

## Effects and Aftereffects of Stressor Expectations

Shirlynn Spacapan  
University of Oregon

Sheldon Cohen  
Carnegie-Mellon University

Is stressor exposure necessary to produce "stress" effects, or can these effects result from stressor anticipation alone? The present research explores whether it is possible to obtain "stress responses" *during* and *after* the period in which stressor exposure is being anticipated. In the first study, the expectation of submerging one's hand in ice water resulted in decreased frustration tolerance and increased blood pressure when compared with control groups not expecting this stressor. A second study replicated and extended these results to show that the expectation of control over the stressor ameliorates the negative impact of stressor expectation. The second study also examined the aftereffects of expectations. Particularly, it found that despite being relieved of the expectation that they would immerse their hand in ice water, subjects who had expected stressor exposure had decreased frustration tolerance when compared with either subjects who had expected a nonstressful procedure or those who had expected to have control over stressor termination. A third study, using noise as the expected stressor, replicated both the aftereffect of the anticipation period and the moderation of that effect by perceived control. The discussion (a) focuses on the implications of this work for understanding why aftereffects occur and (b) proposes that previously observed stressor exposure effects may in fact be postexpectation effects.

In recent years, cognitive models of the stress process have dominated the environmental stress literature. In particular, Lazarus's (1966, 1980) proposal that stress arises only in situations that are *appraised* as threatening, challenging, or otherwise demanding has become gospel among psychologists studying stress. Empirical work related to the cognitive model has focused almost exclusively on the role of various cognitive factors in lessening or totally ameliorating the effects of stressor exposure. For example, Lazarus's (1966) early work established the importance of coping

strategies in moderating physiological reactivity to stressful movies, and work by other investigators (cf. Baum & Valins, 1977; Cohen, Glass, & Phillips, 1979; Glass & Singer, 1972; Seligman, 1975) established the role of perceived control over the stressor (ability to avoid, escape, or lessen the stressor) in moderating whether various stressors cause increased arousal, deficits in performance, and other stress-induced effects. However, existing work has not addressed the ultimate question posed by the cognitive stress model. Specifically, is stressor exposure necessary to produce stress effects or can these effects result from merely *thinking about* an imminent stressing experience? If the latter is true, the mere (and imminent) anticipation of exposure to a situation that is appraised as stressful would result in the same effects and aftereffects found for those actually exposed to the stressor.

There is some evidence that the expectation of stressor exposure results in effects similar to those found during exposure. For example, the work of Baum and his colleagues (Baum & Greenberg, 1975; Baum & Koman, 1976) suggests that the expectation of being in a socially or spatially dense situation is sufficient to produce effects similar to those that occur

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Requests for reprints should be sent to Sheldon Cohen, Department of Psychology, Carnegie-Mellon University, Pittsburgh, Pennsylvania 15213.

under crowded conditions. In these studies, subjects expecting crowded conditions chose more distant, solitary positions (avoiding contact with a confederate) and reported more discomfort before they were actually crowded than subjects not expecting crowded conditions. In addition, subjects expecting to be crowded rated the setting as already more crowded, more stuffy, and less comfortable and reported less liking for the two confederates present.

Data on physiological changes similarly suggest that the anticipation period is as stressful if not more stressful than the exposure period. For example, anticipating an injection of dental anesthetic resulted in no less an increase in serum hydrocortisone than did actually receiving the injection (Shannon & Isbell, Note 1). Moreover, two studies found greater elevations in skin conductance and heart rate during the period of anticipating viewing a portion of a film with a gory woodshop accident than during the actual viewing of the incident (Birnbaum, 1964; Nomikos, Opton, Averill, & Lazarus, 1968).

There is also evidence that the expectation of control over the anticipated stressor reduces negative effects. In one study, the possibility of controlling shock reduced subjects' pulse rate and volume to the level of subjects not threatened by shock during a 90-sec anticipation period but not during a subsequent performance period (Solomon, Holmes, & McCaul, 1980). In another study, pulse rate was higher for subjects expecting a shock in 30 sec, regardless of potential control; however, control did raise skin resistance (i.e., lower stress) and lessen self-reported anxiety somewhat (Holmes & Houston, 1974).

In sum, there is evidence that the anticipation of stressor exposure results in increased physiological arousal, behavioral coping, and self-reported stress. This increase is sometimes more pronounced during the anticipatory period than during exposure to the stressor. Moreover, interventions that provide subjects with an expectation of being able to control the stressor may reduce these effects.

The present research is an attempt to extend the work on the effects of stressor expectations during the anticipatory period. It tests the generality of the work on anticipatory periods cited above (Experiment 1 and 2) and includes

the first test of the possibility that there are *aftereffects* of the anticipatory period (Experiments 2 and 3). Our premise is that if stressor anticipation is equivalent to stressor exposure, one would expect the same effects found during and after exposure to occur during and after anticipation.

The dependent measures used in our studies are several that have been found to be affected after stressor exposure is terminated. Exposure effects that we will attempt to replicate with anticipation include decreased tolerance for frustration (e.g., Glass & Singer, 1972; Rotton, Olszewski, Charleton, & Soler, 1978; Sherrod, Hage, Halpern, & Moore, 1977; Wohlwill, Nasar, DeJoy, & Foruzani, 1976), increased blood pressure (e.g., Cohen, Evans, Krantz, & Stokols, 1980; Spacapan & Cohen, Note 2), and increased self-reported physical symptoms (Pennebaker, Burnam, Schaeffer, & Harper, 1977).

### Experiment 1

The purpose of the first study was to test the hypothesis that the anticipation of stressor exposure results in the same deleterious effects that have been observed in previous studies in which subjects were actually exposed to a stressor. Thus, the dependent measures were administered during the period in which subjects anticipated stressor exposure.

### Method

#### Design

Subjects were recruited to participate in two "environmental psychology experiments." They were not told at this point that they would be exposed to a stressor but only that we were studying the effects of different environmental factors on human behavior. Some specifics about what they would be doing were also revealed, for example, that their blood pressure would be taken, they would be working on some puzzles, and so on. They were also told that participation involved two different experiments that would be spread over two sessions separated by 48 hours.

During the first session, three fourths of the subjects were given the experience of immersing a hand in ice water. This procedure was used because pilot studies had indicated that previous experience with this particular stressor resulted in uniformly stressful expectations when the stressor was presented again. In order to test for the (unlikely) possibility that this immersion experience would affect (poststimulation) performance on the dependent variables administered during the second session (2 days later), a control group of one fourth of the subjects immersed their hands in room-temperature water.

The subjects were told that the second experimental session was to be split between two short experiments. The first part of the session would involve completion of the water immersion study, whereas the second part of the session would be dedicated to a study of human task performance being conducted by another experimenter. By separating the experimental manipulation (administered as part of the first experiment) and the administration of the dependent variables (part of the second experiment), we were able to avoid the possibility that exposure to an aversive condition would lead to negative attitudes toward a particular experimenter or experiment and hence an expenditure of less effort on the dependent tasks. Moreover, by keeping the second experimenter blind to the experimental condition, the possibility of experimenter bias was eliminated.

*Experimental conditions.* During the first part of the second session, subjects who had experienced the ice-water immersion during the first session were led to believe that they would either immerse their hands in ice water (*cold-cold* condition), immerse their hands in room-temperature water (*cold-warm* condition), or perform a nonstressful movie-rating task (*cold-no-expectation* condition). Those subjects who immersed their hands in room-temperature water during the first session were all led to expect room-temperature water during the second session (*warm-warm* condition).

### Subjects

The subjects were 32 male and 31 female undergraduates enrolled in a introductory level psychology course. Participation in both sessions resulted in one unit of extra credit. Subjects were randomly assigned to the four experimental conditions.

### Procedure

*Session 1* Subjects were run individually. Upon arrival at the laboratory, baseline measures of blood pressure were obtained on the Automatic Blood Pressure Recorder, Sphygmometrics Model SR2. A 14-item measure of self-reported physical symptoms was also administered (Pennebaker et al., 1977). The subject was then led to an adjacent room containing the cold pressor apparatus. Three fourths of the subjects were seated in front of a metal pan of water and floating ice (kept at 1 °C). They read a consent form describing previous painful cold pressor experiments and informing them of their subsequent immersion (*cold* pretreatment). The remaining one fourth entered the room containing the same apparatus. However, in this condition the water was kept at 20–25 °C, no ice was present, and the consent form described soaking one's hand in room temperature water (*warm*<sup>1</sup> pretreatment). After the subject had signed the consent form, the experimenter described the procedure. Subjects were to hold the hand that they did not use for writing in the water, palm flat on the bottom surface. The experimenter would tell them when to remove their hand. In the *cold* condition, the words *ice water* were emphasized, whereas in the *warm* condition, the words *room temperature* were substituted for *ice*. All subjects consequently submerged their hand for 45 sec. This procedure provided them with an experience with the stressor on which to form subsequent expectations.

Finally, subjects were thanked and reminded of their appointment for the next session.

*Session 2* The second session took place 2 days later. Upon arrival at the laboratory, a subject was taken to the room that had previously contained the cold pressor apparatus. All subjects who had received the *warm* pretreatment were again presented with the 20–25 °C water and the "room temperature" consent form (*warm-warm* condition). Subjects who had received the *cold* pretreatment were randomly assigned to one of three groups: One group again confronted the 1 °C ice water and the cold pressor consent form (*cold-cold* condition); one group was presented with the 20–25 °C water and the "room temperature" consent form (*cold-warm* condition); one group saw no cold pressor apparatus but was presented with a rating form for 10 current films and an innocuous consent form to allow use of the information they would provide on various scales (*cold-no-expectation* condition).

After subjects had signed the consent form, the experimenter detailed the procedure. The instructions for the immersion conditions were identical to those used in Session 1, with the exception that the *cold-expectation* subjects were told the water would be "a bit colder" and they would have their hands in "a little longer" than in Session 1. This sentence was added in order to maximize the level of anticipated stress. *Warm-expectation* subjects were told the water would be "a bit warmer" and their hands would be immersed a shorter period of time. The film-rating form was explained to the no-expectation subjects. The experimenter then administered the Physical Symptoms Checklist as well as an experimental questionnaire assessing the expectations of stress, pain, and water temperature and took the subject's blood pressure.

At this point, the experimenter explained that scheduling constraints required the subject to participate in the "second experiment" immediately and then return later to finish the "first experiment" (water immersion or film rating). Subjects agreed and were led to an adjacent room, where the second experimenter administered a two-puzzle version of the Tolerance for Frustration task (Feather, 1961; see also Glass & Singer, 1972).

In this version of the Tolerance for Frustration task, the subject is presented with two piles of line diagrams. Each pile is approximately 1 in. (2.54 cm) tall and contains multiple copies of the same diagram. The diagrams are printed on 5 × 7 in. cards and placed face down in front of the subject. The task is to trace over all the lines of the diagram without lifting pen from card and without tracing over any lines twice. The piles were placed in a specific order such that the subject would work first on an unsolvable diagram and then on a solvable one. Subjects could take as many trials on a given diagram as they wished. The subject could choose to continue working on the same diagram or move on to the next pile (diagram) at any time, but the subject could not return to the first pile after proceeding to the second. If the subject suc-

<sup>1</sup> In Experiments 1 and 2 the nonstressful control procedure involved the immersion of the subject's hand in room temperature water of 20–25 °C. For the sake of simplicity, this condition is not labeled *room temperature* but *warm* throughout the article.

cessfully completed the task for diagram one, he or she was to proceed to the second pile immediately. The total time allotted for the task was 10 minutes. The amount of time spent on each diagram was recorded. The more time spent on the unsolvable diagram (Diagram 1), the greater was his or her tolerance for frustration (see Feather, 1961, for a full description of the task and its development).

When the subject finished this task, the experiment, for our purposes, was complete. Extensive pilot testing, however, had revealed that failing to follow through with the expectations we had manipulated resulted in suspicion and mistrust. Consequently, subjects returned to the first experimenter and submerged their hands for 1 minute (or, as appropriate, rated films). All subjects were then debriefed and had their height and weight measured (for use in the analysis of blood pressure data).

### Results

#### Manipulation Check<sup>2</sup>

When asked to estimate the expected water temperature on a 7-point scale (1 = 108 °F, 4 = 70 °F, 7 = 32 °F), *cold-cold* ( $M = 6.53$ ), *warm-warm* ( $M = 3.81$ ), and *cold-warm* ( $M = 3.75$ ) subjects expected the different temperatures as manipulated,  $F(2, 44) = 99.15$ ,  $p < .001$ ,  $\omega^2 = .81$ . Subjects expecting the cold pressor (*cold-cold*) felt the experience would be more stressful than either *cold-warm*- or *warm-warm*-expectation subjects ( $M_s = 4.53$ , 1.50, 1.50, respectively, where 1 = not at all, 7 = very),  $F(2, 44) = 47.27$ ,  $p < .001$ ,  $\omega^2 = .66$ . *Cold-cold* subjects also expected the experience to be more painful than *warm-warm* or *cold-warm* subjects ( $M_s = 5.07$ , 1.06, 1.31, respectively, where 1 = not at all, 7 = very),  $F(2, 44) = 175.67$ ,  $p < .001$ ,  $\omega^2 = .88$ . For each of the preceding three analyses, post hoc comparisons by Scheffé's method were made. In each case *cold-cold* was different from *cold-warm* and *warm-warm* (all  $ps < .05$ ), whereas the latter two conditions did not differ from each other.

#### Tolerance for Frustration

The time spent on the first (unsolvable) diagram was the measure of frustration tolerance. As Table 1 indicates, subjects expecting the cold pressor (*cold-cold*) spent less time on the task than subjects in all other conditions,  $F(3, 59) = 17.05$ ,  $p < .001$ ,  $\omega^2 = .43$ . Post hoc comparisons, by Scheffé's method, revealed that the three nonstressful conditions (*warm-warm*, *cold-warm*, *cold-no* expectation) did not differ from one another, whereas all were

Table 1  
Mean Seconds Spent on an Unsolvable Diagram  
(Experiment 1)

| Expectation       | Sec.   | n  |
|-------------------|--------|----|
| Warm pretreatment |        |    |
| Warm              | 365.88 | 16 |
| Cold pretreatment |        |    |
| Cold              | 145.33 | 15 |
| Warm              | 408.94 | 16 |
| No                | 380.50 | 16 |

different from the *cold-cold* condition (all  $ps < .05$ ).

#### Physiological Arousal

Two judges independently coded the blood pressure data from paper discs recorded by the blood pressure machine. Correlations between judges ranged from .79 to .96 (all  $ps < .001$ ). The judgments were then averaged across judges to produce one baseline systolic reading, one baseline diastolic reading, one preexposure (i.e., taken before exposure to stressor but after the manipulation of expectations) systolic reading, and one preexposure diastolic reading for each subject. Preexposure systolic blood pressure was examined in a covariance analysis in which the covariates were a measure of ponderosity (weight/height<sup>3</sup>) and the subject's baseline systolic pressure. This analysis revealed a significant effect,  $F(3, 57) = 3.11$ ,  $p < .03$ ,  $\omega^2 = .60$ . As apparent from Table 2, this effect is due to the increased systolic blood pressure of subjects expecting the cold pressor. A similar trend was observed for diastolic blood pressure,  $F(3, 57) = 2.38$ ,  $p < .08$ ,  $\omega^2 = .43$  (see Table 2).

#### Physical Symptoms

Analysis of self-reported physical symptoms revealed no effect of the experimental manipulation when initial symptoms-reported was

<sup>2</sup> Results reported in this section are from the questionnaire administered to subjects in the immersion conditions only. This questionnaire would have made little sense to the no-expectation subjects.

Table 2  
Mean Blood Pressure (Experiment 1)

| Expectation       | Systolic | Diastolic | <i>n</i> |
|-------------------|----------|-----------|----------|
| Warm pretreatment |          |           |          |
| Warm              | 115.66   | 66.85     | 16       |
| Cold pretreatment |          |           |          |
| Cold              | 121.83   | 71.36     | 15       |
| Warm              | 113.05   | 69.39     | 16       |
| No                | 117.04   | 67.18     | 16       |

Note: Mean blood pressure reported is adjusted for ponderosity and initial blood pressure measured.

used as a covariate and the dependent measure was preexposure symptoms-reported.

### Summary

Those expecting the stressor showed less tolerance for frustration and increased blood pressure than subjects expecting the non-stressful control procedures. The absence of differences between the *cold-warm* and *warm-warm* control conditions suggests that these results are not due to aftereffects of previous stressor exposure in Session 1 of this study. The absence of differences between the *cold-no-expectation* and the other two control conditions (*cold-warm* and *warm-warm*) suggests that increased blood pressure and decreased tolerance for frustration when expecting a stressor are not simply due to having to immerse one's hand in water.

### Experiment 2

The second study in this series was designed with three purposes in mind. The first purpose was to replicate the results obtained in the previous experiment. Thus, one group of subjects was led to expect ice-water immersion, whereas a second group expected room-temperature water. As in Experiment 1, the dependent measures were administered before exposure to the stressor.

The results of Experiment 1, and the replication described above, pertain to effects that occur *during* the anticipation period. The second purpose of the present study was to explore the possibility that there are effects of the anticipation period that occur *after* the expectation of stressor exposure has been termi-

nated. Hence, in each of the conditions, half of the subjects were told, just prior to immersion, that they would not have to immerse their hand after all. If the anticipation period has effects that are similar to actual exposure, we would predict that subjects who were relieved of having to immerse their hands in ice water would still show decreased frustration tolerance in comparison with those relieved of room-temperature water immersion.

The third purpose of the present study was to extend the results of Experiment 1 to include the full paradigm usually used in aftereffects studies. The typical design of aftereffects research, as conducted by Glass and Singer (1972) and others, involves three conditions: a condition in which subjects are exposed to a stressor; a nonstressful comparison condition; and a third condition in which subjects are exposed to the stressor but told that they can, if they so desire, terminate the stressor (see Cohen, 1980, for a full review). Such perceived control has been found to ameliorate or lessen the negative aftereffects of stressor exposure. In the present study, this perceived control condition was added by telling one third of the subjects that although they were going to be exposed to the cold pressor again, they could decide to remove their hand from the ice water if necessary. Our hypothesis, in this regard, was that expectations of perceived control would alleviate the negative effects associated with expecting to be exposed to the cold pressor, both during and after the anticipatory period.

### Method

#### Subjects

Ninety-one undergraduates (46 females and 45 males) were each randomly assigned to one of the six experimental conditions. The data collected from one subject in the perceived control condition were discarded, because she had exercised control in the postexperimental immersion. As in Experiment 1, all subjects were recruited to participate in "two separate, short experiments," one of which would require "two separate, short sessions." Participation in both sessions resulted in one unit of extra credit for the subject for an introductory psychology course.

#### Procedure

The first session was identical to the *cold* pretreatment of Experiment 1. In addition, an initial measure of the subject's mood was obtained with the Multiple Affect Ad-

jective Checklist (MAACL; Zuckerman, Lubin, & Robins, 1965). Because all subjects received the identical pretreatment in this experiment, the previously adopted convention of referring to conditions as *cold*— will be dropped.

**Manipulation of stressor factor.** The second session took place 2 days later. Upon arrival at the laboratory, a subject was taken to the room that had contained the cold pressor apparatus. One third of the subjects (*cold* condition) were treated as in the —*cold* condition of Experiment 1. The perceived control manipulation involved treating another one third of the subjects identically to the *cold* group with the additional instructions that "although I would really like you to keep your hand in the water for a predetermined length of time for the sake of my research, you may, if necessary remove your hand. Please let me know if you have to remove your hand so that I can stop my stopwatch . . ." (*cold* perceived control [PC] condition). The final one third of the subjects (*warm* condition) were treated identically to the —*warm* condition of Experiment 1.

The experimenter then gave the subject a manipulation check questionnaire to answer, and there was a knock at the door. The experimenter answered the door and excused herself. A muffled conversation was held outside the door. This procedure was deemed necessary in order to lend credence to the subsequent experimental manipulation.

**Manipulation of expectation factor.** After approximately 1 minute, the experimenter rejoined the subject. The experimenter waited in the room until the subject had completed the experimental questionnaire, as necessary. For half the subjects in each of the three different stressor conditions, the experimenter then announced that due to scheduling problems and a backlog of subjects, there would not be enough time to do both experiments. Therefore, the subject would not have to immerse his or her hand after all. Even though the subject was relieved of having to immerse his or her hand, the experimenter explained that she wanted to go ahead and take the subject's blood pressure and have the subject fill out the forms he or she had completed in the first session, as well as participate in the "second experiment" with the "other experimenter." The act of terminating the expectations in this manner provided the manipulation of the expectation factor and resulted in three of the conditions: *cold*-relieved, *warm*-relieved, and *cold* PC-relieved. Postexperimental interviews indicated that subjects believed this manipulation was sincere. Moreover, mood data indicating decreased anxiety and depression among relieved condition subjects (details reported below) provide further support for the effectiveness of the manipulation.

The remaining half of the subjects were given the same instructions as in Experiment 1. That is, they were told that due to scheduling problems and a backlog of subjects, they would not be immersing their hand right away, but would participate in that "second experiment" before immersing their hand. Thus, there were three additional conditions: *cold*-expected, *warm*-expected, and *cold* PC-expected. All subjects agreed to this change in plans. Their blood pressure was taken, and they again filled out the Physical Symptoms Checklist and the MAACL.

The subject was then led to an adjacent room where the second experimenter (blind to the subject's experimental condition) administered the Tolerance for Frustration task as in Experiment 1. After completion of the task, the subject returned to the first experimenter. Only

those subjects expecting to immerse their hand did so, in water of the appropriate temperature. All subjects were then debriefed and measured for height and weight.

## Results

### Manipulation Check

The pertinent measures assessing expected stress, pain, and water temperature were collected on the experimental questionnaire administered before the manipulation involving termination of expectations. Thus, differences would only be expected between conditions on the stressor factor (*cold*, *cold* PC, *warm*) and not on the expectation factor (relieved, expected). This data was first analyzed in a two-way analysis of variance (ANOVA) to ensure that no significant differences had randomly occurred between —expected conditions and their parallel —relieved conditions. No main or interaction effects for the expectation factor were obtained. Hence, the results for the manipulation checks were collapsed over the expectation factor and are reported only in terms of the stressor factor.

Three items of the questionnaire (expected water temperature, pain, and stress) were identical to the questionnaire items in Experiment 1. Subjects expected the water temperatures as manipulated (*warm*  $M = 3.80$ , *cold*  $M = 6.40$ , *cold* PC  $M = 6.60$ ),  $F(2, 87) = 191.82$ ,  $p < .001$ ,  $\omega^2 = .81$ . Subjects expecting the room-temperature water felt the experience would be less stressful (*warm*  $M = 1.87$ , *cold*  $M = 3.63$ , *cold* PC  $M = 3.17$ ),  $F(2, 87) = 13.45$ ,  $p < .001$ ,  $\omega^2 = .22$ , and less painful (*warm*  $M = 1.60$ , *cold*  $M = 4.53$ , *cold* PC  $M = 3.97$ ),  $F(2, 87) = 66.08$ ,  $p < .001$ ,  $\omega^2 = .59$ , than subjects expecting ice water. For each of the preceding three analyses, post hoc comparisons revealed that *warm* differed from *cold* and *cold* PC (both  $ps < .05$ ), whereas the latter two conditions did not differ from one another.

An additional item on the questionnaire measured subjects' perceived freedom to remove their hand from the water (where 1 = not at all free, 7 = very free). *Cold* PC subjects ( $M = 4.57$ ) felt more free to remove their hand from the ice water than either *warm* ( $M = 3.30$ ) or *cold* ( $M = 2.53$ ) subjects,  $F(2, 87) = 12.56$ ,  $p < .001$ ,  $\omega^2 = .20$ . Post hoc comparisons of *warm* versus *cold* PC and *cold* versus *cold* PC were both significant ( $p < .05$ ).

A final questionnaire item was included to provide a measure of current (as opposed to expected) self-reported "stress." Subjects in the *warm* condition felt less nervous than *cold* or *cold* PC subjects ( $M_s = 1.83, 2.60, 2.27$ , respectively, where 1 = not at all nervous, 7 = very nervous). This effect was also significant,  $F(2, 87) = 3.60, p < .03, \omega^2 = .06$ ; however, comparisons revealed that only the *warm* and *cold* conditions differed ( $p < .05$ ).

#### *Tolerance for Frustration*

The time spent on the first unsolvable diagram was the measure of frustration tolerance. A two-way ANOVA of time spent on Diagram 1 revealed a main effect for the stressor factor,  $F(2, 84) = 45.75, p < .001, \omega^2 = .51$ . Neither the main effect for the expectation factor nor the interaction term was significant (both  $F_s < 1$ ). As Table 3 indicates, subjects in the *cold*-expected and *cold*-relieved conditions spent the least time on the task before going on to the second diagram. This is supported by post hoc comparisons that reveal that although the mean time spent on the diagram was no different for *cold*-expected and *cold*-relieved, each of these means was different from those obtained for all other conditions (all  $p_s < .05$ ).

#### *Physiological Arousal and Physical Symptoms*

Data collected on these measures were handled as in Experiment 1. For the blood pressure data, correlations between judges ranged from .93 to .99 (all  $p_s < .001$ ). There were no effects of the experimental manipulations on these measures.

#### *Mood*

The MAACL provided four measures: one scale for each of the moods of depression, anxiety, and hostility, and an overall mood measure (a combination of the three scales). Each of these measures was analyzed separately using the subject's initial score on the measure as a covariate and the postmanipulation score as the dependent variable. Such analyses of the overall mood measure and the hostility scale revealed no effects of the experimental manipulations. Marginal main effects for the expectation factor were found for postmani-

Table 3  
*Mean Seconds Spent on an Unsolvable Diagram (Experiment 2)*

| Expectation | Stressor |        |         |
|-------------|----------|--------|---------|
|             | Cold     | Warm   | Cold PC |
| Expected    | 208.47   | 498.40 | 443.67  |
| Relieved    | 201.20   | 451.27 | 478.27  |

Note PC = perceived control.

pulation anxiety,  $F(1, 83) = 3.25, p < .075, \omega^2 = .03$ , and depression,  $F(1, 83) = 3.18, p < .08, \omega^2 = .01$ . As can be observed in Table 4, subjects in the expected conditions were more anxious and more depressed than subjects in the relieved conditions.

#### *Summary*

As in Experiment 1, subjects who expected to be exposed to the stressor showed less tolerance for frustration than those who expected only the nonstressful procedure. In addition, subjects with perceived control over the stressor showed increased frustration tolerance relative to subjects who expected stressor exposure without control.

Effects similar to those found during the expectation period (expected condition) were found *after* the expectation had been terminated (relieved condition). That is, subjects whose expectations of stressor exposure were relieved showed decreased frustration tolerance in comparison with the room-temperature water condition. Subjects who had expected to be able to control the length of time their hand was immersed in ice water did not show decreased tolerance for frustration. Moreover, evidence of decreased anxiety and depression on the part of \_\_\_-relieved subjects and anecdotal data collected during postexperimental interviews suggest that the manipulation involving termination of expectations was successful.

#### Experiment 3

The purpose of this study was to test the generality of the finding of an aftereffect of the anticipation period. Thus, "noise" was the anticipated stressor in this third study, and the

Table 4  
*Self-Reported Mood Anxiety and Depression*  
*(Experiment 2)*

| Expectation | Stressor |       |         |
|-------------|----------|-------|---------|
|             | Cold     | Warm  | Cold PC |
| Anxiety     |          |       |         |
| Expected    | 7.78     | 7.83  | 7.91    |
| Relieved    | 6.80     | 7.09  | 6.66    |
| Depression  |          |       |         |
| Expected    | 14.81    | 15.13 | 15.02   |
| Relieved    | 13.75    | 14.66 | 12.31   |

*Note.* Data reported are means, adjusted for initial measurements of each variable. Anxiety score may range from 0 to 21; lower numbers indicate less anxiety. Depression score may range from 0 to 39; lower numbers indicate less depression. PC = perceived control.

experimental procedure was similar to that of the \_\_\_-relieved conditions of Experiment 2. Three procedural changes were made, however. First, the Physical Symptoms Checklist was omitted due to a failure to find effects on this measure in the preceding two studies. Second, all subjects expected to perform a task as part of the "first experiment." This task (crossing out the letter *a* in columns of words) provided a convenient focus for subjects in the *quiet* condition who otherwise would have expected only to sit in the (quiet) laboratory. The third change involved a modification of the stressor pretreatment (Session 1) of the preceding studies. Pilot testing revealed that it was unnecessary to expose subjects to a separate session of the noise stressor. Consequently, the entire experiment was conducted in one session, and subjects were given one burst of noise on which to base their subsequent expectations.

### Method

#### Subjects

Fifty-five female subjects were randomly assigned to one of three experimental conditions. All subjects were recruited to participate in "two separate, short experiments" that together would take half an hour. Approximately half the subjects in each condition received one unit of extra credit for their participation; the remaining subjects were recruited through a local newspaper ad and were paid \$3 for participation.

#### Procedure

As in Experiments 1 and 2, subjects were run individually. Upon arrival at the laboratory, initial measures of the subject's blood pressure and mood (on the MAACL)

were obtained. All subjects were then presented with a pair of headphones and a consent form describing the experiment. The experimenter explained the "cross out *a*" task. Approximately one third of the subjects were also informed that they would be listening to bursts of noise played through the headphones while they worked on the task. The noise was described as the sound of a dentist drilling out a cavity, played at a sound level "about as loud as the level of a jackhammer if you walked past it while it was operating on the street" (*noise* condition). The subjects were then given several minutes to practice the task. During the practice session, they were given a sample burst of the noise (2 sec at 100 dB[A]).

The perceived control manipulation involved treating another one third of the subjects identically to the noise group. Additionally, these subjects were shown how a switch would turn on a light in the experimenter's control room. They were told that "although it is important for my research that you listen to all the noise . . . you may, if necessary, use this switch to alert me to stop the noise" (*noise PC* condition).

The remaining subjects were told only about the task of crossing out *a* (*quiet* condition). Neither the consent form nor the experimenter's instructions mentioned the noise. They were told that they would wear a pair of headphones (unplugged) to block out any "extraneous distractions." They, too, practiced the task while wearing headphones.

All subjects were then given manipulation check questionnaires to answer. The remainder of this experiment was identical to the \_\_\_-relieved conditions of Experiment 2. That is, subjects were told that they would *not* be exposed to the noise because of scheduling problems. They were then delivered to a different room with a different experimenter where they participated in the "task performance" experiment. Because the expectations of all subjects were terminated before measurement of the dependent variables, the previously adopted convention of referring to conditions as \_\_\_-relieved will be dropped.

### Results

Data collected on each of the dependent measures were first analyzed in two-way ANOVAs in which one factor was the "method of reimbursement" (paid or extra credit) and the other factor was the stressor condition. No main or interaction effects of the reimbursement factor was obtained. The results were then collapsed over the reimbursement factor and are reported only in terms of the Stressor factor in this section.

#### Manipulation Check

Data collected on the 7-point scales (where 1 = not at all, 7 = very) of the experimental questionnaire provided information on subjects' expectations of stressor exposure. Subjects expecting noise felt the experience would be more upsetting (*noise M* = 4.63, *quiet M* = 1.47, *noise PC M* = 3.82),  $F(2, 50) = 33.41$ ,

$p < .001$ ,  $\omega^2 = .55$ , and more stressful (*noise*  $M = 4.53$ , *quiet*  $M = 2.19$ , *noise PC*  $M = 3.59$ ),  $F(2, 49) = 10.50$ ,  $p < .001$ ,  $\omega^2 = .27$ , than subjects expecting the *quiet* condition. For both of these measures, post hoc comparisons by Scheffé's method reveal that *quiet* is different from *noise* and from *noise PC* (all  $ps < .05$ ), whereas the latter two conditions do not differ from one another. In addition, *noise* subjects felt more nervous (*noise*  $M = 3.05$ , *quiet*  $M = 2.06$ , *noise PC*  $M = 2.47$ ),  $F(2, 49) = 3.43$ ,  $p < .04$ ,  $\omega^2 = .09$ , about the experiment than the other two groups. Post hoc comparisons by Scheffé's method revealed that in this case, *quiet* differed from *noise* ( $p < .05$ ), whereas the mean for the *noise PC* group fell between the *noise* and *quiet* means. It did not differ from either.

Subjects who expected exposure to noise also answered a scale assessing the degree to which they felt free to have the noise stopped. Although subjects who expected to be able to control termination of the noise felt more free (*noise PC*  $M = 4.23$ ) than subjects without control (*noise*  $M = 3.79$ ), the difference was not significant.

#### Tolerance for Frustration

Time spent on the unsolvable diagram (Diagram 1) was the measure of frustration tolerance. An ANOVA on this measure revealed an effect of the manipulation,  $F(2, 52) = 6.13$ ,  $p < .004$ ,  $\omega^2 = .16$ . As Table 5 indicates, subjects who expected the noise without control spent the least time on the task. Post hoc comparisons support the fact that although the *noise* group was different from the *quiet* group and the *noise PC* group (both  $ps < .05$ ), the latter two conditions did not differ from one another.

#### Physiological Arousal and Mood

Data collected on these measures was handled as in Experiment 2. For the blood pressure data, correlations between judges ranged from .90 to .98 (all  $ps < .001$ ). There were no effects of the experimental manipulations on these measures.

#### Summary

As in Experiment 2, these data indicate an aftereffect of expecting to be exposed to an

Table 5  
Mean Seconds Spent on an Unsolvable Diagram  
(Experiment 3)

| Expectation   | No. Sec | <i>n</i> |
|---------------|---------|----------|
| Noise         | 280.95  | 20       |
| Quiet         | 424.59  | 17       |
| Noise with PC | 437.22  | 18       |

Note. PC = perceived control.

environmental stressor. Moreover, this study also provides a replication of ameliorative role of perceived control in this process. Unexpectedly, however, expectation of a stressor did not affect blood pressure levels.

#### Summary and General Discussion

This series of studies clearly demonstrates a stressor exposure effect (decreased tolerance for frustration) occurring as a result of stressor anticipation in the absence of actual stressor exposure. Hence, the anticipation of a stressful event is sufficient to cause this stress effect. In two studies, the expectation of immersing one's hand in ice water resulted in decreased frustration tolerance during the anticipatory period when compared with groups not expecting this stressor. When subjects' expectations of stressor exposure (either ice-water immersion or noise) were terminated in two of the experiments, decreased frustration tolerance was still observed in those subjects who had expected stressor exposure. Moreover, regardless of whether the stressor was ice-water immersion or noise, the expectation of control over stressor termination lessened the negative impact of stressor expectation both *during* and *after* the anticipation period. In sum, it is apparent that there are effects and aftereffects of the anticipatory period that are similar to those produced by actual exposure to a stressor.

Although the anticipation of control affected postanticipation performance, control was only marginally related to self-reported ratings of distress. Because the mean differences in Experiments 2 and 3 are both in the direction of control resulting in less distress, it is inviting to attribute the lack of a difference to the insensitivity and lack of reliability of one-item scales. It is worth noting, however, that Glass and Singer (1972, pp. 66 and 68) similarly found only marginal evidence for a relation-

ship between control and self-reported distress. (They also used one-item scales.) Hence it is possible that any effect of perceived control on self-rated distress is in fact quite small.

It is not totally clear why there were no reliable differences between stressor conditions in mood, blood pressure, and physical symptoms. Previous studies of the anticipation period have generally measured only an "anxiety" dimension of mood, and results have been inconsistent (cf. Holmes & Houston, 1974; Stotland & Blumenthal, 1964). When some measures of qualities that are moodlike have been obtained (e.g., comfort, feelings of aggressiveness), subjects expecting a stressor have reported more negativity than those not expecting the stressor (Baum & Greenberg, 1975; Baum & Koman, 1976). Although results from these studies are in contrast to our failure to find differences between conditions in mood, they do not actually assess traditional mood states. It is also worth noting, however, that these latter studies used a social stressor (crowding) in contrast to the nonsocial stressors (cold pressor and noise) used in our work.

With regard to blood pressure and physical symptoms, other studies of the anticipation period have not reported measuring these variables. Thus, it could be argued that each of these measures is only affected by actual exposure to a stressor and not by the anticipation of such exposure. Exposure to a stressor, however, is not the only difference between poststimulation research and the present study. In poststimulation research, more time passes between the initial expectation of exposure and the poststimulation of dependent variables than occurred between our manipulation of expectations and dependent measures. When investigators have manipulated the length of the anticipation period, longer periods have results in increased physiological response (cf. Nomikos et al., 1968). Although neither mood nor physical symptoms have yet been studied in relation to length of the anticipation period, it is possible that the lack of differences between conditions on these measures is attributable to insufficient time for subjects' mood, blood pressure, or physical symptoms to change between manipulation of expectations and measurement of these variables. It should be noted, however, that studies of poststimulation effects have not consistently found effects on these measures, whereas work with

the tolerance for frustration task has been consistent (cf. Cohen, 1980).

Although the present research is an addition to previous work showing increased physiological arousal, increased self-report of stress, and evidence of coping behavior during the anticipatory period, it raises several additional questions. First, it is unclear what mechanism is responsible for the observed decrease in tolerance for frustration. Second, given the demonstration of the powerful nature of stressor expectations, one might well question the actual contribution of stressor exposure in producing "poststimulation" effects. Finally, there is the question of generalizing these results to real-world stressors. Each of these issues is addressed below.

#### *Possible Mediators*

Heightened arousal, negative mood, and attentional overload are a few of the explanations that have been offered for the poststimulation effects of stressor exposure (see Cohen, 1980). It is noteworthy that effects and aftereffects of the anticipation period were obtained in the absence of evidence for these possible mediators. First, neither self-report nor physiological data support a heightened-arousal hypothesis. Although self-report data indicated that expected stress was greater when anticipating ice-water immersion or noise, in only one of the first two experiments was blood pressure affected by stressor expectations during the anticipatory period. In neither Experiment 2 nor 3 was self-reported anxiety affected by stressor expectations. Second, the lack of differences between stressor conditions in self-reported mood (Experiments 2 and 3) suggests that mood is likewise unaffected by the anticipation of stress exposure and hence plays a minor role (at best) in producing the frustration tolerance effects. Finally, it is difficult to argue that attentional capacity was seriously depleted in the present research, given the brevity of expectations and the absence of task demands during the anticipation period.

There are a number of explanations offered for the postexposure effect that are consistent with these results, although there is no direct evidence that they are applicable. For example, it is possible that those anticipating exposure to uncontrollable stressors use coping strategies

during the anticipation period and maintain these strategies even after the expectation is terminated. Similar "carryover effects," in which reinforced behavior persists outside of the experimental setting in which it was reinforced, have been found across a wide variety of experimental paradigms (cf. Bridger & Mandel, 1965; Manis & Ruppe, 1969). Although a particular strategy may be adjustive during the anticipation period, it may interfere with task performance after expectancy termination (cf. Cohen, 1980). Similarly, a preoccupation with the threatening situation may persist to some degree after expectation termination resulting in distraction that affects performance on postanticipation tasks.

It is worth noting that the fact that we find effects of anticipation that are analagous to the effects of exposure does not definitively indicate that these effects are mediated by the same mechanisms. However, the similarities are striking, and such an assumption is not unfounded at this point.

#### *Poststimulation Versus Postexpectation Effects*

Is it possible that previously observed during-stimulation and poststimulation effects are really "postexpectation" effects? There is reason to argue that it is the anticipation period and not the actual exposure to a stressor that is responsible for poststimulation effects reported by Glass and Singer (1972) and others (see Cohen, 1980). First, Experiments 2 and 3 demonstrated that stressor expectations are sufficient to produce aftereffects. Second, there is evidence that the expectation of stressor exposure results in effects usually found only during stressor exposure (Baum & Greenberg, 1975; Baum & Koman, 1976) and that longer anticipation periods are more aversive (Breznitz, 1967; Nomikos et al., 1968) just as are longer periods of stressor exposure (Wilkinson, 1969). Third, there is evidence that expectations of stressor exposure result in stress reactions that are equal to or greater than the reactions produced by actual exposure to the stressor (Birnbaum, 1964; Nomikos et al., 1968; Shannon & Isbell, Note 1). Finally, although the anticipation of a stressor results in increased physiological arousal compared with subjects not expecting a stressor (Folkins, 1970), the anticipation of being able to control the stressor can reduce such arousal (Stotland

& Blumenthal, 1964) and self-reported anxiety (Szpiler & Epstein, 1976) in much the same way as perceived control during stressor exposure reduces poststressor effects. Moreover, such control has been found to reduce arousal during the anticipation period but not during a subsequent performance period (Solomon et al., 1980). Taken together, the research on stressor anticipation suggests that not only is the anticipation period stressful but it is in some cases more stressful than exposure to the stressor itself. Given these demonstrations of the powerful nature of stressor anticipation, one might well question the actual contribution of stressor exposure in producing stressor effects. In other words, is it possible that both during-exposure and afterexposure effects reported in the literature are wholly or partly attributable to residual effects of the anticipation period? Although expectations of stressor exposure are *sufficient* to produce aftereffects, it remains for further research to demonstrate whether the manipulation of stressor expectation is *necessary* to produce similar effects during and after stressor exposure.

#### *Generality of the Effect*

It is apparent that the expectation of stressor exposure results in deleterious effects both during and after the period in which the stressor is being anticipated. These results must, however, be interpreted within the framework of the paradigm used in these studies. One generality issue has to do with the short anticipation periods used in this work. Studies of the effects of stressor anticipation on physiological arousal suggest that there are drastic changes in cognition and physiology that occur over the course of longer anticipation periods (Breznitz, 1967; Folkins, 1970). It is certainly possible that longer periods may also alter the effects reported above.

Another issue is the nature of laboratory stress studies. Both the research reported here and research reviewed earlier have focused on anticipation of laboratory stressors. Certainly, even the most naive of subjects knows that exposure to a laboratory stressor will be of short duration, localized in time and setting, and undoubtedly of minor consequence to that individual's present or future lifestyle. Thus it is particularly noteworthy that we obtained

quite replicable effects despite the mild threats and short durations involved in our studies. Of course, there are numerous real-world stressors that are also anticipated and that end quickly (e.g., exams, an errand in a crowded shopping mall, retrieval of items in the depth of one's freezer, etc.) to which these results may be generalized. It remains for further research, however, to demonstrate the generalizability of our findings to some of the more sobering life-threatening events individuals encounter in the real world.

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