# CONSISTENCY OF PERFORMANCE CHANGE AND AUTONOMIC RESPONSE AS A FUNCTION OF EXPRESSED ATTITUDE TOWARD A SPECIFIC STRESS SITUATION

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## I. Introduction.

Aviation occupations often require the performance of tasks under stressful conditions which may impair performance. Although a great deal of research on the effects of stress on performance has been reported, many problems still remain unanswered,[7] the foremost of which is the problem of individual differences in stress susceptibility.[5] It is well known that some individuals show performance impairment under certain stress conditions, some improve in performance, and others show no change.[9] Identification of the personality variables responsible for the differences in the behavioral and/or physiological response of individuals under stress, however, has generally not been too successful. This has been particularly true whenever general anxiety measures, such as Taylor's Manifest Anxiety Scale (TMAS),[15] have been used.[3,7] Recently, emphasis has been placed upon the individual's cognitive appraisal of a stress situation as a determining factor which may affect performance, i.e., an individual's attitude toward the object of stress may determine, to a considerable degree, his response to stress.[1,12]

The hypothesis that a subject's (*Ss*) attitude toward an object he considers threatening may account for much of the variance in stress susceptibility has received support from several recent studies. Hodges and Spielberger[6] reported significant heart rate differences between individuals classified as low fear of shock (LFS) types and those classified as high fear of shock (HFS) types on the basis of the individuals' prior expression of fear toward a threat of shock item embedded in a multi-item attitude questionnaire. More recently, Thackray and Pearson[16] found essentially the same heart rate relationships between HFS *S*s and LFS *S*s as were reported by Hodges and Spielberger. Both studies found that HFS *S*s exhibited greater increases in heart rate under a threat of shock condition relative to LFS *S*s. Additionally, Thackray and Pearson[16] reported significant performance differences between the HFS and LFS groups. It was found that HFS *S*s demonstrated significantly greater performance impairment on a perceptual-motor task (pursuit rotor (PR)) relative to the performance levels of the LFS *S*s. No *S* in this latter study was aware that threat of shock would be used as the stressor prior to the test phase of the experiment. Shock was not actually administered to any *S*. In addition, both studies showed no relationship between *S*'s expressed attitude toward fear of shock and scores obtained on the TMAS.

To the extent that an individual's perception of threat is specific to a given stressor, it could be predicted that any performance impairment occurring under that stressor would not occur under a different stressor which was not perceived as threatening. It could also be predicted that if a given stressor is perceived as threatening, any change in performance should not be specific to the particular task employed. However, rather than expose the same individual to a variety of stressors or a variety of tasks within a common stressor and then attempt to determine whether differences in perceived threat are related to performance differences as suggested by Opton and Lazarus,[12] an alternative would be to separate individuals in advance on the basis of differing attitudes toward specific situations. Thus, between-groups comparison of *S*s separated on the basis of a variable, such as an expressed attitude common to each group toward a specific stressor, with each group exposed to this single stressor, would eliminate some of the problems of a repeated measures design.[8,4,13]

The question of whether response consistency or lack thereof across stressors can be predicted from a knowledge of an individual's prior attitude toward the specific stressors is a separate issue which will not be treated here. The present study was designed, using a between-groups approach, to examine only the related question of whether or not relative performance change and physiological reactivity of *S*s classified according to their attitude toward a specific stressor are independent of the type of task when the stressor remains constant. It was predicted that (a) *S*s expressing a HFS would perform significantly below the level of *S*s expressing a LFS under a threat of shock condition, (b) that HFS *S*s would exhibit greater increases in heart rate than LFS *S*s under a threat of shock condition, and (c) that performance and heart rate changes for the HFS and LFS *S*s would exhibit consistent differences in the direction predicted in (a) and (b), above, for both a perceptual-motor and cognitive-interference type task.

## II. Method.

**Subjects.** *S*s were male undergraduates from the University of Oklahoma, ranging in age from 18 to 25 years. Selection of *S*s was based upon scores obtained from an attitude questionnaire containing items relating to a number of potentially stressful situations. The questionnaire was administered by an associate 1 month prior to the experiment. Each item was rated on a seven-point (equi-distance) scale ranging from "slightly concerned" to "strongly concerned." *S*s responding to the first two or last two equi-distance spaces of the "fear of shock" item under study were classified as HFS or as LFS types. From a larger group thus classified as HFS or LFS types, an associate randomly selected 20 *S*s from each classification as participants in the experiment. All *S*s were informed only that they had been randomly selected to participate in a motor-learning experiment.

**Apparatus.** Performance tasks consisted of a modified, commercial version of the Stroop Test,[14] called the Press Test (PT),[2] and a pursuit rotor (PR) (LaFayette Instrument Co., Model 2203A with hinged stylus) attached to a Hunter Model 120 A Klockounter (Series D). The PT task contained three separate parts. Part I required the *S* to write down the first letter of a series of color names printed in black ink; Part II required the *S* to write down the first letter of the color of a series of different colored circles. Part III consisted of color words printed in incongruent ink colors; the *S*'s task was to write down the first letter of the ink color and to ignore the name of the color. The PR was maintained at a speed of 60 r.p.m. throughout the experiment. Beckman biopotential electrodes attached to the lateral walls of the *S*'s lower rib cage were used to obtain heart rate (HR), which was recorded on a Beckman Type R Dynograph. Eye blinks, obtained from Beckman miniature biopotential electrodes attached immediately above and below the left eye, were recorded for a separate purpose and will not be reported here. An electrocardiogram (EKG) plate electrode was attached to the wrist of the *S*'s nonpreferred hand (the hand not normally used in writing) which served as a ground. The "dummy" threat of shock apparatus was an Applegate Model 230 stimulator. All *S*s performed while seated in a wooden cubicle containing the PR or the PT task. A one-way vision glass inserted in the front of the cubicle provided the experimenter (*E*) with an unobstructed view of the *S*. Two tape recorders were used for presenting all instructions.

**Procedure.** Half of the 20 HFS *S*s were assigned to the PT task and the other half to the PR task by means of a rotational schedule. The same procedure was followed for the LFS *S*s. If the first *S* was given the PR task, then the second *S* was given the PT task, etc. The *E* was given no knowledge by an associate as to any *S*'s HFS or LFS classification. *E* escorted each *S* to the experimental room and instructed him to be seated inside the cubicle. All further instructions were on tape recordings. Following an initial greeting, an explanation of the purpose of the experiment was given. The purpose was disguised to the extent that *S*s were not told anything about the experiment beyond the fact that they were being tested with respect to studying the effects of generalized muscle tension on learning, and that this was the reason for using electrodes. *S*s were also told that the purpose of the one-way mirror provided the *E* with the opportunity to know when to assist them in the event that the performance instructions were not entirely clear. Electrode attachments were then made and the Dynograph adjusted. (See Figure 1).

*S*s assigned the PT were given all three parts during the training phase, with each part consisting of five 20-second trials, with 20-second rest periods between each trial. Separation of

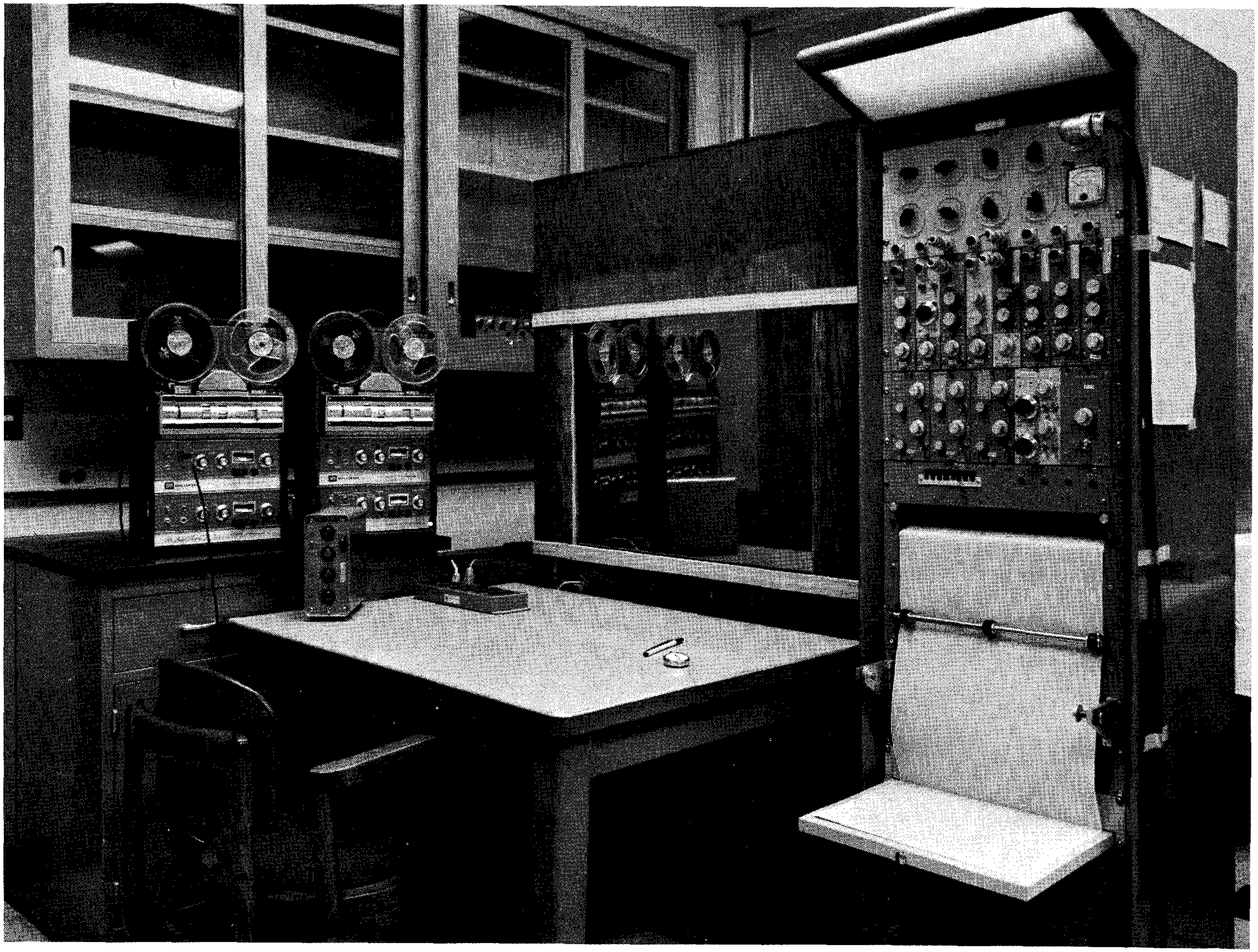

FIGURE 1. Photograph of equipment arrangement from the experimenter's position.

trials was accomplished by having the $S$ draw a line under the last response of each trial. The score consisted of the total correct responses minus errors. $S$s assigned the PR task were also given 15 trials with 20–second rest periods between each trial. The score of each trial consisted of the total time that the $S$ kept the stylus in contact with the metal target disk of the PR. The total time of each trial was recorded by the $E$. HR was recorded continuously throughout the experiment.

Following completion of the training phase, $S$s were given a 3–minute rest period after which identical test-phase instructions were played for $S$s assigned either the PT or PR task. All $S$s were informed that the next phase of the experiment would be essentially the same, except that now they would have to perform under threat of shock if they failed to maintain the average performance level established during the training phase; i.e., if their performance dropped below the previously obtained average score, they would receive an electrical shock. They were further told that the shock, should they receive it, would not be harmful but would be uncomfortable and that the $E$ had no control over the possible receipt of shock since the shock apparatus would be adjusted to automatically deliver electrical current should performance drop. The $E$ then turned off the recorder and placed the "dummy" shock apparatus in a position clearly visible to the $S$. A white cloth, which prevented the $S$ from seeing it prior to this time, covered the apparatus. Two EKG plate electrodes were then fastened to the $S$'s leg. The apparatus was plugged into a wall outlet which, in turn, illuminated a green "power-on" light. Two face dials were manipulated while the $S$ watched in order to enhance his belief that the apparatus was capable of delivering the promised electrical current. (See Figure 2). All $S$s were then given an additional five trials. Only Part III of the PT task, requiring complex discrimination judgments, was used for the testing phase since it was felt that the lack of task complexity of Parts I and II would result in too low a task demand with resultant loss of measurable response differences between the training and testing phase.

At the completion of the experiment all $S$s were requested to complete a post-experiment form containing an item designed to tap their feelings about the possibility of receiving shock. They were then congratulated for maintaining their performance average and thus avoiding shock. This was done to reduce $S$ rumor that no shocks were actually being used in the experiment.

## III. Results.

Prior to the introduction of the experimental condition, $t$ tests of mean differences between the HFS and LFS groups conducted on HR and on the PR and PT performance measures during training revealed no significant differences at the .05 level. Additionally, tests for homogeneity of variance between HFS and LFS groups on HR and performance measures indicated no significant differences. Training data selected for analysis consisted of the mean score and mean HR of the last five trials for both the PR and PT tasks.

Test phase performance measures for the PT consisted of the algebraic difference between each $S$'s mean score on the last five 20–second training trials (Part III), and his score on the first 20–second test trial (Part III). Although five test trials were given to each $S$, only the first trial was used in data analysis. This was deemed appropriate due to the fact that maximal effects of a threat of shock situation are generally obtained during the first trial, with progresssively less effect being present thereafter if the threat of shock is not reinforced. Further, it was felt that the most appropriate measure of the training phase should be the mean of the last five trials rather than the last trial itself in order to reduce error variance as much as possible. PR performance measures used in data analysis were obtained by the same method described above for the PT task. Likewise, HR measures consisted of the algebraic difference between the mean number of beats during the last five 20–second training trials and the number of beats during the first 20–second test trial. All HR scores were multiplied by three to convert them to a rate-per-minute base. The periods scored for HR were the same as those employed for performance analysis in order to make the data as comparable as possible.

In analyzing the test phase data, $t$ tests of the difference scores between training and testing for HFS and LFS $S$s performing the PT or PR task and HR were made. The summary analysis presented in Table 1 reveals significant performance

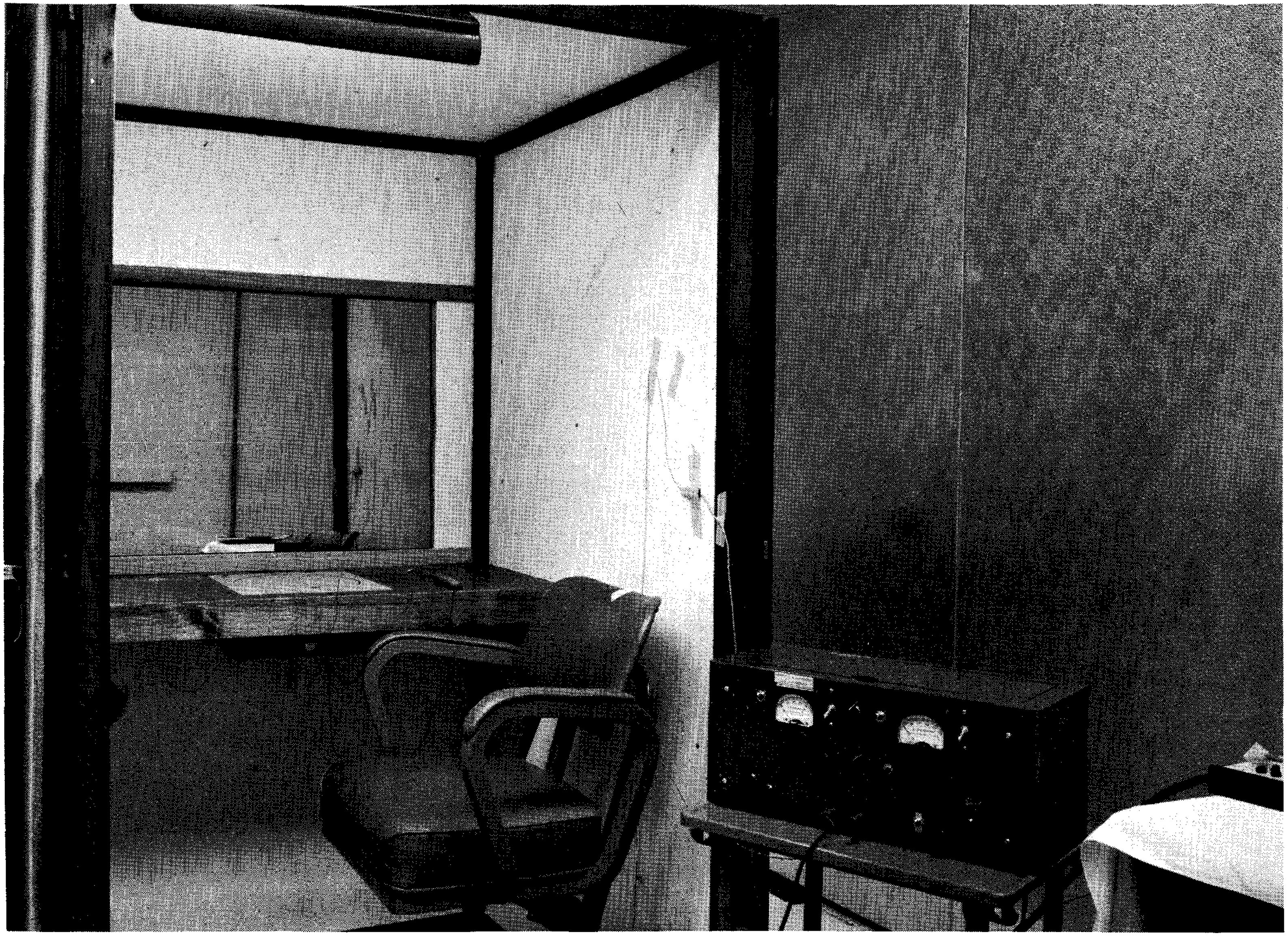

FIGURE 2. Photograph of equipment arrangement from the subject's position.

differences between the HFS and LFS *S*s for both the PR task ($p<.001$) and the PT task ($p<.01$) respectively, with HFS *S*s exhibiting relatively greater performance impairment. Significant HR differences were also found between the HFS and LFS groups. Table 2 shows that HFS *S*s assigned the PR task have significantly higher HR's relative to LFS *S*s ($p<.01$) and HFS *S*s assigned the PT task show similar differences in comparison to LFS *S*s ($p<.001$).

TABLE 1. Comparison of Mean Performance Change from Training to Testing Phase of High and Low Fear of Shock Subjects.

| Task | Group | Change Score | Variance | $t$ | $p$ |
|---|---|---|---|---|---|
| Pursuit Rotor | HFS | 0.57[1] | 2.05 | 4.52 | .001 |
| | LFS | 3.60[1] | 2.48 | | |
| Press Test | HFS | 0.70[2] | 2.03 | 3.73 | .01 |
| | LFS | 3.54[2] | 3.94 | | |

1. Mean Time on Target (secs.).
2. Mean Correct Responses.

TABLE 2. Comparison of Mean Heart Rate Change from Training to Testing Phase of High and Low Fear of Shock Subjects.

| Task | Group | Mean Heart Rate Change (bpm) | Variance | $t$ | $p$ |
|---|---|---|---|---|---|
| Pursuit Rotor | HFS | 25.2 | 192.10 | 3.27 | .01 |
| | LFS | 6.9 | 130.84 | | |
| Press Test | HFS | 26.0 | 26.22 | 4.22* | .001 |
| | LFS | 4.0 | 245.55 | | |

*Computations based on two sample t-test where variances are considered unequal (Walker and Lev 1953, pp. 157–158).

## IV. Discussion.

The results suggest that an attitude questionnaire may be used effectively to elicit differences between *S*s toward a possibly threatening object or situation, and that the subsequent behavioral manifestations of these expressed evaluations may be reliably reflected in terms of both performance and heart rate response patterns. The data thus confirm the previous findings of Thackray and Pearson[16] and suggest further that an individual's cognitive appraisal (expressed attitude) of a threatening object or situation may be subsequently manifested in a consistent manner irrespective of the task employed. This latter condition, however, may apply only within certain limits insofar as consistency across tasks is concerned. For example, Murphy[10] has shown that the introduction of some types of tasks may confound results due to the fact that the task itself may be stress inducing. This could have the effect of masking differences between groups exposed to a specific stressor despite prior classification of *S*s on the basis of their expressed attitude toward the externally imposed stress situation. Thus, it is necessary to determine the extent to which a task may differentially affect the performance and/or physiological reactivity of groups which have been classified *a priori* as different before the introduction of the stressor under investigation.

The results of this study, taken together with those of Hodges and Spielberger[6] and Thackray and Pearson[16] suggest that the direct, objective assessment of attitudes toward specific stress situations may have greater heuristic value in stress research than approaches which rely upon self-descriptive inventories of general anxiety.[11] To the extent that different degrees of threat may be elicited by different stressors, the assumption that "high anxious" individuals are also high in stress susceptibility, regardless of the nature of the stressor, may be one of the principle reasons for the lack of success of most self-descriptive anxiety inventories.[3] It should be noted that in neither the previous study by Hodges and Spielberger[6] nor the later study by Thackray and Pearson[16] was a relationship obtained between the TMAS and the "fear of shock" classification, although the "fear of shock" classification was highly predictive of behavioral response to the induced stressor of threat of shock. Thus, the use of general or nonspecific items, such as "more fearful than my friends," (a typical statement found in the TMAS) may connote fears of quite different stress situations to different individuals, all of whom may be classified as "anxious." If this is the case, it would seem more appropriate or advisable in stress research for an *E* to introduce stressors that are consistent with a *S*'s cognitive appraisal of the specific stressor, i.e., if a subject indicates fear toward a threat of shock situation it would be expected that significant performance or physiological changes would occur whenever shock or the threat of shock is introduced.

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