but do not show biased predictions of one or more of the stimulus features, then this would count against the assumption that est. S > S plays a role in the overprediction of fear.

The assumption that $\underline{f}_2 > \underline{f}_1$ is a source of overprediction could be subjected to falsification by exposing subjects to a fear stimulus that they were familiar with (i.e., est. S ≈ S). The intensity of the stimulus could then be varied (e.g., varying the distance of a snake from a snake-phobic subject) and the relationship could be determined between predicted fear and the stimulus intensity, and between reported fear and the stimulus intensity (e.g., by linear or nonlinear regression). In this way the values of $\underline{f}_2$ and $\underline{f}_1$ can be determined and hence compared. Clearly, the finding that the overprediction of fear occurs when $\underline{f}_2 < \underline{f}_1$ or $\underline{f}_2 = \underline{f}_1$ would not support the assumption that $\underline{f}_2 > \underline{f}_1$ is a source of overprediction. Similarly, the differential-weighting model would not be supported if it was shown that environmental safety information had a greater effect on fear predictions than on fear reports.

It was hypothesized in Chapter 5 that the verbal mode of fear acquisition produces a greater magnitude of overprediction in comparison to other modes of fear acquisition. This hypothesis could be tested by inducing fears by various means (e.g., conditioning, observational learning,

verbal information) and then comparing the magnitude of overprediction that is associated with each mode of fear acquisition. A lack of difference between the modes would fail to support the hypothesis.

New Phenomena

A general prediction from the model is that if people tend to overpredict aversive stimuli, then they should tend to overpredict a range of aversive affective states. In Experiment 3 evidence for the overprediction of disgust was found. There may be biases to overpredict other aversive affective states. In cases of intense, protracted grief, it is common for the bereaved to avoid reminders of the deceased (Parkes, 1986; Ramsay, 1979). Could it be that these people tend to overpredict the intensity of grief that these stimuli will elicit? If this is the case then the overprediction of grief would play a role in perpetuating excessive avoidance, thereby maintaining prolonged grief reactions. The stimulus estimation model predicts that the overprediction of grief will occur if the person overpredicts the likelihood of encountering grief-evoking stimuli (e.g., sympathetic others), or if the bereaved overpredicts the likelihood that a given stimulus will evoke vivid memories of the deceased.

The Overprediction of Pleasant States and Events?

Rachman and Arntz (1991) raised the question of whether the bias toward overprediction is limited to aversive states and events. It may be that there is a tendency to overpredict the intensity of any emotion, regardless of its valence. Similarly, there may be a tendency to overpredict the likelihood of positive events. Biases to overpredict positive emotions and events may have motivating properties. That is, they may enhance the positive reinforcement value of the stimulus. For example, an individual may work harder and longer toward a particular objective if he/she overestimates the benefits that will accrue from its attainment. This view is complementary to the argument that the overprediction of aversive events serves to enhance the negative reinforcement values of potentially threatening stimuli, as suggested by the link between the overprediction of fear and excessive avoidance behaviour (Rachman, 1988, 1990). Thus, the biases to overpredict pleasant and aversive events may play an important role in enhancing reinforcer effectiveness. The enhancement of the tendency to seek out positive events and avoid

aversive ones has clear survival value, and so people may tend to display both kinds of bias. Alternatively, it may be that the overprediction of fear is part of a broad pessimistic tendency for fearful people to "expect the worst." If this is the case then the overprediction of fear would be associated with the underprediction of positive emotions and events.

Individual Differences

A further issue is whether the tendency to make predictive biases is an individual difference variable. Are some types of people more prone to these biases than others? People with a characteristically pessimistic attributional style may be most likely to overpredict. If this is the case, then the overprediction of fear would be expected to be exacerbated when depression is present, since this state is characterized by a pessimistic attributional style (Alloy, 1988).

Implications for Treatment

Can the model be used to develop methods for "treating" overprediction and its associated features, such as excessive anticipatory anxiety and unnecessary avoidance behaviour? At this stage it is too early to say. Craske and Barlow (1990), in their treatment of panic disorder, attempt to "de-bias" their patients by making them aware of the tendency toward the overprediction of fear/panic. In this treatment the patient is informed of this bias, and exposure trials incorporate a predict-report component of the type used in the studies by Rachman and coworkers (e.g., Rachman & Lopatka, 1986a). The stimulus estimation model suggests a modification of this approach, where the focus of de-biasing is on the feared stimulus and on the fear. Patients could be trained to make better use of danger and safety information in shaping their fear predictions. This treatment strategy deals with more of the elements that are hypothesized to play a role in the overprediction bias, and so may be more efficacious in reducing anticipatory anxiety and avoidance than simply training patients to predict their fears more accurately.

Summary and Conclusions

It has long been argued that expectation plays an important role in fear and avoidance (e.g., Kirsch, 1985). Yet, the study of fear-relevant expectations and their mechanisms is still in its early stages. This dissertation outlined a theoretical framework to account of the overprediction of fear and related phenomena. From the results obtained, the model appears to be a useful way of conceptualizing the overprediction of fear. However, its cognitive mechanisms are in need of further development and evaluation. The refinement of this model may provide a fruitful means of furthering our understanding of predictive biases, and for deriving treatments for the maladaptive consequences of predictive biases, such as excessive anticipatory anxiety and unnecessary avoidance behaviour.

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APPENDIX 1. UNITS OF ANALYSIS

The phenomenon of overprediction is defined by the difference between predicted and reported fear. As such, the question arises as to the best method to analyze difference scores. The experimental predictions in this dissertation can be examined with three different units of analysis. Previous studies (e.g., Rachman & Lopatka, 1986a, 1986b, 1986c) have investigated overprediction by determining the frequency of overpredictions, underpredictions, and correct matches according to the two point criterion. Here, an overprediction is said to occur when predicted fear is two or more points greater than reported fear, an underprediction occurs when predicted fear is two or more points less than reported fear, and a correct match occurs when predicted fear is within two points of reported fear. A second method (e.g., Rachman & Lopatka, 1986a) simply takes the difference between prediction and report as the unit of analysis, without imposing an arbitrary classification rule such as the two point criterion. The bias toward overprediction is demonstrated when the mean level of predicted fear is greater than the mean level of reported fear.

There are problems with both approaches. Frequency analysis loses information about the magnitude of the differences between predicted and reported fear. As mentioned in Chapter 2, this approach also presents statistical problems. In order to obtain an adequate sample of trials to compare the frequency of over- and underpredictions, it was necessary in previous studies (e.g., Rachman & Levitt, 1985) to sum the trials between and within subjects. This confound of between- and within-subject effects represents a violation of the assumption of independent observations, and produces problems in the estimation of the error terms and Type I error rate. Hence, the $\underline{F}$, $\underline{t}$, and χ^2 tests cannot be used (Hays, 1981).

The second approach, which uses the predict - report difference score as the main dependent variable, also encounters difficulties. The use of difference scores tends to increase the error of measurement (Cronbach & Furby, 1970). This can be seen by regarding predicted and reported fear as "tests." Each test is made up of a "true" score and error component. When a difference score is constructed from two tests, the factors in common to the two tests are cancelled out, leaving the "true" difference between the measures and the sum of the errors of

measurement associated with each test. Thus, difference scores tend to have larger errors of measurement that either of the component tests (Thorndike & Hagen, 1977).

The use of residualized scores reduces, to some degree, the error associated with difference scores (Cronbach & Furby, 1970; Rogosa, Brandt, & Zimowski, 1982; Tabachnick & Fidell, 1989). On balance, it was decided that there was more in favour of using residualized difference scores instead of frequency analysis in the experiments reported in this dissertation.

As applied ot the overprediction of fear, the difference between predicted and reported fear is residualized by using predicted fear as a covariate. When the overprediction score is expressed as a residualized difference score, it is expressed as {ß(predicted fear) - (reported fear)}, where ß is a weighting derived by using predicted fear as a covariate. The ß weighting compensates, to some extent, for the increase in error associated with the use of difference scores (Cronbach & Furby, 1970). This form of error adjustment was used instead of {(predicted fear) - ß(reported fear)} because the experimental manipulations used in this dissertation had effects on reported fear rather than predicted fear. Thus, an error correction was required that did not rob the experimental manipulations of their effecrs. This type of adjustment procedure is the same as that used in treatment outcome studies, where the change in scores from pre- to posttest is measured by using the pretest score as a covariate (Tabachnick & Fidell, 1989).

A third method of analysis was used to supplement the use of residualized difference scores. Here, the fear predictions and fear reports were simply used as separate dependent variables. This strategy was adopted in order to investigate the relative contribution of fear predictions and reports in the bias toward overprediction, and to examine how these contributions were influenced by the experimental manipulations.

To summarize, residualized difference scores and their components served as the units of analysis throughout this dissertation. Frequency scores were not used because of their lack of sensitivity.

APPENDIX 2: EXPERIMENTER'S PROTOCOL FOR EXPERIMENT 1

Some weeks before the start of the first experiment, subjects filled out a "Fear Survey Schedule." Subjects who stated on that questionnaire that they were interested in participating in a fear study, and indicated that they were fearful of spiders, were contacted by telephone and invited to participate.

Telephone contact. Information conveyed by the experimenter to potential subjects: "Over the next two weeks we're running an experiment looking at spider fears, and are asking people to participate for course credit. The experiment lasts approximately 50 min. It involves the completion a number of questionnaires and subjects may be asked to view a live, harmless spider housed in a glass container." If potential subjects asked whether they had to touch the spider, and/or whether it was a tarantula, they were informed that neither would be the case.

Conducting the experiment. At the beginning of the experiment, the experimenter informed the subject that most of the experiment simply consisted of working through the test booklet. All the directions for conducting the experiment, including the verbal prompts required of the experimenter, are listed in Appendix 3 as part of the procedural reliability protocol.

APPENDIX 3. PROCEDURAL RELIABILITY CHECKLIST

The following checklist was completed by an observer in order to determine the extent to which the experimenter adhered to the experimental procedure when testing each subject. As this checklist shows, a number of measures were obtained that were not used in this experiment (i.e., heart rate before and after the priming task, and speed of approach during the approach task). In addition, a bogus pipeline was also employed in order to reduce any experimental demand effects (Jones & Sigall, 1971). The latter proved to be unnecessary, given the pattern of obtained results (see Chapter 6).

Instructions to observer. Most of this experiment simply requires the subject to work his/her way through the test booklet. However, the experimenter is required to arrange the testing room in a particular, standardized manner, and to issue a standardized set of verbal instructions to each subject. In order to ensure consistency of delivery, rate the extent to which the experimenter followed these instructions. Make your rating by circling either Y or N for each item. (Y = instructions exactly or very nearly followed [i.e., up to two or three words changed for a given item that does not alter the meaning of the item]. N = clearly departed from instructions for that item.)

1. Bowl covered. Y / N
2. Stopwatch on desk and running before S enters room, or inconspicuously turned on when S enters. Y / N
3. S seated at table opposite E. Y / N
4. E introduces rater as "sitting in to learn about how to run the experiment." Y / N
5. If S asks: "Do I have to touch the spider?" --> E: "No. You won't have to do anything you don't want to, and will be free to withdraw at any time." (If S does not ask question, rate item as Y). Y / N
6. E's first instructions: "The first thing I'll get you to do is to read the consent form, and if you agree to it, to fill it out." Y / N
7. E hands S a copy of consent form. Y / N
8. S completes course credit form and E answers any questions. Y / N
9. INSTR: "I'd like you to read the instructions and answer these three questions, then I'd like you to complete the questionnaires on the next three pages" [DEMONSTRATES TO S]. Y / N
10. Heart rate instructions given at completion of scales: "Now I'm going to take some measures of your heart rate using this pulse monitor [POINTS]. You see this light? It works by clipping this to your earlobe so that the light is on the inside of your earlobe" [DEMONSTRATES]. Y / N

11. If S makes a comment about the heart rate monitoring, such as, "I've just been exercising" --> E responds: "We can control for that." (If S does not ask question, rate item as Y). Y / N

12. S puts on clip. Y / N

13. INSTR: "I keep the readings covered up because if you can see your own heart rate you can influence it..." Y / N

14. INSTR: "While I'm doing this, I'd like you to complete this questionnaire and the one on the next page" [SHOWS S]. Y / N

15. E records heart rate and then removes clip. Y / N

16. INSTR: "This next inventory consists of three pages [SHOWS S], and should take you about 10 to 15 minutes to complete. There are instructions at the top." Y / N

17. INSTR: "Now I'm going to take some more measures of your heart rate." Hands S clip and S attaches it. Y / N

18. INSTR: "While I'm doing this, I'd like you to complete this questionnaire and the one on the next page" [SHOWS S]. Y / N

19. E records heart rate and then removes clip. Y / N

20. INSTR for next set of questions: "Now, I'd like you to read the instructions and complete these scales and the ones on the next page" [SHOWS S]. Y / N

21. INSTR: "Now, I'd like you to stand at this red line facing down this way" [POINTS]. Y / N

22. S complies and E comes up to S's right side with pen, test booklet, and instruction sheet. Y / N

23. INSTR: "This part is a little complicated, so I'll try to explain it as best as I can. You see these instructions [SHOWS S], they're the same ones that are up on the wall..." [POINTS]. Y / N

24. INSTR: "What I'd like you to do, when I tell you, is to go up to the black line there, rate your level of fear..." Y / N

25. INSTR: "Then lift the cloth, touch the bottom of the bowl (or as close as you can go), and then rate your level of fear again." Y / N

26. INSTR: "I'll just go through that again. Go up to the bowl, rate your level of fear, then lift the cloth, and so-on." Y / N

27. E hands S the pen and test booklet. Y / N

28. INSTR: "OK, go ahead." Y / N

29. E returns to desk to record S's approach time. Y / N

30. RATER: RECORD APPROACH TIMES ON 2nd STOPWATCH:
    (i) Duration from "go ahead" until S makes first rating = ... seconds.
    (ii) Duration from first rating until S lifts the bowl so that rater can see that the bowl is empty = ... seconds.

31. If S asks for guidance, E simply repeats instructions. Y / N

32. After S makes second rating: INSTR: "Ok, you can come back and sit down now." Y / N

33. INSTR: "Now I'm going to take some more measures of your heart rate." E hands S clip and S attaches it. Y / N

34. E records heart rate and then removes clip. Y / N

35. INSTR: "While I'm doing this, I'd like you to work through the remaining questionnaires; there's about six pages. You'll know when you get to the end." Y / N

36. Debriefs S. Y / N

THROUGHOUT EXPERIMENT:

37. Handling of questions (apart from item 5): E repeats or rephrases instructions; i.e clarifies, but does not give additional information. If S says that some of the questions were repeated earlier, E says "thats right" and/or asks that S complete them again. Y / N

38. While S is completing questionnaires etc, E is not reading S's responses, but is attending elsewhere (e.g. reading other material). Y / N

39. Rating of demeanor of E: Friendly but not excessively so. Not cold, rude, etc. Y / N

40. RATER: Estimate which group the subject was assigned to. In the priming group the S is to recall a fearful, spider-related memory. In the control group the subject is to recall a non-fearful event. Base your estimate predominantly on the behaviour of E. If S makes a comment which clearly identifies the group, circle "invalid."

    ESTIMATE EXPERIMENTAL CONDITION (circle one):

    PRIMING / CONTROL / INVALID

APPENDIX 4. SUBJECT PROTOCOL FOR EXPERIMENT 1

Consent Form

This study examines the way that people make predictions and reports of their fear levels. It is important that you try to be as honest as possible when making your ratings. Heart rate and other measures will be made in order to check whether people are being honest in their responses. The experiment will consist of a single 50 minute session. Subjects will be asked to complete a number of questionnaires, and may be asked to approach a live, harmless spider.

If for you wish to withdraw from the experiment at any time, you are free to do so without jeopardizing your class standing. However, we hope that you will be willing to participate. After completing the experiment a written explanation and opportunity for discussion will be provided. Course credit will also be given for participation. Subjects will receive partial course credit if they feel that they are unable to complete the experiment and must withdraw part way through the study.

Although this is not a treatment study, participants are likely to benefit in that they will have the opportunity to learn more about their fear. Treatment of fears can be arranged upon request. All information collected in the course of this study is kept strictly confidential, and access to it will be restricted to Dr. S. Rachman (principal investigator) and Steven Taylor (Clinical Ph.D. student). For further information contact Steven Taylor, Department of Psychology, U.B.C.,

Please sign below if you agree to participate and acknowledge receiving a copy of this consent form.

NAME.....

TODAY'S DATE.....

DATE OF BIRTH.....

GENDER (M/F).....

Ratings of Spider Fear, Worry, and Mood

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate how frightened you would be right now if, from a viewing distance of 12 inches, you saw a spider that was 2 inches wide and slowly moving.

Not frightened at all 0 _____ Extremely frightened 100

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate your response: What percentage of the last hour that you have spent worrying about this experiment?

0% _____ 100%

Instructions. Place a vertical slash (|) at the appropriate point on each line to indicate how you are feeling right now.

(i) HOW HAPPY DO YOU FEEL?

I am not at all happy 0 _____ I am extremely happy 100

(ii) HOW SAD DO YOU FEEL?

I am not at all sad 0 _____ I am extremely sad 100

(iii) HOW ANGRY DO YOU FEEL?

I am not at all angry 0 _____ I am extremely angry 100

(iv) HOW ANXIOUS DO YOU FEEL?

I am not at all anxious 0 _____ I am extremely anxious 100

Fear-Relevant Priming

SPIDER FEAR INVENTORY

The following inventory consists of 3 pages, and should take 10 to 15 minutes to complete. It is intended to help you to get in touch with your experiences.

1. Describe, as vividly as possible, a memorable, highly fearful experience you have had with a spider, where the peak intensity of your fear was 85 or higher on a 0 to 100 scale (0 = no fear, 100 = terrifying fear). Describe this experience in the space provided below, giving details about what happened, where you were, what the spider looked like, and your reactions.

THE SUBJECT WAS PROVIDED ONE PAGE TO WRITE ABOUT THIS EXPERIENCE

PLEASE COMPLETE THE FOLLOWING QUESTIONS ABOUT THE EVENT YOU JUST DESCRIBED.

2. Were you startled?.....

3. Describe the features of the spider:

(a) Could you see the spider clearly?.....

(b) Colour.....

(c) Shape.....

(d) Texture (e.g., shiny, hairy).....

(e) Was it moving? If so, how fast? (e.g., creeping slowly, scuttling rapidly).....

4. Did the spider do anything to you? (e.g., crawl on you, bite you).....

.....

5. Did you touch the spider, or any place that it might have been?.....

.....

6. What did you do? (e.g., freeze, run, squash it). List your reactions in the order that they occurred.....

.....

.....

7. What went through your mind at the time? i.e., were you aware of any thoughts? Did you have difficulty thinking clearly?.....

.....

8. What reactions did you experience? Circle any of the following sensations that you experienced: breathelessness or smothering sensations, choking, pounding or racing heart, chest tightness or pain, sweating (e.g. sweaty palms), faintness, feeling sick, abdominal distress, nausea, dizziness, feeling unreal or in a dream, numbness or tingling sensations, hot flushes or flashes, chills, trembling or shaking, tensed muscles, hair standing on end, urge to cry out or scream, tearfulness, increased energy, feelings of insecurity, anger, sadness, increased alertness.

9. A panic attack is a high level of anxiety accompanied by (i) strong bodily reactions (e.g. pounding heart, muscle tremors); (ii) the temporary loss of the ability to plan, think, or reason; and (iii) the intense desire to escape or flee the situation. (Note that this is different from high anxiety or fear alone.) <u>During the fearful episode you just described, did you have a panic attack? YES / NO</u>.

10. What was your peak level of fear during that episode? Place a vertical slash (|) at the appropriate point on the line.

No fear at all 0 _____ Terrifying fear 100

11. How vivid is your recollection of this event?

Not clear at all 0 _____ Extremely vivid 100

Fear-Irrelevant Priming

LIFE EXPERIENCES INVENTORY

The following inventory consists of 3 pages, and should take 10 to 15 minutes to complete. It is intended to help you to get in touch with your experiences.

1. Describe, as vividly as possible, a memorable experience you have had. This should be an event where you did not have any unpleasant emotions, such as fear, anger, or sadness, and should not be related to spiders. It can be any event that stands out in memory, such as meeting an interesting person, going on a trip, or watching a good movie. It could even be a commonplace event such as enjoying a good meal. Describe this experience in the space provided below, giving details about what happened, where you were, what the scene looked like, and your reactions.

THE SUBJECT WAS PROVIDED ONE PAGE TO WRITE ABOUT THIS EXPERIENCE

PLEASE COMPLETE THE FOLLOWING QUESTIONS ABOUT THE EVENT YOU JUST DESCRIBED.

2. Were you startled at all during this event?.....

3. Describe the features of the situation:

   (a) Can you picture the event clearly?.....

   (b) What colors were the most memorable?.....

   .....

   (c) What sounds do you recall?.....

   .....

4. Briefly describe the characters in the event.....

.....

.....

5. What went through your mind at the time? i.e., were you aware of any thoughts?

.....

.....

6. What reactions did you experience? Circle any of the following sensations that you experienced: increased energy, liveliness, calmness, relaxation, euphoria, amusement, happiness, boredom, sleepiness, sweating, curiosity, feeling absorbed, increased alertness.

7. Did you experience any other reactions (including emotions) not listed here? If so, what were they?.....

.....

.....

8. How happy were you during that episode? Place a vertical slash (|) at the appropriate point on the line.

Not at all happy 0 _____ Extremely happy 100

9. How exciting was that episode?

Not at all exciting 0 _____ Extremely exciting 100

10. How calm were you during that episode?

Not at all calm 0 _____ Extremely calm 100

11. How vivid is your recollection of that episode?

Not clear at all 0 _____ Extremely vivid 100

Predictions Questionnaire

B.A.T. - PREDICTIONS OF PEAK FEAR

Instructions. You will now be asked to make some fear predictions for a task that involves approaching a glass bowl covered by a cloth, which you can see at the end of the room. The bowl will either be empty, or will contain a slow-moving spider that is 2 inches wide. There is a 50% chance that the bowl will contain the spider. The task consists of going up to the bowl, removing the cloth, and touching the bottom of the inside of the bowl (or as close as you can get to doing this). Again, there is a 50% chance that the bowl will either be empty or contain the spider.

(1) PREDICT THE LEVEL OF FEAR THAT YOU WILL EXPERIENCE AS YOU ARE ABOUT TO LIFT THE CLOTH:

No fear at all — Terrifying fear

0 _____ 100

(2) PREDICT THE LEVEL OF FEAR YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE BOWL:

No fear at all — Terrifying fear

0 _____ 100

(3) HALF OF THE SUBJECTS IN THIS EXPERIMENT WILL FIND THE SPIDER IN THE BOWL. WHAT DO YOU THINK THE CHANCES ARE THAT YOU WILL FIND THE SPIDER IN THE BOWL ?

Not at all likely — Extremely likely

0 _____ 100

(4) IF YOU KNEW THAT THE SPIDER WAS IN THE BOWL, PREDICT THE LEVEL OF FEAR YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE BOWL.

No fear at all — Terrifying fear

0 _____ 100

(5) IF YOU KNEW THAT THE SPIDER WAS NOT IN THE BOWL, PREDICT THE LEVEL OF FEAR YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE BOWL:

No fear at all 0 _____ 100 Terrifying fear

Printed Instructions Given to Subjects for the Approach Task

1. Walk up to the bowl.
2. Rate the level of fear that you experience.
3. Remove cover.
4. Put hand into bowl and touch the bottom of the inside of the bowl (or as close to this as you can go). You may look into the bowl while you are doing this.
5. Rate the level of fear that you experience when you touch the bottom of the bowl.

Approach Task

B.A.T. - REPORTED PEAK FEAR

(1) RATE YOUR LEVEL OF FEAR AS YOU ARE ABOUT TO LIFT THE CLOTH:

No fear at all 0 _____ 100 Terrifying fear

(2) RATE YOUR LEVEL OF FEAR WHEN YOU TOUCH THE BOTTOM OF THE BOWL:

No fear at all 0 _____ 100 Terrifying fear

Debriefing

The experiment you have just completed is intended to investigate factors that determine how people predict the level of fear they will experience in particular situations. Various measures, such as state anxiety, taken prior exposure to a fearful situation, provide useful information about the level of fear a person will predict and experience. A question of interest concerns the accuracy with which people can predict their fear levels, and how this can be improved. A related question is how people develop fear expectancies (i.e. predictions). By sampling people's past experiences, as well as taking measures of state anxiety, the cognitive bases of fear expectancies will be explored. Thank you for your participation. If you have any further questions you can contact Steven Taylor at

Summary of Results and Further Debriefing Information that was Mailed to Subjects[1]

Recently, you participated in a fear study conducted at the Psychology Department at UBC. The results are summarized here for your interest. The experiments concerned a phenomenon known as the overprediction of fear, which is defined as the tendency to expect fearful events to be more fearful than they usually turn out to be. Little is known about this bias to "expect the worst." One theory is that overprediction occurs because people selectively recall memories for highly fearful experiences. We tested this in our first experiment where we asked spider-fearful subjects to recall memories that were either related to a fearful encounter with a spider, or irrelevant to spiders. Subjects then completed a fear-evoking task where they were asked to walk up to a container, remove the cover, and touch the inside of the container. They were told that there was a 50% chance that the container would have a spider in it. It was found that recalling a fearful memory increased the amount of fear that was experienced in the subsequent fear-evoking task. Interestingly, recall had no effect on the amount of fear that was predicted. Thus, the recollection of a fearful memory decreased the tendency to overpredict fear. This failed to suport the selective recall theory.

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[1] A debriefing form summarizing the results of Experiments 1 and 2 was mailed to all subjects who participated in those experiments, including the subjects in the pilot studies.

In the second experiment we tested a theory that states that people overpredict their fears because they fail to notice the elements of safety present in a fearful situation. This theory predicts that safety information effects the amount of fear that is experienced, but not the amount of fear that the person expects to have. To test this, subjects completed a fear-evoking task where they were asked to walk up to a container, remove the cover, and touch the bottom of the inside of the container. They were told that there was a 50% chance that the container would have a spider in it.

Subjects were divided into two groups. One group received accurate information about the features of the spider that could have been present (e.g., it was harmless, timid, etc.). The other group of subjects was not given this information. We found that the provision of safety information decreased the amount of fear that was experienced, but not the amount of fear that was expected. Thus, the provision of safety information increased the magnitude of overprediction, and so supported the theory.

Although we initially intended to have the spider present in 50% of cases in both experiments, the actual proportion was much lower (10%)[2] because of constraints involved in getting a sufficiently large sample of spider-fearful subjects for our experiments. Fortunately, this did not seriously effect the results.

Thank you for your participation. If you are interested in obtaining further information about this phenomenon, a useful review article has been published by Dr. S. Rachman and S. Bichard, entitled "The overprediction of fear," which appeared in the Clinical Psychology Review, vol. 8, 1988, pp. 303-312.

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[2] These subjects were part of a pilot study that used earlier versions of the experimental protocols. The data from the pilot studies were not included in Experiments 1 or 2.

APPENDIX 5. EXPERIMENT 1: PROCEDURAL RELIABILITY RESULTS

Procedural reliability is an index of the extent that an experiment is executed according to the requirements of the experimental protocol (Billingsley, White, & Munson, 1980). In the present study this was determined by having an observer rate the experimenter's adherence to the experimental protocol. Using the method recommended by Billingsley et al., the experimental procedure was broken down into a series of actions and statements that were required of the experimenter when testing each subject. An example of one of these units of analysis is the wording of the instructions used in the approach task. The observer rated whether each unit was executed according to the requirements of the protocol. The observer received three practice sessions prior to making the ratings in the experiment proper. The rating scale used by the observer is presented in Appendix 3.

Ratings of procedural reliability were obtained for 25 of the 100 testing sessions (i.e. for 25 subjects). According to Billingsley et al. (1980), procedural reliability = E/R, where E = the number of the experimenter's behaviours emitted in accordance with the protocol, as judged by the observer, and R = the total number of experimenter behaviours required by the protocol. If a behaviour had been emitted in an acceptable form, it was assigned a score of 1, otherwise a score of 0 was recorded. Thus, procedural reliability was calculated for each subject by summing the obtained scores and then dividing by the maximum score. The mean reliability was 0.99 ($\underline{SD}$ = 0.01; range: 0.97 - 1.00). This indicated a high degree of adherence to the experimental protocol, at least for sessions that were rated by the observer.

The effects of observer's presence versus absence on fear ratings was tested by two sets of analyses. A two-way MANOVA was performed, where the independent variables were the Priming condition (fear-relevant vs. fear-irrelevant) and the Observer condition (present vs. absent). The dependent variables were FP1, $FP2_{.0\%}$, $FP2_{.50\%}$, $FP2_{.100\%}$, FR1, and FR2. Since there were unequal numbers of rated and unrated sessions, analyses were conducted using unique sums of squares (Tabachnick & Fidell, 1989). The Priming x Observer interaction was not significant [Pillai $\underline{F}(6, 91) < 1.00$, $\underline{p} > .1$]. All univariate interactions were nonsignificant [$\underline{F}(1, 96) < 1$, $\underline{p} > .1$ for each dependent variable]. This indicates that the priming effects did not

differ as a function of whether a session was rated for procedural reliability.

The possibility of differential observer effects on the overprediction of fear was also examined. A pair of two-way ANCOVAs were performed. The independent variables in each analysis were the Priming and Observer conditions. For the first ANCOVA the dependent variable was the difference score, OP1 = FP1 - FR1. Since difference scores are associated with an increase in measurement error (Cronbach & Furby, 1970), OP1 was residualized by using the covariate, FP1.

As in all of the analyses of covariance reported in this dissertation, the assumption of homogeneity of regression across each of the between-subject conditions was examined by testing the pooled interactions between the covariate and the between-subject factors. In the present analysis, the result was not significant [F (1, 94) < 1.00, p > .1], indicating that the assumption had not been violated. The covariate was a significant predictor of the dependent variable [F (1, 95) = 22.97, p < .0005]. The Priming x Observer interaction was not significant [F (1, 95) < 1.00, p > .1].

In the second ANCOVA, Priming and Observer conditions were the independent variables. The dependent variable was OP2, defined as $FP2_{.0\%}$ - FR2. The covariate was $FP2_{.0\%}$. The assumption of homogeneity of regression was violated [F (1, 94) = 6.04, p < .02], and the covariate was significant [F (1, 95) = 10.55, p < .002]. As in the previous analysis, the Priming x Observer interaction was not significant [F (1, 95) < 1.00, p > .1]. Because the assumption of homogeneity of regression was violated, the analyses were also run without the inclusion of the covariate. The pattern did not change, with the Priming x Observer interaction remaining nonsignificant [F (1, 96) < 1.00, p > .1].

The results of the analyses reported in this section indicate that fear predictions, fear reports, and the difference scores in the observed sessions did not differ from those of the unobserved sessions. Since there was no evidence of experimenter bias in the sessions that were rated for procedural reliability, these results suggests an absence of experimenter bias in sessions that were not rated by the observer.

As part of the procedural reliability rating, the observer was also required to guess the

priming condition that each subject was in. This was done in order to detect any subtle experimenter biases that might have been present and might not have been detected by the preceding analyses. In making this estimate, the observer was instructed to pay particular attention to the experimenter's behaviour (e.g., tone of voice, posture, facial expressions, pacing of experiment). If the observer could correctly identify the priming condition on the basis of the experimenter's behaviour, then this would suggest the presence of experimenter bias. Of the 25 sessions that were observed, 13 guesses were correct, 10 were incorrect, and 2 were invalid because subjects made remarks that revealed the conditions they were in. The proportion of correct guesses did not differ from that expected by chance [$\chi^2(1) < 1.00$, $p > .1$], and the proportion of correct guesses did not differ across the priming conditions (Fisher's exact test: $p > .1$).

In all, these data offer no evidence of experimenter bias, and suggest that the experiment was executed according to the protocol presented in Appendix 3. The absence of experimenter effects is not surprising since most of the experiment simply required the subject to work through a test booklet.

APPENDIX 6. INSTRUCTIONS TO EXPERIMENTERS FOR EXPERIMENT 2

Telephone Contact with Potential Subjects

A few months prior to the commencement of the present experiment, all first and second year undergraduate students completed a fear screening questionnaire. On this they indicated their levels of fear of a variety of stimuli, including spiders, and gave their names and telephone numbers if they wished to participate in our experiments. In the initial telephone contact with potential subjects, the experimenter began by reminding them that they filled in a fear questionnaire earlier in the year and had indicated that they were interested in participating in a fear study for course credit. The potential subject was told that the experiment required 15-20 minutes to complete, was worth 0.5 course credits, and subjects would be asked to complete a number of questionnaires. They were also told that they may be asked to view a live, harmless spider that is kept in a glass bowl, and that they would not be asked to touch the spider or do anything that they did not want to do.

Dr. Rachman's research group had been running fear studies all year, and so it was expected that some subjects would have already completed a fear study. Subjects were ineligible to participate in the present experiment only if they had their spider fear eliminated as a part of participation in a previous study, or if they had participated in any of the other studies in this dissertation.

Instructions to Experimenters

Instructions: In preparing the room for testing, ensure that the desk is next to the door and that there is an adequate supply of test booklets. The booklets can be found in a box in room 1713. The booklets contain all that is needed, including the course credit form. At the beginning of the experiment, the partition should be in front of the bowl for the L but not H condition. For the latter, the partition is to the side of the bowl throughout the experiment. This experiment largely consists of having the subject work through one of the test booklets. There are two experimental conditions. These differ in the type of test booklet that is used (L or H), and whether the partition between the subject and the bowl at the time the fear predictions are made.

The experimental procedure should be clear after reading through the test booklet for each

experimental condition. The experiment commences when the subject is seated and informed that the experiment should take 25 - 30 min to complete and is worth 0.5 course credits. The subject is told that most of the experiment simply requires him/her to work through the test booklet. The subject starts by reading and completing the consent form. After that, the experimenter turns the page and tears out the second page (subject's copy of the consent form) and gives it to the subject.

In all conditions, once the Predictions Questionnaire is completed, the subject is asked to stand at the red line and the experimenter goes through the instructions for the approach task (i.e., walk up to bowl, rate peak fear, lift cover, etc.). The instructions to this are given on the page following the predictions questionnaire. The experimenter should explain the instruction to the subject twice and check that he/she understands them:

1. Walk up to the bowl.
2. Rate the peak level of fear you experience.
3. Remove cover.
4. Put hand into the bowl and touch the bottom of the bowl (or as close to this as you can go). You may look into the bowl while you are doing this.
5. Rate the peak level of fear that you experienced when your hand was touching the bottom of the bowl.

The subject is then sent on the approach task. If the subject looks like he/she is not going to perform the task correctly (e.g., is about to lift the cover before making the first rating), the experimenter should verbally prompt the subject to follow the instructions (e.g., tell the subject to make his/her first rating before lifting the cover).

After completing the approach task the subject is asked to return to his/her seat to complete the last few pages of the booklet. The final page is a debriefing, which is torn off and given to the subject. The experimenter gives the subject a brief (1-2 min) explanation of the experiment (paraphrasing the written debriefing), and the course credit form is then completed. The subject is then given the course credit form and dismissed.

Throughout the experiment, the experimenter should attempt to keep occupied (e.g., bring some reading material), so that the subject does not feel scrutinized. However, the experimenter should also attempt to monitor the subject's progress through the test booklet to ensure that items

are not omitted.

Dealing with questions. Possible questions and appropriate responses are as follows.

1. "Do I have to touch the spider? " Tell subject that "No. You won't have to do anything that you don't want to do."

2. Questions about the nature of the spider: It is essential that you do not provide any additional information abou the spider or the task, other than that presented in the subject's particular test booklet.

3. Questions about the meaning of instructions: Simply restate instructions. Rephrasing should be kept to an absolute minimum.

APPENDIX 7. SUBJECT PROTOCOL FOR EXPERIMENT 2

Consent Form

This study examines the way that people make predictions and reports of their fear levels. It is important that you try to be as honest as possible when making your ratings. The experiment will consist of a single 25 - 30 min session. Subjects will be asked to complete a number of questionnaires, and may be asked to approach a live, harmless spider.

If for you wish to withdraw from the experiment at any time, you are free to do so without jeopardizing your class standing. However, we hope that you will be willing to participate. After completing the experiment a written explanation and opportunity for discussion will be provided. Course credit will also be given for participation. Subjects will receive partial course credit if they feel that they are unable to complete the experiment and must withdraw part way through the study.

Although this is not a treatment study, participants are likely to benefit in that they will have the opportunity to learn more about their fear. Treatment of fears can be arranged upon request. All information collected in the course of this study is kept strictly confidential, and access to it will be restricted to Dr. S. Rachman (principal investigator) and Steven Taylor (Clinical Ph.D. student). For further information contact Steven Taylor, Department of Psychology, U.B.C.,

Please PRINT your name and sign below if you agree to participate and acknowledge receiving a copy of this consent form.

NAME.....

SIGNATURE.....

TODAY'S DATE.....

AGE (YEARS AND MONTHS).....

GENDER (M/F).....

Ratings of Spider Fear and State Anxiety

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate how frightened you are of spiders.

Not frightened at all 0 _____ Extremely frightened 100

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate how anxious you are feeling RIGHT AT THIS MOMENT.

HOW ANXIOUS DO YOU FEEL RIGHT AT THIS MOMENT?

I am not at all anxious 0 _____ I am extremely anxious 100

Predictions Questionnaire

Low Information Version.

INSTRUCTIONS. You will now be asked to make some predictions concerning a task that involves approaching a glass bowl covered by a cloth. The bowl will either be empty, or will contain a live, harmless spider. There is a 50% chance that the bowl will contain the spider, and a 50% chance that the bowl will be empty. The task consists of going up to the bowl, removing the cloth, and then placing your hand into the bowl until you touch the inside of the bottom of the bowl (or as close ot this as you can go). Again, there is a 50% chance that the bowl will either be empty or contain the spider. You may look into the bowl while you are performing this task.

High Information Version.

INSTRUCTIONS. You will now be asked to make some predictions concerning a task that involves approaching a transparent glass bowl covered by a cloth, which you can see behind you at the end of the room. (Please turn around and take a look at the bowl.) The middle of the bowl is eight inches wide, and its opening is four inches wide. The bowl will either be empty, or will contain a live, harmless spider. The spider is timid, rarely moves, and has never escaped from the bowl. There is a 50% chance that the bowl will contain the spider, and a 50% chance that the bowl will be empty. The task consists of going up to the bowl, removing the cloth, and then placing your hand into the bowl until you touch the inside of the bottom of the bowl (or as close ot this as you can go). Again, there is a 50% chance that the bowl will either be empty or contain the spider. You may look into the bowl while you are performing this task.

(1) HOW ANXIOUS DO YOU FEEL RIGHT AT THIS MOMENT ?

Not anxious at all 0 _____ Extremely anxious 100

(2) FOR HALF OF THE SUBJECTS THE SPIDER IS IN THE BOWL, WHAT DO YOU THINK THE CHANCES ARE THAT YOU WILL BE ONE OF THE SUBJECTS FOR WHOM THE SPIDER IS IN THE BOWL ?

Not at all likely 0 _____ Extremely likely 100

(3) PREDICT THE PEAK AMOUNT OF FEAR THAT YOU WILL EXPERIENCE WHEN YOU ARE STANDING AT THE BOWL JUST ABOUT TO LIFT THE CLOTH:

No fear at all 0 _____ Terrifying fear 100

(4) PREDICT THE PEAK AMOUNT OF FEAR YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE INSIDE OF THE BOWL:

No fear at all 0 _____ 100 Terrifying fear

(5) IF YOU KNEW THAT THE SPIDER WAS NOT IN THE BOWL, PREDICT THE PEAK AMOUNT OF FEAR THAT YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE INSIDE OF THE BOWL:

No fear at all 0 _____ 100 Terrifying fear

(6) IF YOU KNEW THAT THE SPIDER WAS IN THE BOWL, PREDICT THE PEAK AMOUNT OF FEAR THAT YOU WILL EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE INSIDE OF THE BOWL:

No fear at all 0 _____ 100 Terrifying fear

(7) IF THE SPIDER IS IN THE BOWL, HOW QUICKLY DO YOU THINK IT WILL MOVE?

Will not move at all 0 _____ 100 Will move extremely quickly

(8) IF THE SPIDER IS IN THE BOWL, HOW DANGEROUS DO YOU THINK IT WILL BE?

Not dangerous at all 0 _____ 100 Extremely dangerous

*** REMEMBER: THERE IS A 50% CHANCE THAT THE BOWL WILL CONTAIN A SPIDER, AND A 50% CHANCE THAT THE BOWL WILL BE EMPTY ***

Printed Instructions Given to Subjects for the Approach Task

1. Walk up to the bowl.
2. Rate the peak level of fear that you experience.
3. Remove cover.
4. Put hand into bowl and touch the bottom of the inside of the bowl (or as close to this as you can go). You may look into the bowl while you are doing this.
5. Rate the peak level of fear that you experience when you touch the bottom of the bowl.

Approach Task

(1) WHAT IS THE PEAK AMOUNT OF FEAR YOU EXPERIENCE WHEN YOU ARE STANDING AT THE BOWL JUST ABOUT TO LIFT THE CLOTH?

No fear at all 0 _____ Terrifying fear 100

(2) WHAT IS THE PEAK AMOUNT OF FEAR YOU EXPERIENCE WHEN YOU TOUCH THE BOTTOM OF THE BOWL?

No fear at all 0 _____ Terrifying fear 100

Debriefing

The experiment you have just completed is intended to investigate factors that determine how people predict the level of fear they will experience in particular situations. Various measures, such as state anxiety, taken prior exposure to a fearful situation, provide useful information about the level of fear a person will predict and experience.

A question of interest concerns the accuracy with people can predict their fear levels, and how this can be improved. A related question is how people develop fear expectancies (i.e. predictions). By sampling people's past experiences, as well as taking measures of state anxiety, the cognitive bases of fear expectancies will be explored. Thank you for your participation. If you have any further questions you can contact Steven Taylor at

Summary of Results and Further Debriefing Information that was Mailed to Subjects

See Appendix 4.

APPENDIX 8. EXPERIMENTER EFFECTS FOR EXPERIMENT 2

Two experimenters were used in the present study. One of the experimenters was the author (ST), who tested 71.90% of subjects. The second experimenter (JZ) was unaware of the predictions under investigation, and tested 28.10% of subjects. A series of analyses were performed in order to determine whether the results differed as a function of experimenter. Since one experimenter was the author, and the other was not aware of the predictions under investigation, significant interactions between the Experimenter factor and Information condition may be taken as evidence of experimenter bias. (A significant Experimenter main effect does not constitute evidence of bias.)

In the first analysis, a two-way MANOVA was performed, where the independent variables were Experimenter (ST vs. JZ) and Information level (high vs. low safety information). The dependent variables were FP1, $FP2._{0\%}$, $FP2._{50\%}$, $FP2._{100\%}$, FR1, and FR2. At the multivariate level, the Experimenter by Information interaction was not significant [Pillai $F(6, 112) < 1.00$, $p > .1$]. All interactions were nonsignificant at the univariate level [$F(1, 117) < 1.00$, $p > .1$ for each dependent variable]. Thus, the results reveal no evidence of experimenter bias.

The question of experimenter effects was also investigated by an analysis of the difference scores, OP1 and OP2 (where OP1 = FP1 - FR1, and OP2 = $FP2._{0\%}$ - FR2). For OP1, a two-way ANCOVA was performed. The independent variables were Experimenter and Information level, and the covariate was FP1 (cf. Cronbach & Furby, 1970). The assumption of homogeneity of regression was not violated [$F(1, 116) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 116) = 14.94$, $p < .0005$]. The Experimenter by Information interaction was not significant [Pillai $F(1, 116) < 1.00$, $p > .1$]. These results reveal an absence of evidence of experimenter bias.

OP2 was the dependent variable in the second ANCOVA. The independent variables were Information and Experimenter, and the covariate was $FP2._{0\%}$. The assumption of homogeneity of regression was not violated [$F(1, 116) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 116) = 13.05$, $p < .0005$]. The Experimenter by Information interaction was not significant

[Pillai $F(1, 116) < 1.00$, $p > .1$]. As before, this failed to offer any evidence of experimenter bias.

The results presented in this section fail to reveal any evidence of experimenter bias due to differential knowledge of the experimental predictions. This is not surprising since most of the experiment simply required the subject to work through a test booklet.

APPENDIX 9. INSTRUCTIONS TO EXPERIMENTERS FOR EXPERIMENT 3

Telephone Contact with Potential Subjects

In the month before the commencement of the third experiment, all first and second year undergraduate students completed a fear screening questionnaire. On this they indicated their levels of fear of a variety of stimuli, including snakes, and gave their names and telephone numbers if they wished to participate in our experiments.

During the initial telephone contact, the potential subject was told that the experiment required 15-20 min to complete, was worth 0.5 course credits, and subjects would be asked to complete a number of questionnaires. They were told that they would be asked to approach a live, harmless snake that is kept in a glass container. Subjects were also told that they would not be asked to touch the snake, and that they would not have to do anything that they did not want to do.

Dr. Rachman's research group had been running fear studies all year, and so it was expected that some subjects would have already completed a fear study. Subjects were ineligible to participate only if they had their snake fear eliminated as a part of participation in a previous study, or if they had participated in any of the other experiments in this dissertation.

Instructions to Experimenters

Stimulus materials and physical arrangements for testing. In preparing the room for testing, ensure that the desk is next to the door and that there is an adequate supply of test booklets. The booklets can be found in a box in the corner of the room (in room 1709). The booklets contain all that is needed, including the course credit form. The experimenter should go through the following checklist to ensure that the experiment is executed according to design.

1. Remove water dish and tube from large snake container (kept in room 1705), and bring into lab.

2. Paper should be covering two of the four walls of container, such that the subject cannot see the snake without looking into the container. The cloth cover should also be on the container.

3. The two blinds in the corner of the lab should be down and closed, otherwise the subject

can see the snake through the reflection in the window.

4. At the beginning of the experiment, the partition should be in front of the container, except in the ES condition, where the partition is to the side of the container throughout the experiment.

5. In all conditions except ES, pull the partition to one side before the subject completes the approach task.

6. During the modeling in the ES condition, the subject should remain seated while observing the experimenter.

7. In the ES condition, the experimenter should replace the cover on the container after modeling the approach task.

Executing the experiment. This experiment largely consists of having the subject work through one of the test booklets. There are four experimental conditions, C, D, S, and ES, with corresponding, labelled test booklets. Three of the conditions differ only in the type of test booklet that is used. In the ES condition the experimenter is required to model the approach task before the subject makes his/her fear predictions.

The experimental procedure should be clear after reading through the test booklets for conditions C, D, S, and ES. In all conditions except the ES condition, the partition between the subject's seat and the snake container should be present. The experiment commences when the subject is seated and informed that the experiment should take 15 - 20 min to complete and is worth 0.5 course credits. The subject starts by reading and completing the consent form. After than, the experimenter turns the page and tears out the second page (subject's copy of the consent form) and gives it to the subject. With the exception of the ES condition, the subject then completes all ratings up until the approach task. In the ES condition the subject completes the experiment up until the predict-report task. A page with instructions to the experimenter is in the test booklet the prompt the experimenter to perform the modeling task at this point. The experimenter tells the subject to remain seated and to read the instructions to the predict-report task. Before making any fear predictions, the subject is then asked to observe the experimenter demonstrate (i.e., model) the approach task. The subject remains seated thoughout this. In the

modeling condition the experimenter goes up to the container, states that the first fear rating is to be made at that point, and then lifts the cover to the container. The experimenter then places his/her hand into the container and touches the red mark on the inside of the container. The experimenter than removes his/her hand and states that the second fear rating would be made then. The experimenter then covers the container again. The subject should not see the snake during the modeling, and the experimenter should attempt to complete the demonstration without showing any signs of fear.

Verbal instructions to subjects for the approach task. In all conditions, once the Predictions Questionnaire has been completed, the subject is asked to stand at the red line and the experimenter goes through the instructions for the approach task (i.e., walk up to container, rate peak fear, lift cover, etc.). The instructions to this are given on the page following the Predictions Questionnaire. As the following instructions show, the experimenter should explain the instruction to the subject twice and check that he/she understands them. These instructions should be delivered verbatim to each subject:

> "Now I'd like you to go and stand at the red line, facing down this way [POINTS]. The instructions are a little complicated, so I'll go through them and give you these written instructions [SHOW INSTRUCTIONS TO SUBJECT].
>
> "Now, when I tell you, I'd like you to go up to the container and rate your peak level of fear on this scale [POINTS]. Then remove the cover, and touch the red mark on the inside of the container (or go as close to this as you can go). You may look into the container while you are doing this.
>
> "After that, rate the peak level of fear you experienced when you touched the red mark (or were as close to this as you could go).
>
> "I'll go through that again. Go up to the container, rate your peak level of fear, then lift the cover and touch the red mark on the inside of the container. Then rate the peak level of fear you experienced when you touched the red mark (or were as close to this as you could go). Then indicate on the form whether you were able to touch the red mark. The instructions are written down here [POINTS]. Ok, go ahead."

The subject is then sent off to perform the approach task. If the subject looks like he/she is not going to perform the task correctly (e.g., is about to lift the cover before making the first rating), the experimenter should verbally prompt the subject to follow the instructions (e.g., tell the subject to make his/her first rating before lifting the cover).

After completing the approach task the subject is asked to return to his/her seat to complete the last few pages of the booklet. The final page is a debriefing, which is torn off and given to

the subject. The experimenter gives the subject a brief (1-2 min) explanation of the experiment (paraphrasing the written debriefing), and the course credit form is then completed. The subject is then given the course credit form and dismissed.

Throughout the experiment, the experimenter should attempt to occupy him/herself (e.g., bring some reading material), so that the subject does not feel scrutinized. However, the experimenter should also attempt to monitor the subject's progress through the test booklet in order to ensure that test items are not omitted.

Dealing with questions. Possible questions and appropriate responses are as follows.

1. "Do I have to touch the snake? " Tell subject that "you won't have to do anything that you don't want to do."

2. Questions about the nature of the snake: It is essential that you do not provide any additional information abou the snake or the task, other than that presented in the subject's particular test booklet.

3. Questions of definition and clarification about descriptors presented in the test booklet: (i) inquisitive = highly curious, likes to explore its surroundings. (ii) Predictable = able to reliably anticipate the movements of the snake. (iii) Controllable = the possibility of management or restraint of the snake by the subject and/or the experimenter.

4. Questions about the meaning of instructions: Simply restate instructions. Rephrasing should be kept to an absolute minimum.

5. If the subject asks about the length of the distances to be estimated (e.g., "How long is 10 cm?"), it is appropriate to demonstrate the distance.

APPENDIX 10. SUBJECT PROTOCOL FOR EXPERIMENT 3

Consent Form

This study examines the way that people make predictions and reports of their fear levels. It is important that you try to be as honest as possible when making your ratings. The experiment will consist of a single 15 min session. Each subject will be asked to complete a number of questionnaires, and will be asked to approach a live, harmless snake. You will not be asked to touch the animal.

If for you wish to withdraw from the experiment at any time, you are free to do so without jeopardizing your class standing. However, we hope that you will be willing to participate. After completing the experiment a written explanation and opportunity for discussion will be provided. Course credit will also be given for participation. Subjects will receive partial course credit if they feel that they are unable to complete the experiment and must withdraw part way through the study.

Although this is not a treatment study, participants are likely to benefit in that they will have the opportunity to learn more about their fear. All information collected in the course of this study is kept strictly confidential, and access to it will be restricted to Dr. S. Rachman (principal investigator) and Steven Taylor (Clinical Ph.D. student). For further information contact Steven Taylor, Department of Psychology, U.B.C.

Please PRINT your name and sign below if you agree to participate and acknowledge receiving a copy of this consent form.

NAME (PLEASE PRINT).....

SIGNATURE.....

TODAY'S DATE.....

AGE (YEARS AND MONTHS).....

GENDER (M/F).....

Ratings of Snake Fear and State Anxiety

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate how frightened you are of snakes.

HOW FRIGHTENED ARE YOU OF SNAKES?

Not at all frightened 0 _____ 100 Extremely frightened

Instructions. Place a vertical slash (|) at the appropriate point on the line to indicate how anxious you are feeling RIGHT AT THIS MOMENT.

HOW ANXIOUS DO YOU FEEL RIGHT AT THIS MOMENT?

I am not at all anxious 0 _____ 100 I am extremely anxious

Trait Version of the State-Trait Anxiety Inventory

Directions. A number of statements which people have used to describe themselves are given below. Read each statement and then circle the appropriate number to indicate how you generally feel. There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe how you generally feel.

	ALMOST NEVER	SOME-TIMES	OFTEN	ALMOST ALWAYS
1. I FEEL PLEASANT	1	2	3	4
2. I FEEL NERVOUS AND RESTLESS	1	2	3	4
3. I FEEL SATISFIED WITH MYSELF	1	2	3	4
4. I WISH I COULD BE AS HAPPY AS OTHERS SEEM TO BE	1	2	3	4
5. I FEEL LIKE A FAILURE	1	2	3	4
6. I FEEL RESTED	1	2	3	4
7. I AM "CALM, COOL, AND COLLECTED"	1	2	3	4
8. I FEEL THAT DIFFICULTIES ARE PILING UP SO THAT I CANNOT OVERCOME THEM	1	2	3	4
9. I WORRY TOO MUCH OVER SOMETHING THAT REALLY DOESN'T MATTER	1	2	3	4
10. I AM HAPPY	1	2	3	4
11. I HAVE DISTURBING THOUGHTS	1	2	3	4
12. I LACK SELF-CONFIDENCE	1	2	3	4
13. I FEEL SECURE	1	2	3	4
14. I MAKE DECISIONS EASILY	1	2	3	4
15. I FEEL INADEQUATE	1	2	3	4
16. I AM CONTENT	1	2	3	4
17. SOME UNIMPORTANT THOUGHT RUNS THROUGH MY MIND AND BOTHERS ME	1	2	3	4
18. I TAKE DISAPPOINTMENTS SO KEENLY THAT I CAN'T PUT THEM OUT OF MY MIND	1	2	3	4
19. I AM A STEADY PERSON	1	2	3	4
20. I GET IN A STATE OF TENSION OR TURMOIL AS I THINK OVER MY RECENT CONCERNS AND INTERESTS	1	2	3	4

Predictions Questionnaire

Instructions for control condition.

You will now be asked to make some fear predictions for a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task.

Instructions for danger condition.

You will now be asked to make some fear predictions for a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The snake is very inquisitive: It prefers to explore its environment rather than to hide. It almost always moves about. When the snake does move, it always moves very quickly and is difficult to predict and to control. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task.

Instructions for safety and enhanced safety conditions.

You will now be asked to make some fear predictions for a task that involves approaching a covered glass container. Inside the container is a live, harmless snake. The snake is very timid: It prefers to hide rather than to explore its environment. It almost never moves about. If the snake does move, it always moves very slowly and is easy to predict and to control. The task consists of going up to the container, removing the cover, and then placing your hand into the container to touch a red mark that is on the inside wall of the container (or as close to this as you can go). The red mark is 4 inches (10 cm) above the floor of the container. You may look into the container while performing this task.

Items (all versions).

(1) HOW ANXIOUS DO YOU FEEL RIGHT AT THIS MOMENT ?

Not anxious at all 0 _____ 100 Extremely anxious

(2) PREDICT THE PEAK AMOUNT OF FEAR THAT YOU WILL EXPERIENCE WHEN YOU ARE STANDING AT THE CONTAINER JUST BEFORE YOU REMOVE THE COVER.

No fear at all 0 _____ 100 Terrifying fear

(3) PREDICT THE PEAK AMOUNT OF FEAR THAT YOU WILL EXPERIENCE WHEN YOU PUT YOUR HAND INTO THE CONTAINER AND TOUCH THE RED MARK.

No fear at all 0 _____ 100 Terrifying fear

(4) WHEN YOU LIFT THE COVER AND GO TO TOUCH THE RED MARK, HOW MUCH CONTROL WILL YOU HAVE OVER WHETHER THE SNAKE WILL TOUCH YOU?

No control at all 0 _____ 100 Complete control

(5) WILL YOU BE ABLE TO TOUCH THE RED MARK ? Circle one: YES / NO

(6) HOW DANGEROUS DO YOU THINK THE SNAKE WILL BE?

Not dangerous at all 0 _____ 100 Extremely dangerous

(7) HOW UGLY DO YOU THINK THE SNAKE WILL BE ?

Not ugly at all 0 _____ 100 Extremely ugly

(8) WHEN YOU LIFT THE COVER AND GO TO TOUCH THE RED MARK, HOW SAFE DO YOU THINK YOU WILL FEEL ?

Not safe at all 0 _____ 100 Completely safe

(9) HOW MUCH DISGUST WILL YOU FEEL WHEN YOU SEE THE SNAKE ?

No disgust at all 0 _____ 100 Extreme disgust

(10) HOW LONG DO YOU THINK THE SNAKE WILL BE ? (Give your answer in whatever unit of measurement you wish; feet, inches, metres, centimetres, etc.).....

(11) WHEN YOU LIFT THE COVER AND GO TO TOUCH THE RED MARK, HOW FAST DO YOU THINK THE SNAKE WILL MOVE ?

Will not move at all — Will move extremely rapidly

0 _____ 100

Approach Task: Instructions to Subjects

1. WALK UP TO THE CONTAINER.

2. RATE THE PEAK LEVEL OF FEAR YOU EXPERIENCE JUST BEFORE YOU REMOVE THE COVER:

No fear at all 0 _____ Terrifying fear 100

3. REMOVE THE COVER AND TOUCH THE RED MARK (OR AS CLOSE TO THIS AS YOU CAN GO).

4. RATE THE PEAK LEVEL OF FEAR YOU EXPERIENCED WHEN YOU TOUCHED THE RED MARK (OR WHEN YOU WERE AS CLOSE TO THIS AS YOU COULD GO):

No fear at all 0 _____ Terrifying fear 100

5. WERE YOU ABLE TO TOUCH THE RED MARK ? Circle one: YES / NO. IF NOT, HOW CLOSE DID YOU GO ? (GIVE DISTANCE IN INCHES OR CENTIMETRES).....

6. NOW PLEASE RETURN TO YOUR SEAT.

Further Ratings for Approach Task

DIRECTIONS. Please complete the following questions about the task that you just performed.

(1) WHEN YOU LIFTED THE COVER AND WENT TO TOUCH THE RED MARK, HOW MUCH CONTROL DID YOU HAVE OVER WHETHER THE SNAKE TOUCHED YOU?

No control at all 0 _____ 100 Complete control

(2) HOW DANGEROUS WAS THE SNAKE ?

Not dangerous at all 0 _____ 100 Extremely dangerous

(3) HOW UGLY WAS THE SNAKE ?

Not ugly at all 0 _____ 100 Extremely ugly

(4) WHEN YOU LIFTED THE COVER AND WENT TO TOUCH THE RED MARK, HOW SAFE DID YOU FEEL ?

Not safe at all 0 _____ 100 Completely safe

(5) HOW MUCH DISGUST DID YOU FEEL WHEN YOU SAW THE SNAKE ?

No disgust at all 0 _____ 100 Extreme disgust

(6) HOW LONG WAS THE SNAKE ? (Give your answer in whatever unit of measurement you wish; feet, inches, metres, centimetres, etc.).....

(7) WHEN YOU LIFTED THE COVER AND WENT TO TOUCH THE RED MARK, HOW FAST DID THE SNAKE MOVE ?

Did not move at all 0 _____ 100 Moved extremely rapidly

Snake Characteristics Questionnaire

INSTRUCTIONS. For each pair of words, circle the word that would be more likely to describe a snake that was dangerous and unsafe.

A SNAKE WOULD BE MORE LIKELY TO BE DANGEROUS AND UNSAFE IF IT WAS ...

1. ACTIVE / INACTIVE
2. TIMID / INQUISITIVE
3. PREDICTABLE / UNPREDICATABLE
4. UNCONTROLLABLE / CONTROLLABLE

Debriefing

The experiment that you have just completed is part of an investigation into the factors that influence the level of fear that people experience in a fear-evoking situation, and how this related to the amount of fear that they expect to experience. Various measures, such as state and trait anxiety, taken prior exposure to a fearful situation, will provide useful information about this relationship.

A question of particular interest concerns the accuracy of the fear predictions that people make. A related question is how people develop fear expectancies. By sampling people's stimulus expectations, as well as taking measures of state and trait anxiety, the cognitive bases of fear expectancies can be explored.

Some people find that they tend to expect the worst when there is little information about the nature of the feared stimulus. This is a well-known, yet poorly understood phenomena. The various ratings you have completed will hopefully help us to improve our understanding of why some people tend to expect fearful situations to be worse than they usually are. One question of interest is how people process information that is relevant to the feared stimulus.

If you wish to obtain further information about this phenomenon, a review article has been published by Dr. S. Rachman and S. Bichard, entitled "The overprediction of fear." This appeared in the Clinical Psychology Review, 1988, vol. 8, pp. 303-312. Thank you for your participation. If you have any further questions you may contact Steven Taylor.

APPENDIX 11. EXPERIMENTER EFFECTS FOR EXPERIMENT 3

Three experimenters were used in the present study. One of the experimenters was the author (ST), who tested 38.75% of subjects. The remaining experimenters tested 37.92% (EG) and 23.33% (JZ) of subjects. Experimenter EG had no knowledge of the experimental predictions or the aims of the experiment, whereas JZ had some knowledge of the aims and predictions. A series of analyses were performed in order to determine whether there was any evidence of experimenter bias as a function of knowledge about the experimental hypotheses. Significant interactions between the Experimenter factor and the other independent variables may be taken as evidence of experimenter bias. (A significant Experimenter main effect does not constitute evidence of bias.)

To determine whether there were differential experimenter effects, a two-way MANCOVA was performed. The independent variables were Experimenter (ST, JZ, and EG) and Information condition (four levels; control, danger, safety, and enhanced safety). The dependent variables were FP1, FP2, FR1, and FR2. The Information x Experimenter interaction was not significant at the multivariate level [Pillai $F(24, 640) < 1.00$, $p > .1$]. All of the corresponding univariate analyses were nonsignificant [$F(6, 160) < 1.60$, $p > .1$, for each dependent variable].

The question of experimenter effects was also investigated by an analysis of the difference scores, OP1 and OP2 (where OP1 = FP1 - FR1, and OP2 = FP2 - FR2). A two-way ANCOVA was performed for each of OP1 and OP2. For OP1, the independent variables were Experimenter and Information level, and the covariate was FP1 (cf. Cronbach & Furby, 1970). The assumption of homogeneity of regression was not violated [$F(6, 154) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 159) = 19.48$, $p < .0005$]. The Experimenter by Information interaction was not significant [$F(6, 159) < 1.00$, $p > .1$].

OP2 was the dependent variable in the second ANCOVA, and the independent variables were Information and Experimenter. The covariate was FP2. The assumption of homogeneity of regression was not violated [$F(6, 154) < 1.00$, $p > .1$], and the covariate was significant [$F(1, 159) = 13.84$, $p < .0005$]. The Experimenter by Information interaction was not significant [$F(6, 159) = 1.53$, $p > .1$].

These results show that there was no evidence of experimenter bias. As in Experiments 1 and 2, this is not surprising since most of the experiment simply required the subject to work through a test booklet.