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RESEARCH ON BEHAVIOR IMPAIRMENT DUE TO STRESS: EXPERIMENTS IN IMPAIRMENT REDUCTION

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November 1958

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

One of the important features of the study is that its logical and psychological development was subjected to the careful review and critique of experts in the area of stress research after each phase of the study. Research evidence presented in this report and in the interim report (3) indicates that significant progress had been achieved toward the research goals and toward a greater understanding of human behavior under stressful conditions.

A major accomplishment of the study has been the development of a laboratory situation in which behavior impairment under stressful conditions can be cont.

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studied. The development of this situation makes feasible investigation into a number of importment problems in the area of stress research. Some of the more important of these problem areas have been described in this report.

PREFACE

The project staff takes this opportunity to extend its sincere appreciation for the cooperation and assistance of the following Air Force ROTC detachments:

Howard University

The Catholic University of America

The George Washington University

The following consultants reviewed and critiqued progress and plans at various stages of the study:

Dr. Irving Lorge, Teachers College, Columbia University

Dr. James G. Miller, Mental Health Research Institute, University of Michigan

Dr. Neal E. Miller, Yale University

Major Frederick H. Rohles, Jr., of the Unusual Environments Section, Engineering Psychology Branch, Aero Medical Laboratory, Wright Air Development Center, Wright-Patterson Air Force Base, Ohio 45433, served as the Contract Monitor for the Air Force.

This report is being entered in the scientific and technical information system as part of an on-going program to bring historical work, otherwise previously unavailable, to today's research community.

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I. Introduction and Review of Initial Experimental Research

This report presents the results of a series of exploratory studies which were designed to reduce behavior impairment due to stress in a standard laboratory situation. An earlier report (3) described the development of this laboratory situation. This earlier report related in detail the development of the research approach based on prior work by the American Institute for Research, the work of other investigators, and consultation with experts in the area of stress. The development and selection of tasks for the standard performance situation was described, as well as the development of stressful situations. The results of initial experimental work were reported in which behavior impairment in the standard laboratory situation was successfully demonstrated. The standard laboratory situation and these results are reviewed briefly below.

A. The Performance Situation

A number of tasks were selected or developed to measure some of the performances which had been found in prior work (2) to be impaired operationally. The tasks were selected or developed to measure eye-limb coordination, problem-solving, estimating closure rates, noticing changes in environment both inside and outside the aircraft, and selecting and manipulating controls. The tasks were assembled into an enclosure-simulator, controllable from the outside by experimenters. Two simulators were constructed. Figure 1 shows the arrangement of the simulators and the experimenter's desk. Figure 2 shows the arrangement of the tasks within each simulator. The tasks, together with their abbreviations as used in this report, and references to more complete descriptions of them are given below:

1. SAM Complex Coordination Test (CC) (4).
2. SAM Motor Judgment Test (MJT) (4).
3. SAM Direction Control Test (DCT (R)(rights) or DCT (E)(errors)) (4).
4. Inside Vigilance Task (V_I) (3).
5. Outside Vigilance Task (V_O) (3).
6. Math Test (M) (3).

The equipment was operated in 30-minute "missions." Subjects were required to perform the one psychomotor task which was lit at any one time (CC, DCT, or MJT). The task to be performed was changed and these

[1]This research was supported in part by the United States Air Force under contract No. AF 41(657)-39 monitored by the Unusual Environments Section, Engineering Psychology Branch, Aero Medical Laboratory, Wright Air Development Center.

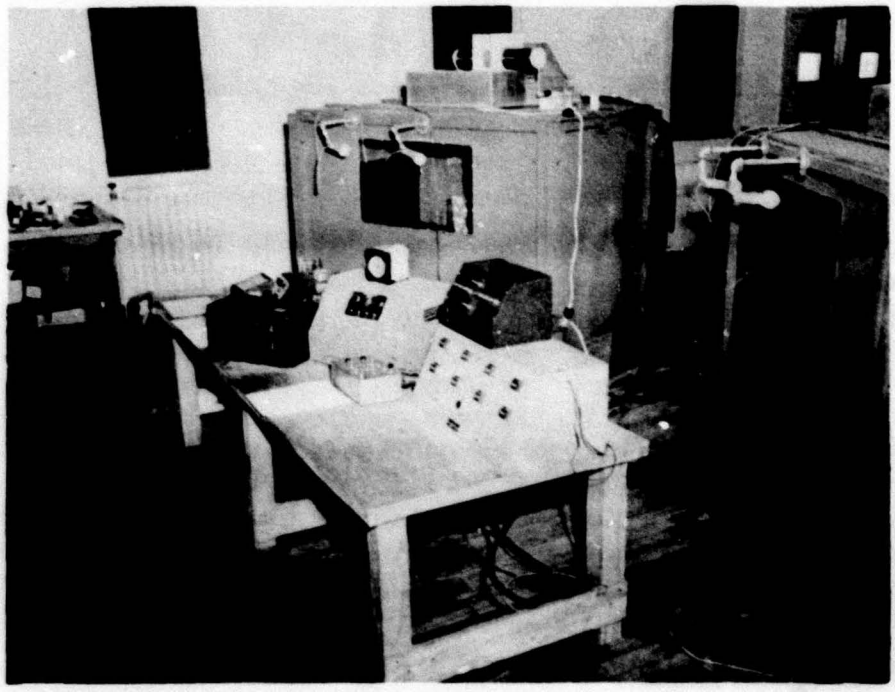

Fig. 1. Arrangement of Equipment

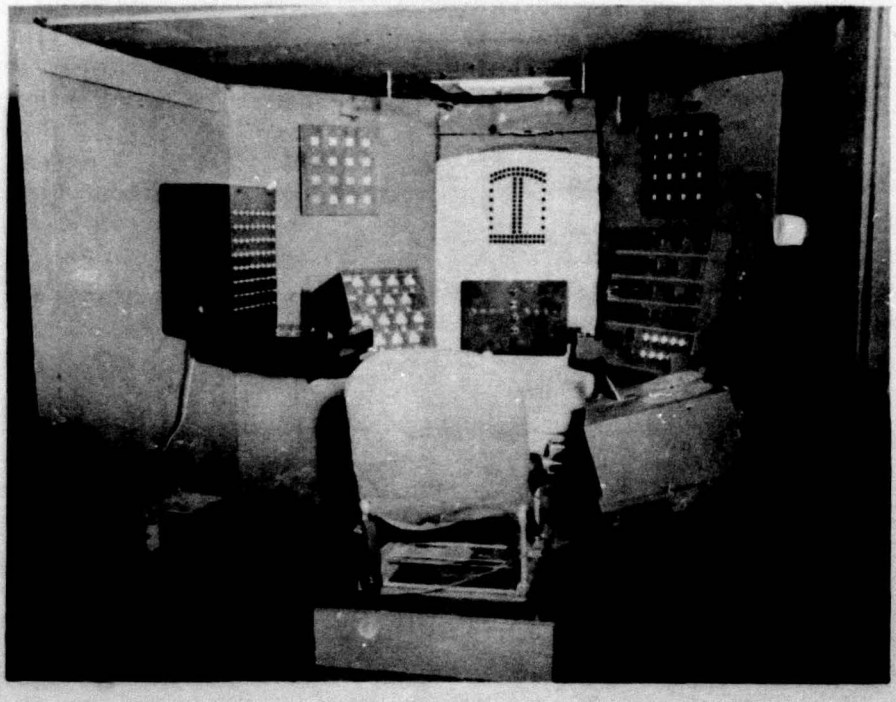

Fig. 2. Arrangement of Tasks

changes programmed to the subjects by the experimenter according to a predetermined schedule. V_I and V_O task responses were required to be made concurrently with performance on the psychomotor tasks, on a time-shared basis. Math problems were programmed to subjects in a predetermined schedule, and were also required to be solved on a time-shared basis. All missions were equivalent with respect to the program of task performances required.

B. The Stressful Situation

Although three types of stressful situations were explored--physical threat, social-evaluative, and long-term performance--the emphasis of the research has been on the physical threat situation. A discussion of exploratory studies on the other two situations may be found elsewhere (3).

Physical threat stress was induced by the following devices:

1. A "stress programmer" which presented visually the several dimensions postulated to be basic to any physical threat situation: strength of threat, odds of harm, effect of performance, performance, and temporal qualities of the situation.

2. Painful but safely tolerated electric shock.

3. An audio-visual display--a six-inch Tesla coil spark of dramatic but harmless high frequency electricity, activated a few inches from the subject's face and accompanied by the intense crackling noise of the discharge, concurrent with shock.

4. Instructions intended to be disquieting.

C. The Initial Experimental Testing

The purpose of the initial experimental testing was to demonstrate performance impairment in the laboratory situation. Paid volunteer Air Force ROTC cadets, from University "X," served as the subjects for this phase of the research. An experimental and a control group of subjects were tested on the task complex. Each experimental subject went through the following schedule of activities:

1. Training on each task, practice on each task.

2. A 10-minute practice period on the integrated task complex.

3. A 30-minute, non-stress, "Training Mission" (T_1).

4. Training on the stress programmer, administration of a sample shock, and orientation (disquieting instructions).

5. A 30-minute, moderately stressful, "Weather Mission" (W).

6. A 30-minute, more stressful, "Reconnaissance Mission" (R).

7. A 30-minute, non-stress, "Training Mission" (T_2).

8. Debriefing.

Control subjects followed the same schedule as experimental subjects, but were exposed to none of the stressful conditions. Results for the experimental group were then compared with those of the control group.

D. Results

1. Absolute score results

Tables 1 and 2 show the raw score means and standard deviations for each of the tests for each of the 30-minute test periods or missions for the initial ("X") control and experimental subjects and for other groups tested subsequently. Further reference to these other groups is made later in this report. The statistical tests computed between the initial experimental and control group mean scores for each of the missions for each task indicated that there were no significant differences in mean initial ability on any task between the experimental and control groups. There were significant mean differences between experimental and control subjects for the two stress missions and for the second training mission on the Inside Vigilance Task, Outside Vigilance Task, and Math Problems Right. There were no significant mean differences for these missions on the Complex Coordination Test, Direction Control Test (rights or errors score) or on the Motor Judgment Test.

2. Decrement scores

A statistic was devised to reflect the relative effects of the stress-inducing procedures on the task performance of experimental subjects compared to control subjects. A difference score was obtained for each control subject for each task using the formula: $W + R - 2T_1$, where W and R stand for absolute scores on a task for the two stressful missions (Weather and Reconnaissance) and T_1 the score on the First Training (non-stress) Mission.

After all control cases (including those from later phases of the study) had been obtained, the control group difference distribution for each task was linearally transformed to a distribution with a mean of 50, and a standard deviation of 10. A set of normative tables was established for converting a difference score into a standard score based upon this distribution. The difference scores for all standard experimental subjects (including those from later phases of the study) were then translated into these standard score terms (called "Delta scores"). Delta scores for each task referred to in the remainder of this report are actually standard difference scores with respect to the combined control distributions.

Table 1

Raw Score Means and Standard Deviations
by Task and Mission for Separate
and Combined Control Groups

Task and Mission	"X" (N=28)		"Y" (N=13)		"Z" (N=16)		Combined (N=57)	
	M	σ	M	σ	M	σ	M	σ
CC								
T_1	52.1	14.47	60.5	14.95	48.2	13.82	52.9	15.07
W	58.6	15.13	67.8	14.33	52.9	16.16	59.1	16.15
R	64.1	20.03	72.4	13.90	60.9	18.44	65.1	18.82
T_2	66.3	20.54	74.8	16.13	64.2	20.25	67.6	19.94
DCT(R)								
T_1	60.3	22.78	67.7	18.75	38.3	24.42	55.8	28.06
W	86.1	28.32	81.7	26.03	53.3	33.58	75.9	32.67
R	99.5	29.12	95.9	28.11	66.1	38.19	89.3	34.90
T_2	107.8	34.35	112.4	36.37	67.9	39.07	97.6	40.72
DCT(E)								
T_1	4.8	5.20	6.1	3.66	5.8	2.98	5.4	4.38
W	4.1	4.44	5.6	3.28	5.9	5.08	4.9	4.48
R	2.8	3.26	3.8	2.65	6.8	5.95	4.2	4.43
T_2	3.5	3.62	4.5	2.60	5.5	4.89	4.3	3.92
MJT								
T_1	1.35	0.38	1.46	0.58	1.25	0.29	1.35	0.42
W	1.56	0.74	1.80	0.77	1.28	0.37	1.54	0.69
R	1.61	0.74	1.84	0.57	1.41	0.47	1.61	0.66
T_2	1.68	0.69	2.18	1.21	1.41	0.43	1.72	0.83
V_I								
T_1	32.3	10.48	32.2	12.95	23.5	12.47	29.8	12.09
W	36.8	11.13	37.0	15.34	27.1	9.69	34.1	12.65
R	37.3	10.50	38.7	14.43	29.1	10.79	35.3	12.24
T_2	38.1	11.24	37.1	16.00	27.3	11.06	34.8	13.31
V_O								
T_1	19.6	6.23	17.8	6.82	16.8	4.17	18.4	6.00
W	24.2	6.02	23.8	5.83	19.4	5.77	22.8	6.27
R	26.7	4.69	24.7	5.53	20.9	7.04	24.6	6.14
T_2	25.9	4.70	26.8	4.95	20.4	7.03	24.6	6.10
M								
T_1	5.3	2.60	5.0	1.96	5.6	2.45	5.3	2.43
W	6.7	2.65	6.3	3.09	6.5	2.78	6.6	2.80
R	6.9	2.46	7.0	2.08	6.6	1.97	6.8	2.25
T_2	6.9	2.84	7.4	2.06	6.8	2.11	7.0	2.50

Table 2

Raw Score Means and Standard Deviations by Task and Mission for Separate and Combined Standard Experimental Groups

Task and Mission	"X" (N=28)		"Z" (N=12)		Combined (N=40)	
	M	σ	M	σ	M	σ
CC						
T_1	54.2	11.52	52.1	13.47	53.6	12.18
W	62.0	14.62	58.0	13.51	60.8	14.34
R	62.5	19.80	55.6	17.13	60.4	19.30
T_2	73.0	18.78	67.2	23.90	71.3	20.62
DCT(R)						
T_1	68.4	21.45	50.5	31.42	63.0	26.18
W	80.8	22.27	65.6	49.27	76.2	33.52
R	93.0	44.54	73.3	51.50	87.1	47.60
T_2	104.5	45.07	81.4	58.38	97.6	50.58
DCT(E)						
T_1	4.7	3.70	4.5	3.97	4.6	3.78
W	5.0	4.77	4.9	4.17	5.0	4.60
R	4.5	4.04	6.7	5.50	4.9	4.65
T_2	3.3	2.75	8.7	13.47	4.9	8.12
MJT						
T_1	1.50	0.68	1.38	0.38	1.46	0.61
W	1.54	0.54	1.56	0.53	1.55	0.54
R	1.79	0.79	1.68	0.65	1.76	0.75
T_2	1.77	0.83	1.61	0.40	1.72	0.73
V_I						
T_1	26.2	11.42	23.2	11.94	25.3	11.66
W	23.5	13.50	24.2	12.29	23.7	13.15
R	24.8	14.92	23.5	13.68	24.4	14.57
T_2	27.8	13.05	31.5	16.76	28.9	14.36
V_O						
T_1	18.4	7.68	18.2	7.40	18.3	7.60
W	15.6	7.12	15.2	5.99	15.5	6.80
R	16.8	8.42	15.2	7.96	16.3	8.26
T_2	20.4	8.20	21.2	9.48	20.6	8.61
M						
T_1	5.8	3.11	5.7	3.11	5.8	3.11
W	3.4	2.39	3.5	2.50	3.4	2.42
R	3.5	2.86	4.3	2.74	3.7	2.85
T_2	5.1	3.09	5.4	3.34	5.2	3.17

Mean Delta scores for the combined control group and the experimental group were statistically compared by task. In addition, the seven Delta scores for each subject were averaged to obtain a single overall Delta score. The means of the Delta scores for the standard experimental and control groups were then statistically compared. Differences in variability were also tested. Tables 3 and 4 present the results of these tests.

Table 3

Significant Differences Between Delta Score Means of Control and Standard Experimental Groups, by Task

Task	Significance
CC	
DCT(R)	S
DCT(E)	
MJT	
V_I	SS
V_O	SS
M	SS
Overall	SS

Note: All Delta scores were lower for the experimental group. One S indicates a difference significant at the 5% two-tail level; two Ss, at the 1% two-tail level.

Table 4

Significant Differences Between Delta Score Variances of Control and Standard Experimental Groups, by Task

Task	Significance
CC	S
DCT(R)	
DCT(E)	
MJT	
V_I	
V_O	S
M	S
Overall	S

Note: All variances were larger for the experimental group. S indicates a difference significant at the 2% two-tail level.

The effects of the experimental stress conditions appeared to impair performance most strongly on the three, non-psychomotor tasks (V_I, V_O, and M).

3. Physiological results

Blood samples were taken from each subject both before and after testing. The results were as follows: The initial ("X") experimental group (N=21) showed a mean percentage eosinophil drop from before testing to after testing of 55.6; the "X" control group (N=17) mean drop was 12.8. This difference is statistically significant (P=.01) and, according to the literature (1), suggests increased anxiety in the experimental subjects. The correlation between mean Delta score and blood eosinophil percentage drop for the 21 initial experimental subjects was .53 (P=.01), indicating that those subjects whose blood eosinophils dropped most tended to show the least performance impairment under stressful conditions. The correlation between these same two variables for the combined control subjects (N=33) was .10, indicating no significant relationship between percentage eosinophil and performance change. In both the experimental and control groups the initial eosinophil count was considerably below the average for normals, indicating that the subjects probably entered the situation with some anxiety.

Several psychogalvanic skin response (PGR) readings were also taken for some of the experimental subjects (N=16) during the initial experimental testing. The data indicated a continual decrease in skin resistance during the testing under stress conditions, and a slight recovery (increased resistance) after a return to non-stress conditions. These data should be interpreted cautiously, however, since no comparison measures were taken on control subjects. The correlation between PGR per cent drop and mean Delta standard score for experimental subjects was .26 (N=26); and between PGR per cent drop and eosinophil per cent drop was .29 (N=21). These correlations are not significant.

4. Experimenter observations

From systematically collected experimenter observations it can safely be said that no subject was able to ignore the experimental conditions. From the time subjects were told that shock would be used, through the remainder of the test session, their behavior indicated increasing tension and anxiety. Actions ranged from symptoms of initial apprehension to outright fear. Most subjects appeared to be highly anxious. In many cases apparently non-functional behaviors, such as stamping, hand or finger waving, and head wagging, occurred. Postural tension and acute concentration were almost always evident.

There was abundant evidence that the situation caused most subjects to lose control of themselves to some degree and to fail to attend to some of the pertinent aspects of the situation. Performance and behavior slowly progressed toward normal after a return to non-stress conditions.

5. Subjects' observations

After testing, the experimental subjects were debriefed, encouraged to express their feelings, and asked to fill out a questionnaire concerning their reactions to the experiment. Almost all subjects admitted having been afraid; many said that they had wanted to ask to quit the experiment. More than half said that they would not go through the experiment again.

Although many subjects said that sometimes they did not know why they were being shocked or what to do about it, all maintained that they had really tried to do well and improve their performances. Free comments revealed fear, frustration, rationalizations, somatic complaints, and aggression.

6. Reliability of the raw scores

Table 5 shows the raw score reliabilities for each of the tasks for the combined experimental group and for the combined control group. These reliabilities were computed by correlating test scores of Mission W with those of Mission R. They seem generally satisfactory.

Table 5

Task Reliabilities for Control and Experimental Groups

Task	Controls	Experimentals
CC	.86	.85
DCT(R)	.93	.94
DCT(E)	.80	.56
MJT	.88	.82
V_I	.87	.77
V_O	.70	.65
M	.68	.76

II. The Development and Exploration of Procedures for Reducing Performance Impairment

Reviewers of the initial experimental research indicated that the experiment had been successful in inducing genuine fear and performance impairment in the physical threat laboratory situation which had been developed. Research efforts were then directed toward the development and exploration of procedures for the reduction of this impairment.

A. Preliminary tests of hypotheses for the reduction of performance impairment

1. Hypotheses

From performance data collected during the initial experimental research, observations of the experimenters, and reports of subjects, three hypotheses were developed for the reduction of performance impairment in the laboratory physical threat situation.

a. Hypothesis A: The reduction of anxiety by suggestion and reassurance will result in a significant reduction in performance impairment.

This hypothesis is based on the assumption that excessive anxiety is partly responsible for performance impairment. In the implementation of the hypothesis, several techniques were used in an attempt to reduce this anxiety. A script was developed in which the experimenter did the following:

1) Reassured the subject that he was doing well; that any anxiety that he might feel was "perfectly normal;" and that people who do well don't become as afraid as those who do poorly.

2) Explained further the purpose of the testing--that our job was to help him do well in this rough situation.

3) Suggested that a (placebo) pill which was given to him would help him relax, be calm, and thus do better, especially in view of his basically good ability.

4) Reassured each subject between the two stress missions that he was doing well.

b. Hypothesis B: Training individuals to understand the nature of their impairment--specifically, where they will go wrong in their performances--will result in a significant reduction in performance impairment.

This hypothesis is based on the assumption that if individuals understand the nature of what happens to them both psychologically and in terms of their performance, anxiety and consequently performance impairment will be reduced. A script was developed in which the experimenter did the following:

1) Pointed out to subjects prior to the first stress mission that they were likely to do poorly on the Vigilance Tasks and Math problems because:

   a) They would forget to look around.

   b) They might assume that these tasks are not as important as others.

   c) They might spend too much time thinking about what might happen to them.

2) Urged subjects to think and work toward eliminating these difficulties. They were told that all tasks counted equally and that they must not dwell on what might happen to them.

3) Asked subjects to repeat what would happen to them and what they should do about it.

4) Encouraged subjects (in the interval between the Weather and Reconnaissance Missions) to express their feelings while the experimenter listened and commented in a non-directive fashion.

5) Again rehearsed subjects in where and why their performances might decline.

c. Hypothesis C: The introduction of a "reminder" into the man-machine system will result in significant reduction in impairment on the Vigilance Tasks.

This hypothesis is based on the observations of experimenters that impairment resulted when subjects failed to look around at the Vigilance tasks. To encourage this "looking around" behavior, subjects were told that in tight spots people do fail to look around. In addition, a "reminder," consisting of a door chime, was installed in each simulator. The chime was sounded automatically every 20 seconds. Subjects were told that they must look around when the chime sounded.

2. Procedures

Arrangements were made to test these three hypotheses at University "Y" where paid volunteer Air Force ROTC students were used as subjects. A new control group was also tested at University "Y" in order to establish the comparability of the "Y" subjects to the "X" subjects.

The experimental procedures were the same as those described above for the initial experimental research with the following exceptions: (a) Eosinophil blood counts were not taken for any subjects

due to the unavailability of close laboratory facilities to process the blood samples; (b) Psychogalvanic skin response readings were taken on the control subjects as well as on the experimental subjects.

While the training and general experimental procedures were exactly the same as those employed previously, the additional instructions and devices described above were employed to implement the hypotheses for reducing performance impairment.

3. Results

The numerical results of testing these three hypotheses were presented elsewhere (3). The general results are summarized below:

a. Raw scores

The mean raw scores for these three groups showed little difference in performance, compared to the "X" experimental group. The Hypothesis B group did do somewhat better on Inside and Outside Vigilance tasks. However, this was accompanied by poorer performance on the DCT(R). The Hypothesis C group appeared to be somewhat better on the Inside and Outside Vigilance tasks.

b. Delta scores

On an overall basis, there was little difference between each of these groups and the combined standard experimental group. However, Hypothesis B and C groups reduced impairment on the Inside Vigilance task significantly. This was accompanied, however, by increased impairment on the DCT(R). The Hypothesis C group improved in Outside Vigilance performance. The Math performance of the Hypothesis C group was extremely low, although not significantly lower than that of the combined standard experimental group.

c. Physiological data

Although blood eosinophil counts were not taken at University "Y," PGR's were taken on control subjects and subjects tested under each of the hypotheses. The mean readings at each point followed the same general pattern as those taken on the "X" experimental subjects, viz., progressively down with a small upturn after a return to non-stress conditions. Somewhat lower readings for the Hypothesis C group suggested, however, that these subjects may have found the situation more upsetting than did the other subjects.

d. Experimenter observations

The general reactions of the "Y" experimental subjects were similar to those of the "X" students. Nervousness, postural tension and strain, apprehension, and intense concentration were observable. There was little difference in this

pattern of reaction among the three groups, except for the subjects tested under Hypothesis B. These subjects were somewhat less nervous and posturally tense than the other two groups. Many of the same tendencies noted previously were also noted in the "Y" group. These included the tendency to pick a favorite task, develop non-functional movements, exhort self and equipment, etc.

e. Subject observations

Most subjects agreed that the stressful situation interfered, at least to some extent, with their performance. Most of the subjects in all groups admitted anticipatory fear of the shock. However, there were relatively fewer of these admissions in the Hypothesis B group.

Essentially, it appeared quite clear from subjects' reports that all groups had been thoroughly shaken up. The general tenor of free response comments was similar to the original experimental group--fear, apprehension, uncomfortableness, frustration, etc.

B. Development and review of additional hypotheses for the reduction of performance impairment

As an outgrowth of the result of the initial experimental research and the testing phase during which three hypotheses were explored, a theoretical framework was developed concerning the nature of the physical threat situation employed in this study. This framework and the research results were the sources from which 25 additional hypotheses for the reduction of performance impairment were generated. The theory concerning the nature of the situation, the hypotheses, data sources, and suggested implementations were presented in the earlier report (3).

1. Selection and review of hypotheses

Since exploration of all 25 hypotheses was not feasible within the limits of the research, it was decided to select, implement, and test those which would be "best bets" to reduce performance impairment. Research personnel evaluated each of the 25 hypotheses in terms of three criteria: (a) relevance of the results of testing the hypothesis to practical Air Force operations; (b) relevance of the results of testing the hypothesis in terms of contributing to psychological theory; and (c) practicability of implementation. The seven hypotheses which best met these criteria were then submitted to consultants for review, together with data sources, tentative plans for implementations, and tentative scripts. The consultants were asked to rank the hypotheses according to how successful they judged them to be in reducing overall performance impairment. In addition, each consultant was asked to rate each hypothesis in terms of how many standard deviation units of impairment might be expected if the procedures were introduced into the standard experimental physical threat situation. Each judge was asked to comment on the reasons for his rating.

To aid research personnel in the evaluation of these reviews and ratings, the hypotheses previously tested (A, B, and C) were included, making a total of ten hypotheses to be reviewed and evaluated. The judges were not told that these three hypotheses had already been tested. Appendix A contains a complete set of the hypotheses and materials sent to each reviewer.

2. Results of the reviews of the hypotheses

The materials were sent to 16 reviewers. The hypotheses are presented below, together with a brief summary of the reviewers' comments. The mean ratings and rankings for each of the hypotheses are found in Table 6.

Table 6

Mean Ratings and Rankings of Ten Hypotheses for Impairment Reduction (N=16)

Hypothesis	Rating		Mean Ranking
	M	σ	
1	-7.2	1.8	5.2
2	-6.7	3.1	5.2
3	-15.4	4.2	*
4	-4.1	4.9	3.0
5	-7.4	5.4	5.6
6	-6.3	3.6	5.0
7	-7.7	5.6	6.3
8	-7.0	3.4	5.8
9	-7.1	9.8	5.7
10	-4.2	3.7	3.3

Note: All Ratings are in terms of the number of standard score points predicted below the control performance mean of 50, σ of 10.

*Not ranked, since this hypothesis concerned increasing performance impairment.

Hypothesis #1: The reduction of anxiety by means of suggestion and reassurance from a prestige figure, combined with the opportunity to ventilate feelings, will reduce performance impairment.

Reviewers found this hypothesis potentially capable of some slight reduction in impairment. It was judged that stress and anxiety would be reduced by reward, prestige suggestion, praise,

and communication with the authority controlling the shock. Judges felt that making the situation convincing would be difficult. Other limiting factors were: the disparity between suggestion and existing feedback on performance; distraction; and the possibility of creating additional anticipatory fear.

Hypothesis #2: Encouraging comment from a crew member, who also receives the consequences of the subject's performance, will reduce performance impairment.

These "peer" procedures were seen as potentially calming, confidence inspiring and motivating. There was some concern expressed about the convincing nature of the procedure and about creating additional anxiety due to the necessity of protecting the partner. There was also some concern with the fact that the partner would not be a real "buddy."

Hypothesis #3: (Hypothesis for Increasing Performance Impairment) The performance of a person may be unfavorably influenced by exposing him to panicky, unnerving comments from one of his companions.

The consensus of the judges' comments was that the procedures would yield increased anxiety, disorganization, distraction, and poorer performance. Some question was raised as to the success of the "act." One judge felt that if the subject felt sorry enough for the buddy, his own anxiety might be reduced.

Hypothesis #4: The insertion of an aural reminder into the man-machine system, combined with training to understand the nature of impairments and training in self-pacing, will reduce performance impairment.

This was the most favored of the hypotheses reviewed. Good points mentioned were: pacing, distribution of effort, focus of attention, and understanding as an anxiety reducer. The aural reminders were seen as distracting, however, by some judges. Others felt that subjects might become disorganized, and that some anticipatory anxiety might be generated.

Hypothesis #5: Performance impairment will be reduced if the individual believes that he has no control over what happens to him in the situation.

Some reviewers indicated that the situation was realistic and that the instructions were motivating, but others felt that these procedures might result in further generalized impairment, loss of motivation, or subjects leaving the situation.

Hypothesis #6: (Same as Hypothesis A, page 11)

In general, opinion was that this was essentially the same as Hypothesis #1, but would be slightly more effective. The placebo aspect was seen as having various results. Reviewers suggested that some persons would be reassured by the placebo, some would not respond, and that others might respond negatively. Some reviewers felt that anticipatory anxiety would be generated by the instructions, others questioned the believability of the experimenter's comments.

Hypothesis #7: Training under task overload will broaden the field of attention and thus reduce performance impairment in a stressful situation.

While one or two reviewers felt that the overload training would result in an increase in attention span, the majority of reviewers felt that the benefits of the procedures would fail to carry over to the stress missions. The small amount of time devoted to this training was questioned as well as the confusion, distraction, and fatigue which might possibly be introduced by these procedures.

Hypothesis #8: An individual's performance will be impaired less if he feels his work is important to a group or cause with which he is strongly identified.

The hypothesis was widely accepted, but certain doubts were expressed as to the effectiveness of the suggested implementation. The expected increase in motivation due to involvement and group prestige was favorably received. However, reviewers questioned the believability of the procedures, the lack of direction for increased motivation, the success of an abstract appeal, and expressed some doubt that the hypothesis could ever be tested in an artificial situation.

Hypothesis #9: (Same as Hypothesis C, page 12)

Most reviewers felt that the aural blip would only confuse and distract, especially without knowledge of specifically what to do about it. There were a few favorable comments referring to the blip as a handy cue.

Hypothesis #10: (Same as Hypothesis B, page 11)

This hypothesis was evaluated relatively favorably. Most positive comments concerned the improved distribution of effort, the opportunity for catharsis, and the broadening of awareness to be expected as a result. Some reviewers suggested that a subject can only attend to so much at once, so that the result might only be a redistribution of effort.

3. Selection of hypotheses for testing

The limitations in time and availability of subjects did not permit the testing of all seven of the new hypotheses, even if this were desirable. There was some question as to the desirability of testing any of the new hypotheses since reviewers had not rated any of them higher than they had the three which had been tested previously, with only limited success. However, research personnel decided to implement and test three hypotheses which appeared to offer the "best bets" to obtain performance scores which would deviate significantly from those of the experimental group. The results of these tests could then guide the development and implementation of other hypotheses for testing. Section III describes these hypotheses more fully, the procedures used for implementing them, and the test results.

III. Further Tests of Hypotheses for Reducing Performance Impairment

This section describes first the further standardization of the control and experimental normative data, a necessary step prior to testing additional impairment reduction procedures. The development and implementation of three hypotheses is then discussed. Two additional hypotheses were then developed and implemented; this work is also described. The comparative results of these tests are then presented.

A. The sample and its comparability to previous samples tested

1. The sample

Arrangements were made at the "Z" University to conduct the testing program using paid volunteer Air Force ROTC cadets--arrangements similar to those which had been made with the other AFROTC detachments.

2. Comparability of the sample to groups previously tested

So that valid conclusions could be drawn about any impairment reduction procedures tested on the "Z" University sample, groups of control and standard experimental subjects were first tested.

a. Control group

Raw score means and standard deviations on the tasks for the "Z" control group are presented in Table 1. Tests of significance of the mean differences are presented in Table 7. It may be seen that the "Z" control subjects were significantly lower in mean performance from control subjects tested at the other two universities on many of the tasks. There were no systematic differences in variability, however, among the three groups (Table 8). Although the raw score data indicated some real mean differences, except for the DCT(R) these were hardly systematic. Certainly no strong case could be made either for overall differences in initial ability or for systematic differences in the learning curves.

b. Experimental group

No standard experimental group was tested at "Y" but the raw scores from the "X" and "Z" groups were compared. Of the 28 tests of significance (7 scores x 4 missions) only two (DCT(R) T_1 and DCT(E) T_2) were significant--at the 5% two-tail level. Thus, these two experimental groups appeared quite similar in their performance ability.

Table 7

Significant Differences in Mean Raw Scores
by Task and Mission among Control Groups

Task	Mission	Comparison Groups: "X" (N=28) vs. "Z" (N=16)	"X" (N=28) vs. "Y" (N=13) [1]	"Y" (N=13) vs. "Z" (N=16)
CC	T_1			S
	W			S
	R			
	T_2			
DCT(R)	T_1	SS		SS
	W	SS		S
	R	SS		S
	T_2	SS		SS
DCT(E)	T_1			
	W			
	R	SS [2]		
	T_2			
MJT	T_1			
	W			S
	R			S
	T_2			S
V_I	T_1	S		
	W	S		S
	R	S		S
	T_2			
V_O	T_1			
	W	S		
	R	SS		
	T_2	S		S
M	T_1			
	W			
	R			
	T_2			

Note: One S indicates a difference significant at the 5% two-tail level; two Ss at the 1% two-tail level.

[1] No significant differences between Groups "X" and "Y."

[2] In each case, "Z" is the lower performance mean, except in DCT(E).

Table 8

Significant Differences in Raw Score Standard Deviations
by Task and Mission among Control Groups

Task	Mission	Comparison Groups: "X" vs. "Z" (N=28) (N=16)	"X" vs. "Y" (N=28) (N=13)	"Y" vs. "Z" (N=13) (N=16)
CC	T_1			
	W			
	R			
	T_2			
DCT(R)	T_1			
	W			
	R			
	T_2			
DCT(E)	T_1			
	W			
	R			S_Z
	T_2			
MJT	T_1			
	W	S_X		S_Y
	R			S_Y
	T_2			
V_I	T_1			
	W			
	R			
	T_2			
V_O	T_1			
	W			
	R			
	T_2			
M	T_1			
	W			
	R			
	T_2			

Note: All differences are significant at the 2% two-tail level. Subscripts identify the group with the larger standard deviation. There were no significant differences between Groups "X" and "Y."

c. Delta scores

Since the statistic used in this research to describe performance impairment is based on the performance of control subjects, it was desirable to pool the data from all control groups to stabilize these norms. New Delta scores were then obtained for all subjects, both standard experimental and control. The means and standard deviations of separate and combined groups are presented in Table 9. In comparing the Delta score means for the "X" and "Z" experimental groups, there were no significant differences on any task, or on overall score. Except for a significant difference ($P<.05$) in favor of the "X" group on DCT(R), there were no significant task Delta score differences between the "X" and "Z" controls or between the "Y" and "Z" controls. In overall Delta score, both "X" and "Y" control groups were significantly ($P<.01$) better than the "Z" group.

Although there seemed to be some indication that the "Z" control group's performances were somewhat lower than those of other control groups, this was not true of the "Z" standard experimental group. On the basis of their observations, research personnel concluded that the control group's differences were largely fortuitous, especially in view of the similarity of the "Z" and "X" experimental groups.

Table 10 presents the significant differences between Delta score means for the combined experimental and combined control groups. Table 11 presents the significant differences between Delta score variances for the combined experimental and combined control groups.

It may be seen from Tables 10 and 11 that the patterns of impairment observed in the original research with the "X" group held when the "Z" group was added. It was concluded that the experimental procedures continued to be stable and effective in inducing performance impairment.

Table 9

Delta Standard Score Means and Standard Deviations
by Task for Separate and Combined Standard
Experimental and Control Groups

		Controls				Experimentals		
Task		"X" (N=28)	"Y" (N=13)	"Z" (N=16)	Combined (N=57)	"X" (N=28)	"Z" (N=12)	Combined (N=40)
CC	M	50.1	50.5	49.4	50.0	48.4	43.8	47.1
	σ	11.21	9.08	8.97	10.00	17.08	12.40	15.61
DCT(R)	M	53.1	47.0	47.1	50.0	44.5	45.6	44.9
	σ	9.19	11.87	8.60	10.00	12.14	14.94	12.86
DCT(E)	M	51.6	51.6	45.8	50.0	48.1	43.9	46.8
	σ	10.38	8.94	9.46	10.00	8.47	7.34	8.29
MJT	M	50.2	53.1	47.0	50.0	48.6	51.1	49.4
	σ	11.08	10.60	6.63	10.00	9.53	6.93	8.82
V_I	M	49.8	51.1	49.4	50.0	40.4	44.0	41.5
	σ	9.56	9.04	11.91	10.00	10.55	11.86	10.92
V_O	M	51.0	53.0	45.8	50.0	34.3	32.6	33.8
	σ	8.01	12.23	10.45	10.00	12.84	21.14	15.52
M	M	50.8	51.8	47.1	50.0	27.1	30.1	28.0
	σ	11.06	7.44	9.80	10.00	14.04	22.86	16.91
Over-all	M	51.0	51.1	47.4	50.0	41.6	41.6	41.6
	σ	3.35	3.82	3.36	3.76	5.37	6.10	5.59

Note: All entries in this table are based upon standardization constants derived from the combined Control group (N=57).

Table 10

Significant Delta Score Mean Differences Between Combined Experimental (N=40) and Combined Control (N=57) Groups

Task	Significance
CC	
DCT(R)	S
DCT(E)	
MJT	
V_I	SS
V_O	SS
M	SS
Overall	SS

Note: One S indicates a difference significant at the 5% two-tail level; two Ss at the 1% two-tail level. In all cases, the experimental group is lower.

Table 11

Significant Delta Score Variance Differences Between Combined Experimental (N=40) and Combined Control (N=57) Groups

Task	Significance
CC	S
DCT(R)	
DCT(E)	
MJT	
V_I	
V_O	S
M	S
Overall	S

Note: All differences are significant at the 2% two-tail level. In all cases, the experimental variances are larger.

B. The selected hypotheses and their implementation

In this section the development and implementation of three hypotheses for the reduction of performance impairment is discussed.

1. Hypothesis D: The reduction of anxiety by means of suggestion and reassurance from a prestige figure, combined with the understanding of the nature of impairments and the opportunity to ventilate feelings will reduce performance impairment.

a. Data Sources:

This hypothesis is a combination of the best features of Hypotheses 1 and 10 (Section II) based upon reviewers' comments. From testing subjects in the standard experimental situation, it appeared to research personnel that much of the performance impairment was attributable to anticipatory anxiety. In addition to considerable overt evidence, many subjects reported this anxiety. In debriefing subjects, it was obvious that many were not aware of the locus of their impairments, i.e., largely on the non-psychomotor tasks, and of the fact that the tasks on which they fell down counted just as much as the rest of the tasks.

b. Implementation:

This hypothesis was implemented by a script which is presented in Appendix B. In general, it was suggested to subjects by the examiner that they had done and were doing well. They were periodically reassured that they were holding up well and that their performances were acceptable. Between the two stressful missions they were given an opportunity to talk about their feelings and problems. In addition, subjects were told prior to the onset of the stressful conditions where and why they might be likely to fall down in performance.

2. Hypothesis E: An individual's performance will be impaired less if he feels his work is important to a group or cause with which he is strongly identified, and if he receives encouraging comments from a buddy who also receives the consequences of his performance.

a. Data Sources:

This hypothesis is a combination of the best features of Hypotheses 2 and 8 (Section II) based upon reviewers' comments. Research data on the standard experimental group suggested that those subjects who really appeared to become involved in the situation, "playing out" their pilot roles,

were impaired less than subjects who were not as involved. In addition, it is a commonly held belief, supported by research evidence, that individuals who believe in a group cause perform better. Experimenters also observed that, even though electronic communication was not provided between subjects in the simulators, there were tendencies for one subject's responses which could be heard only slightly, and certainly not specifically distinguishable, to affect the other subject's responses. This tendency almost to grasp any stimulus from the outside which was not unfriendly, was part of the rationale for this hypothesis.

b. Implementation:

Two AFROTC cadets who had previously performed as standard experimental subjects acted as "buddies" or "crew members" to the real subjects. They sat outside the simulators, and had specific tasks to perform. Each "buddy" subject had electrodes attached to him and each real subject was led to believe that his "crew member" would be shocked according to his (real subject's) performance. During the course of the experiment each "crew member" read a script to his "pilot" containing encouraging and supportive comments. This script is presented in Appendix B. At the same time they actually recorded the comments of the subjects. The same two cadets were "crew members" for all of the subjects used in testing this hypothesis. Of course they were not shocked. Each buddy or crew member spoke privately to his pilot, the real subject. Each buddy used the same script; the comments were made so that each subject heard only his own buddy.

Just before the onset of the stress missions, an examiner entered the room and was introduced as an Air Force Reserve Colonel, Director of a Board, etc. He informed the subjects that at a meeting at the Pentagon from which he had just come, it had just been decided to deactivate some AFROTC detachments. The tests, therefore, were going to be one of the important factors in deciding whether the AFROTC detachment at this University would continue, or whether the cadets would be transferred to the Army ROTC detachment on the campus. This script is also presented in Appendix B.

3. Hypothesis F: (Same as Hypothesis #3)
The performance of a person may be unfavorably influenced by exposing him to panicky, unnerving comments from one of his companions.

The data sources, implementation, and script for this hypothesis are contained in Appendix A (Materials sent to reviewers). Essentially, the procedure involved having a cadet make a tape recording of "panicky" comments which was played back to real subjects during their performance.

Each subject was lead to believe that the "panicky buddy" was being shocked when the subject in the other simulator got shocked.

C. The development and implementation of additional hypotheses

During the course of testing Hypotheses D, E, and F, two additional hypotheses were developed and tested. These are described below:

1. Hypothesis G: A combination of the procedures employed in Hypotheses D and E will result in greater impairment reduction than either method employed by itself.

a. Data Sources:

Observations made by the experimenters during the testing of Hypotheses D and E suggested that both procedures were somewhat successful in reducing the subjects' anxieties. In addition, subjects from both groups reported that the procedures were helpful.

In terms of performance, it appeared that the Hypothesis E procedures produced distinctly better results in the psychomotor area than did the Hypothesis D procedures. In fact, these scores averaged better than control scores for some tests. On the other hand, the Hypothesis D procedures tended to raise the scores on the non-psychomotor tasks. It seemed logical, therefore, that employing both procedures concurrently might result in even better performance on an overall basis.

b. Implementation:

The implementation merely integrated the scripts and procedures of the two earlier hypotheses. The specific details are found in Appendix B.

2. Hypothesis H: Providing an extended learning period on the task complex before the introduction of the stressful conditions will result in reduced impairment.

a. Data Source:

The laboratory situation developed as part of this research provided considerably less training and experience than aircrew members get prior to exposure to a real threatening condition. Research personnel felt, therefore, that it was desirable, within the administrative limits of the project, to study the effects of increasing performance time under non-stress conditions

prior to the onset of the stressful conditions. In this way, some exploration of the influence of training time on performance impairment could be made.

b. Implementation:

The 16 cadets at "Z" University previously tested as control subjects were scheduled for retesting, half of them under the standard experimental procedures and half as controls. Thus the experimental subjects had two hours of additional practice in performing on the task complex before the introduction of the stressful conditions.

1) Control group

Four of the subjects chosen to be controls failed to keep their appointments. The other four subjects were given brief refresher instruction on each task. This consisted of repeating the object, and/or rules, of the task and allowing questions, a two-minute practice period, and further questions. After the essentials of each task were covered, the explanation of integrating them into the task complex was read to the subjects and they were given the ten-minute practice mission. Then, as before, they performed four standard missions under non-stress conditions.

2) Experimental group

Eight subjects were tested under standard experimental conditions. They were treated the same as the control subjects until after the first non-stress mission was completed. At that time, they were given the standard experimental procedures: stress programmer training, sample shock, orientation, and the W, R, and T_2 Missions.

D. Results

In this section the results of testing Hypotheses D through H on small groups of subjects are presented. Small groups were used in order to explore more hypotheses than would have been otherwise possible within the scope of the project. The use of these small groups, however, had the disadvantage that only gross differences on the various scores used could be identified as statistically significant. Thus, it should be emphasized that the failure of sizeable score differences to reach statistical significance may well be due, at least in part, to the lack of power which characterizes the usual statistical tests, when they are applied to measurements based upon small groups. Definitions of terms used in discussing the data and results follow, with reference to the appropriate tables.

1. Definition of terms

a. Raw score

A score on any test, for any mission (Tables 12 and 13).

Table 12

Raw Score Means and Standard Deviations by Task and Mission for Hypotheses D, E, F, and G

Task	Mission	Hypotheses D (N=11)*		E (N=10)		F (N=10)		G (N=10)	
		M	σ	M	σ	M	σ	M	σ
CC	T_1	53.5	14.51	44.8	14.32	35.0	11.50	45.9	14.03
	W	53.8	15.22	52.8	18.96	40.4	15.01	45.3	23.10
	R	54.8	15.97	60.9	21.65	39.0	17.70	49.7	21.15
	T_2	60.7	18.83	67.8	16.93	49.7	17.88	60.2	20.30
DCT(R)	T_1	34.0	21.94	50.9	19.42	47.9	18.84	42.1	17.69
	W	36.8	22.36	65.0	25.89	65.9	21.87	45.2	20.44
	R	47.0	30.43	80.9	33.85	80.4	31.31	55.1	26.70
	T_2	56.5	32.62	90.7	31.56	86.1	33.36	65.3	26.47
DCT(E)	T_1	6.1	4.50	7.6	3.98	4.2	3.82	7.6	4.25
	W	8.4	6.85	7.6	7.72	4.3	3.86	8.2	4.73
	R	8.2	7.63	8.7	11.01	5.4	3.84	7.8	4.19
	T_2	4.7	3.66	8.8	12.73	4.0	3.06	6.0	3.16
MJT	T_1	1.52	0.52	1.20	0.27	1.19	0.34	1.23	0.33
	W	1.66	0.52	1.33	0.24	1.37	0.55	1.23	0.32
	R	1.82	0.88	1.71	0.76	1.34	0.46	1.38	0.46
	T_2	1.60	0.55	1.44	0.36	1.58	0.53	1.28	0.34
V_I	T_1	20.6	11.32	28.2	7.79	29.9	7.39	29.7	13.08
	W	32.5	13.69	28.5	10.31	27.0	12.53	28.0	11.25
	R	34.2	14.91	27.9	11.98	29.3	10.83	33.2	8.98
	T_2	35.5	14.67	31.2	11.18	30.3	10.77	36.0	12.59
V_O	T_1	15.4	5.45	19.6	8.98	19.4	6.96	15.7	6.80
	W	17.8	5.00	16.8	7.87	11.8	7.38	17.2	7.77
	R	21.2	6.98	20.3	6.90	19.1	9.79	24.1	6.26
	T_2	26.2	5.62	23.9	8.52	20.3	8.46	26.2	2.74
M	T_1	4.1	2.30	3.7	2.50	5.5	3.17	2.6	2.07
	W	3.4	2.06	1.8	1.81	3.3	2.06	2.5	2.32
	R	4.5	2.16	2.7	3.06	5.3	2.87	2.4	1.90
	T_2	4.3	2.53	4.2	3.46	6.3	3.20	3.8	2.62

*N=10 for MJT due to equipment failure.

Table 13

Raw Score Means and Standard Deviations by Task and Mission for Hypothesis H (Extended Learning) Subjects, First and Second Testing

Task and Mission		Controls (N=4) First Testing M	Controls (N=4) First Testing σ	Controls (N=4) Second Testing M	Controls (N=4) Second Testing σ	Experimentals (N=8) First Testing M	Experimentals (N=8) First Testing σ	Experimentals (N=8) Second Testing M	Experimentals (N=8) Second Testing σ
CC	T_1	54.8	7.09	82.8	6.75	49.5	16.27	60.5	20.59
	W	60.2	3.30	80.0	7.87	53.4	20.72	68.6	26.30
	R	75.0	16.15	87.8	9.14	57.5	20.06	67.8	23.91
	T_2	74.2	14.57	89.8	6.55	65.6	23.93	72.5	22.91
DCT(R)	T_1	48.0	31.55	99.2	28.51	41.0	24.08	76.9	33.82
	W	67.2	26.69	116.0	24.91	57.9	39.47	82.5	32.14
	R	92.5	38.96	125.2	26.47	65.0	39.53	88.8	39.25
	T_2	93.8	38.29	127.8	26.00	67.5	39.69	98.2	40.44
DCT(E)	T_1	5.5	2.65	6.5	1.29	5.4	2.72	4.4	3.74
	W	3.2	3.40	5.2	3.78	6.1	4.16	2.8	1.49
	R	3.8	1.26	4.2	4.72	6.8	4.37	3.1	2.42
	T_2	4.2	2.22	2.8	2.63	4.9	4.05	1.6	1.30
MJT	T_1	1.20	0.25	1.18	0.38	1.35	0.33	1.55	0.59
	W	1.15	0.31	1.32	0.59	1.37	0.34	1.72	0.87
	R	1.26	0.30	1.60	0.94	1.49	0.45	1.81	1.06
	T_2	1.49	0.42	1.41	0.57	1.56	0.45	1.62	0.68
V_I	T_1	22.0	8.60	38.0	2.94	24.6	14.25	33.9	11.05
	W	23.8	7.14	31.8	10.21	26.2	10.51	28.5	12.46
	R	27.8	10.28	30.5	4.66	29.8	10.71	31.6	9.59
	T_2	26.2	10.11	32.8	8.77	28.5	11.12	34.2	10.38
V_O	T_1	13.0	3.83	21.5	3.70	18.5	3.16	26.9	6.18
	W	16.5	4.20	22.2	4.43	19.9	6.85	20.0	5.01
	R	17.5	9.33	23.2	4.86	21.8	6.54	22.8	5.01
	T_2	19.5	6.35	23.2	3.86	22.2	7.29	24.0	5.66
M	T_1	5.8	2.06	5.8	1.26	6.6	2.20	6.6	3.11
	W	7.5	2.65	6.8	2.50	7.2	2.31	4.4	2.07
	R	7.0	3.16	9.8	1.71	6.9	1.13	5.6	2.45
	T_2	7.0	0.82	8.5	1.29	7.2	2.49	7.2	2.49

b. Delta score

A score used to express performance impairment (Table 14).

c. Cutoff score

It was reasoned that perhaps slight impairment to an individual on any task might not have serious implications for a mission. The cutoff point for "seriousness" is, of course, arbitrary. However, research personnel agreed that, for this analysis, a Delta score less than 40 (one standard deviation below the control group mean) for any task seemed to be a reasonable cutoff point. Using minus one standard deviation as the cutting point, fourfold tables were formed by task, and the Chi square technique applied to test the Delta score distributions for each hypothesis group against those for the standard experimental group. Table 15 shows the percentage of subjects in each group below the cutoff point. Three of the Chi square tests were significant at the 1% level:

Hypothesis D - V_0
Hypothesis G - DCT(R)
Hypothesis G - V_0

d. Subjects' reports

Subjects reported on their experiences and feelings in two ways. They were given an adjective checklist after the first training mission, and a second identical checklist after the reconnaissance mission. They checked those words which they felt applied to them or to the situation. The checklist was scored on an a priori key for positive affect words and for negative affect words; separate positive and negative scores were obtained for words referring to equipment, and for words referring to self. The keyed checklist is exhibited in Appendix C. The mean numbers of positive and negative checked words were computed by group and kind of word for each of the two administrations. No statistical comparisons of these means were attempted; they were simply examined to estimate the changes which were reported from before to after the stressful missions. For this purpose, a mean net change in affect between the two administrations was obtained for each group. These data are presented in Table 16.

In addition, subjects filled out a questionnaire at the end of the testing period. The questionnaire was analyzed by research personnel who had no knowledge of the differential treatment which the groups received. Significant findings are reported under each hypothesis. The questionnaire may be found in Appendix C.

Table 14

Delta Score Means and Standard Deviations for Hypotheses D, E, F, G, and H, with Control and Experimental Data Included for Comparative Purposes

Task		Group						
		Control (N=57)	Expt'l (N=40)	D (N=11)	E (N=10)	F (N=10)	G (N=10)	H (N=8)
CC	M	50	47.1	38.2	54.2	38.6	42.7	47.5
	σ	10	15.61	17.42	17.78	20.59	17.08	12.43
DCT(R)	M	50	44.9	39.7	47.4	49.3	39.8	38.2
	σ	10	12.86	11.08	10.34	6.92	6.38	10.73
DCT(E)	M	50	46.8	36.8	46.1	45.9	46.5	51.6
	σ	10	8.29	22.42	25.46	13.57	6.91	7.32
MJT	M	50	49.4	49.8	50.8	48.5	46.5	49.8
	σ	10	8.82	19.09	8.50	6.52	5.67	11.51
V_I	M	50	41.5	60.5	43.0	40.6	44.4	37.9
	σ	10	10.92	15.90	14.16	14.45	16.67	11.16
V_O	M	50	33.8	47.2	36.5	30.6	49.1	27.2
	σ	10	15.52	16.74	14.50	13.46	18.29	10.75
M	M	50	28.0	40.4	32.6	34.1	40.5	31.5
	σ	10	16.91	18.37	18.21	15.85	13.92	12.48
Over-all	M	50	41.6	44.6	44.4	41.8	44.2	40.5
	σ	3.76	5.59	5.16	5.80	5.75	3.36	2.68

Table 15

Percentages of Subjects Below Delta Scores of 40 (-1σ), by Group and Task

Task	Group						
	Control	Expt'l	D	E	F	G	H
CC	10.5	27.5	45.6	20.0	30.0	40.0	37.5
DCT(R)	14.0	42.5	45.0	30.0	10.0	50.0	50.0
DCT(E)	14.0	22.5	27.0	20.0	30.0	10.0	0.0
MJT	7.0	12.5	10.0	0.0	10.0	10.0	0.0
V_I	16.0	45.0	9.0	40.0	50.0	40.0	62.5
V_O	12.0	30.0	36.0	60.0	30.0	30.0	87.5
M	17.5	77.5	64.0	80.0	70.0	60.0	62.5
Overall	0.0	35.0	9.0	20.0	40.0	20.0	50.0

Table 16

Subject Adjective Checklist

Mean Numbers of Positive and Negative Checked Words by Group, Word-type, and Administration

Score		Group Expt'l	D	E	F	G	H
1st Administration							
Eq.	+	5.2	5.2	6.6	6.2	6.2	5.2
	-	1.7	1.9	1.9	2.4	1.7	2.2
Self	+	3.7	2.3	2.2	2.6	1.7	2.4
	-	1.2	2.0	1.9	1.7	2.5	1.5
Total	+	8.8	8.0	8.8	8.8	6.6	7.6
	-	2.8	3.9	3.8	4.1	4.2	3.7
	Σ	6.0	4.1	5.0	4.7	2.4	3.9
2nd Administration							
Eq.	+	2.0	3.8	4.3	3.3	3.7	3.8
	-	2.7	2.6	2.3	3.8	3.1	2.8
Self	+	.3	1.2	1.2	1.3	.9	1.4
	-	5.2	3.8	3.2	5.5	4.6	3.4
Total	+	2.3	5.0	5.5	4.6	4.6	5.2
	-	8.8	6.4	5.6	9.4	7.6	6.2
	Σ	-6.5	-1.4	-0.1	-4.8	-3.0	-1.0
Mean Net Change *		-12.5	-5.5	-5.1	-9.5	-5.4	-4.9

* Negative signs in this column indicate on the average, a less positive or more negative attitude on the second administration than on the first.

e. Experimenter observations

An experimenter recorded each subject's behavior and responses during the testing. The recording form is exhibited in Appendix C. The salient features of each subject's protocol were abstracted on a card. The cards were then classified by the experimenter into a group of "stressed" and a group of "non-stressed" subjects. Chi square tests of significance were computed for stressed-non-stressed vs. above and below the Delta score mean for all "Z" University subjects tested under non-control conditions (42.9). Qualitative observations are also presented under each hypothesis.

f. Physiological results

Physiological results, including PGR and eosinophil data, are presented separately, following the results of the hypotheses testing.

g. Score variances

Variances were computed for each group, by task and mission, for both raw and Delta scores. Statistical comparisons were made between each of the hypothesis groups and the standard experimental group. However, since the results of these comparisons did not appear to be consistent, no reference has been made to them in the discussion which follows. The data are presented, for reference, in Appendix D.

2. Performance Results

a. Hypothesis D: The reduction of anxiety by means of suggestion and reassurance from a prestige figure, combined with the understanding of the nature of impairments and the opportunity to ventilate feelings will reduce performance impairment.

1) Raw scores

In terms of raw scores, this group was not much different from the standard experimental group. On the DCT(R) the group was significantly below the standard experimental group on all four missions. Apparently, however, this test was more difficult for all subjects in the "Z" sample, since the scores for control and standard experimental subjects are similarly depressed. In addition, this hypothesis group was significantly higher on the V_0 task during the second training mission.

2) Delta scores

In terms of Delta scores, the procedures produced significant mean improvement over the standard experimental group on V_I, V_O, and M scores. Concurrently, the mean level on CC, DCT(R) and DCT(E) dropped off, although not significantly. The V_I mean Delta score was raised to one full standard deviation above the control mean. The overall Delta mean was somewhat higher than the standard experimental group, although not significantly so.

3) Cutoff scores

There were significantly fewer subjects below the cutoff score of 40 on V_O Delta scores. Although the statistical test of the overall score was not significant, the percentage of subjects below 40 was smaller than for any other hypothesis group tested.

4) Subject reports

On the adjective checklist subjects reported a smaller increase in negative feelings about the situation than did the standard experimental group. Analyses of the subject questionnaire indicated no response differences between this group and the standard experimental group.

5) Experimenter observations

On the average this group showed fewer of the behaviors characteristic of the standard experimental group. The subjects appeared to be calmer and more in command of the situation and of themselves. It should be noted that only three of the eleven in this group were classified as stressed, and that these three were the only three who fell below the common mean Delta score. (Chi square $P<.01$).

6) Summary

Performance-wise, these procedures were successful in reducing impairment on the V_I, V_O, and Math tasks. As found previously in testing this hypothesis, however (Hypothesis B), this improvement was accompanied by poorer performance on some of the psychomotor tasks (CC, DCT), so that the overall net result was some performance improvement, but not enough to be statistically significant.

Subject reports and experimenter observations do indicate that the subjects seemed to feel better about the situation than the standard experimental group, and that overtly they were better adjusted to the stressful conditions.

b. Hypothesis E: An individual's performance will be impaired less if he feels his work is important to a group or cause with which he is strongly identified, and if he receives encouraging comments from a buddy who also receives the consequences of his performance.

1) Raw scores

These procedures had no significant effect on raw scores.

2) Delta scores

The procedures raised the CC and overall Delta scores to a point only slightly short of significance ($P<.14$). Delta scores on the other tasks were about the same as those of the standard experimental group.

3) Cutoff scores

There were essentially no differences in the percentages of subjects below 40 on any of the tasks compared with the experimental group.

4) Subjects' reports

On the adjective checklist, subjects again reported a smaller increase in negative feelings than did the standard experimental group.

Questionnaire responses were quite different, in many instances, from those of the standard experimental group. On Question 3 (effects of shock on performance), Hypothesis E subjects indicated that it helped their performance. (In comparing the responses on this item with those of the standard experimental group, a Chi square was obtained with a P less than .01.) Similarly, with respect to how anticipating "what was to come" affected performance (Question 5b), these subjects felt that it made them work faster and more accurately. In addition, nine out of the 10 subjects in this group said that they became accustomed to the shock as time went on. Seven out of the 10 subjects answered "No" to the question "Did you ever feel that you wanted out?" This was approximately a reversal of the standard experimental group's responses. In summary, the questionnaire responses indicated that the subjects held up relatively well, psychologically, and that they felt they had good control of the situation.

5) Experimenter observations

Again, the range of standard experimental behaviors appeared, but there were more oral responses to the "buddies." Only two of the 10 subjects fell below the common Delta mean, and these two did not talk to their buddies.

6) Summary

Although the overall Delta score mean for this group was short of statistical significance, there was a trend toward less performance impairment. At the same time, there are strong indications that the subjects were overtly better adjusted to the situation than the standard experimental group. It is likely that the chance to talk freely with the "buddies" had some cathartic effect on anxiety. At the same time, the presence of the buddies may have blocked excessive overt expressions of anxiety. At any rate, the processes are complicated at this point and need considerable investigation before cause and effect relationships can be reliably established.

c. Hypothesis F: The performance of a person may be unfavorably influenced by exposing him to panicky, unnerving comments from one of his companions.

1) Raw scores

There was apparently no effect on raw scores attributable to these procedures. Although the group was significantly lower on the CC during the two stressful missions, it was significantly lower on that task initially (T_1).

2) Delta scores

There were no statistically significant differences between this group and the standard experimental group on Delta scores.

3) Cutoff scores

Again, there were no significant differences between this group and the standard experimental group.

4) Subject reports

It is interesting to note that on the adjective checklist, subjects in this group expressed a more negative attitude than any of the groups tested under procedures designed to reduce rather than increase performance impairment.

On the subject questionnaire, this group stands out as the only hypothesis group in which a majority of the subjects reported two or more tasks as "especially difficult." In addition, there was a higher incidence of negative remarks about the W mission and fewer positive remarks about T_2 mission than in any of the other hypothesis groups.

5) Experimenter observations

It was obvious that some subjects did not fall for the "panicky buddy" procedures. Some of them realized, after a while, that a tape recording was being used. Despite the fact that a number of subjects had reacted to the situation in the same way as the voice on the transcription, many subjects felt that it was overplayed, and that no one would really respond that way. Despite this feeling, there was a considerable increase in complaining, protesting, and in agitated behavior compared to other hypothesis groups, at least until the subjects began to catch on to the situation.

6) Summary

While the performance results from this group are not different from the standard experimental group, and the subjects obviously "caught on" to the situation, there is some indication from their behavior that they were relatively more disturbed than subjects in other hypothesis groups. It is likely that with more convincing procedures (e.g., a live actor) performance impairment might be increased.

d. Hypothesis G: A combination of the procedures employed in Hypotheses D and E will result in greater impairment reduction.

1) Raw scores

In terms of raw scores, this group performed better on V_0, but lost ground significantly on the CC and DCT(R) scores. Although the group performed higher on the Math task initially (T_1) there were no mean differences in any of the other mission scores.

2) Delta scores

The V_0 Delta score for this group reached the level of the Control group, and there was a significant increase in the Math Delta score over that of the standard experimental group. However, these gains were offset in the overall Delta score by drops in CC, DCT(R), and MJT Delta scores. None of these drops was significant by itself, but the net effect was that the overall Delta mean was about the same as for the hypotheses D and E groups. The variance of the overall score was reduced, however (although not significantly so), indicating a trend toward more consistent performance from task to task.

3) Cutoff scores

On the DCT(R), there were significantly more subjects below a Delta score of 40 compared to the standard experimental group. On the V_O, there were significantly fewer below 40.

4) Subject reports

On the adjective checklist subjects' feelings changed less in the negative direction than the standard experimental group. This change was about the same as that of the F and E groups. The responses of this group of subjects on the questionnaire brought out the following results. This group reported that shock helped performance rather than interfering with it. In fact only one subject out of the 10 in the group reported that shock interfered with performance, compared to seven out of 16 subjects in the experimental group. In addition, this hypothesis group indicated that while they were afraid of what was coming, this anticipating fear increased both the speed and accuracy of their performance. Eight out of the 10 subjects in this group reported that they became accustomed to the shock. While, statistically, this was not significantly different from the standard experimental group where 50 per cent reported they became accustomed to the shock, the trend would seem to be consistent with the other findings concerning the better adjustment of the Hypothesis G group. Taken together, the responses suggest that these subjects were better able, somehow, to resolve some of the anxieties connected with the situation so that, at its conclusion, they reported the anticipatory fear as exerting a positive effect on their performance.

Finally, the responses to Question 15g (When it was all over, I thought. . . .") indicated a relatively positive attitude toward the situation. They found the experiment worthwhile and interesting. In comparison with other groups, these responses imply that the subjects felt they had come through the situation rather well.

5) Experimenter observations

The overt behavior of this group was similar to that of other groups. However, in spite of this, only three of the 10 subjects fell below the common Delta mean. All three were classified in the "stressed" category. Three others in the group appeared to be stressed, but performed above the average, while no subject who was classified as "non-stressed" fell below the mean.

6) Summary

While the performance results of this group were similar to those of groups D and E, there are indications that the subjects were better able to adjust to the situation. The reported attitudes, compared to those of the standard experimental group indicate that the subjects found the situation not too disturbing.

e. Hypothesis H: Providing an extended learning period on the task complex before the introduction of the stressful condition will result in reduced impairment.

1) Raw scores

There was little or no difference between the experimental group and its own control group when they were tested as controls (first testing). On the second testing, one difference stands out, viz., controls had a significantly higher Math score at R.

2) Delta scores

Interpretation of the Delta scores is tentative because of the small Ns involved. However, comparing the two groups on overall Delta score for the first testing suggests that they might not have been comparable. This difference was even greater on the second testing.

It should be pointed out that there was a distinct tendency for both the experimental and control Hypothesis H groups to do less well in terms of Delta score on the second testing. Controls did less well on five of the seven tasks and experimentals did less well on four of the seven. There are several possible explanations for this. The data may represent a negatively accelerating learning curve, so that Delta scores, based upon a more positively accelerating section of that curve would be depressed. In addition, the experimental effects of the stressful conditions for the second testing may have been paralleled by a loss of motivation for the second control testing of the control group. Other data certainly indicate that this latter group did not approach the possible performance limits on the task, however. Even with the experience of four extra non-stress training periods prior to the onset of stress, it does seem that this group did no better, and, perhaps overall, even poorer than the standard experimental group.

3) Cutoff scores

The additional training time had no significant effect on the number falling below the cutoff score, on any task.

4) Subject reports

On the adjective checklist, the subjects reflected a less negative change in attitudes than the standard experimental group. They seemed to feel about the same as the subjects in groups D, E, and G. Analyses of the subject questionnaire revealed no significant differences between this group and the standard experimental group.

5) Experimenter Observations

This group was not distinguishable from the standard experimental group either overtly or in decrement terms.

6) Summary

There is no evidence that the additional training time helped either to reduce performance impairment, or to make the subjects more adjusted to the situation.

3. Physiological results

Blood samples were taken before and after testing for eosinophil counts, as well as periodic PGR readings. These results are presented in this section.

a. Eosinophil counts

Table 17 presents the means and standard deviations of eosinophil count drops from before to after testing for each group. The table also shows the mean and standard deviation of the eosinophil percentage drop from before to after testing for each group. Several findings should be noted.

1) These counts have a large intra-group variability, although the inter-group variability is not excessively large.

2) There is a significant mean difference between the "X" University standard experimentals and controls on the percentage drop score, but no such difference for the "Z" subjects.

3) None of the experimental hypothesis groups differed from either standard experimental group in mean percentage drop score.

4) There appears to be a tendency to drop less at the second testing session (Hypothesis H subjects).

Table 17

Eosinophil Results

Group	Drop		% Drop	
	M	σ	M	σ
"X" Controls (N=17)	26.9	48.4	12.8	53.4
"X" Experimentals (N=21)	40.0	36.6	55.6	31.3
"Z" Controls (N=16)	75.5	73.5	41.7	69.3
"Z" Experimentals (N=12)	51.8	41.6	53.0	55.4
Hypothesis D (N=11)	156.4	177.1	61.7	23.2
Hypothesis E (N=10)	50.0	42.9	58.3	28.8
Hypothesis F (N=10)	48.9	82.0	44.6	57.8
Hypothesis G (N=10)	52.2	31.9	71.8	34.7
Hypothesis H (Controls) (N=4)				
First	55.6	15.7	60.9	32.6
Second	25.0	22.9	43.8	42.7
Hypothesis H (Expt'ls) (N=8)				
First	53.9	30.8	50.5	24.4
Second	29.3	80.3	32.0	65.6

b. PGR readings

Table 18 presents the means and standard deviations of the PGR readings, taken at various points throughout the testing sessions, for each of the groups. The following points should be noted.

1) All of the experimental and hypothesis groups have mean readings much below those of the controls at the R and Final points.

2) The mean percentage drops for the various hypotheses are not significantly different from the mean percentage drop for the standard experimental group. However, the percentage drops for the experimental and hypotheses groups are larger than for the control group, with the single (and probably fortuitous) exception of the Hypothesis H group.

3) The mean readings for the Hypothesis H experimental group, first testing (control) compared to second (experimental) testing indicate typical differences between control and experimental readings at various points.

4) While the Hypothesis H experimentals showed an increased mean percentage drop in their second (experimental) testing, this drop was matched by the Hypothesis H controls for their second testing.

In summary, it appears that while PGR readings were sensitive to the situation, they were not sensitive to whatever relief was afforded by the special procedures involved in any of the hypotheses.

c. Physiological intercorrelations

It seemed of interest to explore the interrelationships of decrement score, eosinophil percentage drop and PGR percentage drop. Table 19 presents these correlations. The following points should be noted.

1) There is a general tendency for higher eosinophil percentage drops to be associated with better Delta scores, for experimental subjects. For control subjects, there is a tendency for higher percentage drops to be associated with lower Delta scores.

2) PGR data do not seem to be systematically related to Delta scores.

Table 18

PGR Results (in thousands of ohms)

Group	Initial	Sample	W	R	Final	% Drop
"X" Experimentals (N=22)						
M	26.0	12.1	5.6	3.3	5.3	83.5
σ	29.5	10.7	3.1	2.7	3.2	40.2
"Y" Controls (N=14)						
M	47.7	----	18.7	12.9	9.1	68.5
σ	32.1	----	15.6	8.4	7.3	19.8
"Z" Experimentals (N=12)						
M	38.4	11.9	6.1	3.8	3.8	78.2
σ	35.1	12.1	4.9	3.6	4.0	24.1
Hypothesis D (N=11)						
M	60.9	13.7	4.8	2.9	2.6	88.4
σ	60.0	10.9	2.5	1.4	1.4	14.8
Hypothesis E (N=10)						
M	43.2	6.3*	4.4	3.3	2.9	89.5
σ	41.5	2.9*	3.9	2.8	2.6	6.8
Hypothesis F (N=10)						
M	31.2	8.1	4.4	2.6	1.8	86.9
σ	19.4	6.0	2.6	2.0	0.7	1[illegible].2
Hypothesis G (N=10)						
M	11.4	3.4	1.8	1.3	1.2	77.7
σ	13.9	2.6	1.2	0.6	0.5	18.2
H Controls (N=4)						
First M	56.2	---	10.6	8.9	6.4	76.2
Second M	171.2	---	18.5	9.4	6.4	91.0
First σ	37.0	---	5.5	4.4	4.1	24.4
Second σ	219.8	---	15.2	6.0	4.6	3.4
H Experimentals						
First M (N=6)	41.0	---	19.6	13.8	7.9	67.5
Second M (N=8)	104.9	9.5	3.7	2.4	1.8	92.9
First σ	31.4	---	17.2	9.9	7.4	13.7
Second σ	110.7	7.7	3.0	1.8	1.2	7.4

*N=8

Table 19

Physiological Data and Delta Score Correlations

Group	Comparison		
	Delta vs. Losin. ∫ Drop	Delta vs. PGR ∫ Drop	Losin. ∫ Drop vs. PGR ∫ Drop
Controls			
"X" (N=17)	-.28	---	--
"Z" (N=16, 14, 14)	-.21	.14	.51
Experimentals			
"X" (N=21, 26, 21)	.53	.26	.29
"Z" (N=12)	.14	-.25	.38
Hypothesis			
D (N=11)	-.35	-.19	-.28
E (N=9, 10, 9)	.20	-.12	-.12
F (N=10)	-.12	.20	-.22
G (N=10)	.39	-.35	-.06
H			
Controls (N=4)			
First	-.87	.28	-.72
Second	-.94	.45	-.70
Experimentals (N=8)			
First	.20	-.04	-.01
Second	.42	.45	.03

IV. Discussion and Implications

A. Major Conclusions

The general results of these experiments in impairment reduction due to physical threat stress suggest three major conclusions:

1. The basic laboratory situation is consistently effective as a stressful one. Significant performance impairment was produced even under a variety of procedures designed to alleviate stress. Even subjects who performed relatively better under the special procedures found the experience disquieting. Those groups of subjects who reported themselves as relatively better adjusted in the experimental conditions still behaved as if they were upset, and still performed well below the level of subjects not exposed to the experimental conditions. In addition, physiological data are similar to those found in anxiety states.

2. Despite the apparent resistance of the laboratory situation to impairment reduction procedures, these procedures produced a number of notable effects on performance and behavior. Impairment reduction did take place to a limited degree, and behavioral patterns were modified.

3. A number of potentially profitable areas for further investigation were isolated based on the research results.

B. Discussion of Major Conclusions

The remainder of this section is devoted to a further discussion of these major conclusions and some of their implications.

1. Examiner-supplied structure and support

Those procedures (Hypotheses B and D) in which the examiner provided subjects with special information about the nature and locus of expected impairment, concurrent with examiner support and reassurance, did produce some impairment reduction. Not only did these groups impair less in terms of performance but, on the average, their overt behavior was less symptomatic of being stressed than that of the other groups tested. In addition, it was common for these subjects to express thanks for the examiner's help, e.g., "I want to thank you, Dr. _____. Knowing you were pulling for me was all that brought me through."

Although they performed better, and overtly appeared better adjusted, it should be emphasized that the post-test reports of B and D groups on the questionnaire indicated just as much anxiety as the standard experimental subjects. Thus these procedures helped subjects adjust on a behavioral level in spite of their admitted feelings of anxiety.

The role of the examiner in the basic situation may be thought of as analogous to that of a supervisor in a job situation. The subjects generally accepted and supported this role by their behavior. For example, they were usually deferent, punctuated their speech with "Sir," and, with few exceptions, were respectful in their manner. Throughout this study, the same examiner directed the testing. His role was relatively consistent, and certainly influenced the results to some degree. For example, throughout all the testing procedures there were subjects who asked to quit. Because of the time investment in them, every attempt was made by the examiner to talk them into staying in the situation. Only a handful rejected the examiner's efforts and refused to go on.

Other roles might be assigned to the examiner, however, in attempts to determine the optimum role dimensions which supervisors should have or assume in stressful situations, to minimize behavior impairment. Also little is known about what kinds of informational inputs are most effective in reducing impairment in such situations. A systematic study of various informational inputs would aid in determining what really helps in optimizing performance output in these kinds of situations.

2. Peer-supplied support

One of the critical differences between the approaches used above in Hypotheses B and D as compared with Hypotheses E and G concerned the source of the psychological support. In Hypotheses E and G, support was derived from figures who were perhaps less remote, psychologically. Although these "buddies" were not long-standing acquaintances, the subjects were apparently able to gain as much or more psychological help from them than from the examiner. These groups scored as well as the examiner-supported groups and their post-test reports indicated relatively better adjustment than either the standard experimental, B, or D groups. Nevertheless, they displayed as many overt signs of being disturbed as the standard experimental group.

An important point here is the obvious disparity between overt behavior and reported internal adjustment. While the "buddy" procedures did not inhibit overt expressions of disturbance, they were more successful than any others in helping reported adjustment. These groups actually reported themselves as performing better and more accurately as a result of the stressors. Since no hypothesis group even approached control group performance, the subjects in the E and G groups certainly perceived themselves less accurately than did the B and D groups.

It seems likely that the peer procedures may have provided needed catharsis immediately (more talking to "buddies" by subjects) and as such aided in adjustment to the situation. For

example, the only two group E subjects who fell below the common Delta mean score for all experimental groups were subjects who did not talk to their buddies. This outlet was not available in the procedures which involved examiner support. While subjects gained support from the examiner (Groups B and D), the "buddies" (Groups E and G) gave the impression of empathizing with the subjects, both verbally and by being in the same "tough spot" as the subjects were. The precise nature of the relationships needs more systematic investigation to determine the support patterns which would result in the best performance and adjustment.

3. Motivational assists

Another critical difference in the Hypotheses E and G procedures involved the introduction of a "cause" for which to work. While the sudden introduction of a cause of considerable importance to an individual's future might easily create greater anxiety, our results suggest that if any such effect occurred, it was counteracted by an even greater increase in motivation. The nature and extent of the contribution(s) of these "cause" procedures to the observed results were not determined in this series of experiments. Further work in this area should determine how the introduction of a cause affects an individual, and just whom individuals usually work for--their unit, their buddies, or themselves. A study of the effects of these "cause" procedures by themselves should make an important contribution to the understanding of the specific need patterns of the individual in a stressful situation, and how these patterns are and can be associated with the reduction of performance impairment.

C. The Effects of Training

One tentative finding which appears to have definite implications for training programs concerns the lack of evidence that additional training time mitigates the influence of stress on performance. The results of this research neither refute nor support the assumption that more training inhibits performance impairment under later stressful conditions. Examiners reported that Hypothesis H subjects seemed to feel betrayed after having experienced a non-stress afternoon, and then later being subjected, without warning, to the then familiar situation under new and difficult conditions. The lack of a larger control group against which to compare the Hypothesis H experimental subjects is unfortunate, but the tentative performance findings do not even support an assumption long accepted because of its face validity, i.e., that more training prior to exposure to stressful conditions helps an individual "hold up" better under those conditions. Thus, the findings in this study point strongly to the need for a systematic investigation of at least two problems in this area:

1) The effects of varying amounts of prior training on later performance under stressful conditions; and

2) The effects of training under stressful conditions on later performance under stressful conditions.

Intensive study of these two problem areas should make it possible to determine at what point in the learning process (if at all) stress should be introduced in order to minimize later performance impairment. Such systematic investigations are especially needed if personnel are to be trained to meet many of the unusual environmental conditions which may be peculiar to flight in and beyond the outer atmosphere.

D. Further Implications of the Research

One of the main achievements of this research is the development and standardization of a laboratory performance situation with demonstrated sensitivity to various environmental inputs. In addition, certain studies, focused on reducing performance impairment, were carried out on an exploratory basis. As intended, these studies resulted in the identification of specific areas in which more systematic research may provide answers of general importance to personnel research.

In addition to the findings discussed above, the research results have implications for a number of other problems:

1. This laboratory situation resulted in a wide spread of performance levels ranging from virtually complete functional breakdown to performance which was equal to that of the average subject tested under non-stress conditions. Thus, the standard situation developed in this study can assume the nature of a proximate criterion of operational physical threat conditions against which a wide range of impairments may be studied. For example, the availability of such a proximate criterion makes possible careful comparative studies of the characteristics of subjects whose behavior is resistant to physical threat situations, as opposed to those who succumb to such stresses.

2. Although the research was largely confined to the study of individual performances, the situation is apparently sensitive to supervisory and peer inputs as well. By enlarging it to include more crew members, the specific dimensions of such situations which result in optimal crew performance under stressful conditions could be isolated and studied.

3. This series of studies was confined to a single task complex. Further investigations involving systematic manipulations of the sub-tasks in terms of distribution of effort, number of activities, difficulty of the complex, etc., can now be undertaken. These studies would contribute to an understanding of the optimum utilization of man's capabilities under stressful conditions.

4. Pre-tests have demonstrated the sensitivity of the task complex to two additional types of stressful conditions found in aircrew operations, viz., long-term performance and performance under social-evaluative stress. Systematic studies of these stresses and of the impact of combinations of the three types of stressful

conditions on performance should result not only in greater understanding of behavior impairment, but also in promising methods for successfully resisting such impairment.

5. The basic laboratory situation includes most of the activities which are likely to be involved in air or space flight. Thus, it can be an effective research tool for the study of human behavior under other unusual environments which can be reproduced in the laboratory.

V. Summary

The major goals of this research project have been:

1. To develop procedures for realistically producing in the laboratory certain of the stresses which have been found to exist operationally in aircrew job performance.

2. To study the nature of the performance impairments resulting from various types of stressful conditions. This involved the development of standard tasks to measure the important types of performances which have been found to be impaired under stress situations.

3. To explore techniques for reducing performance impairments due to stress situations.

This research progressed through the following phases:

1. The development of a laboratory task complex, based upon careful psychological analyses of known performance impairments in aircrew operations.

2. The development of laboratory procedures for realistically simulating important operational stresses, based on careful psychological analyses of actual flight conditions.

3. The demonstration of performance impairments in the laboratory situation, resulting in quantitative and qualitative descriptions of the nature of the impairments.

4. The development and exploration of hypotheses for the reduction of performance impairments in the standardized laboratory situation.

One of the important features of the study is that its logical and psychological development was subjected to the careful review and critique of experts in the area of stress research after each phase of the study. Research evidence presented in this report and in the interim report (3) indicates that significant progress had been achieved toward the research goals and toward a greater understanding of human behavior under stressful conditions.

A major accomplishment of the study has been the development of a laboratory situation in which behavior impairment under stressful conditions can be studied. The development of this situation makes feasible investigation into a number of important problems in the area of stress research. Some of the more important of these problem areas have been described in this report.

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Appendix A

Materials Sent to Reviewers

1. Set of 10 Hypotheses

2. Rating Sheet and Instructions

1. Set of 10 Hypotheses

Hypothesis #1. Suggestion-Reassurance

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: The reduction of anxiety by means of Suggestion and Reassurance from a prestige figure, combined with the opportunity to ventilate feelings will reduce performance impairment.

Data Source: It appeared that much performance impairment was a result of anxiety. Many subjects who impaired reported being anxious and gave overt evidence (shaking, voice tremors, etc.) of being so.

Implementation: It will be suggested to the subjects by a prestige figure (the examiner) that they have done and are doing well. The prestige figure will periodically reassure them that they and their performances are acceptable. Between stress missions he will give them an opportunity to ventilate their feelings and problems.

Sample Script:

(after sample shock): "How are you doing so far Able? (Waits for answer) Baker? (Waits for answer) Well, I realize that was a little rough, but you both have one strong point in your favor. That is that according to our observations you have both done very well so far -- better than you may think -- and we are pleased.

"Now this afternoon we are interested in finding out how people, and you in particular, behave in a situation which makes them anxious or afraid. Let me get one thing clear to you, it's no disgrace to get anxious or afraid. One of the things we have found from our wartime experiences is that everyone gets anxious sooner or later if the situation gets tough enough. Actually getting anxious or even scared is a perfectly normal reaction.

"We are also interested in finding out how people carry out their jobs in these situations. More exactly, we want to see how you perform on the tasks we have in our airplane. We know already from the work that we have done that people do make mistakes or slow down when they become upset. Our job is to prevent that from happening, both to you and to airmen who find themselves in a similar fix. We want to do everything possible to see to it that you continue to do well even though you may become somewhat anxious.

"There is one big factor in favor of you both. You have both done very well thus far and made good progress. Not everyone who takes these tests does as well as you have, and we know that those people who make as good progress as you have so far, do well in the tough situations and continue to get even better. Your work so far indicates that you should be able to handle everything that will be asked of you during the next few missions, and that you will continue to do well and to improve your scores as we go along."

Hypothesis #1. Suggestion-Reassurance (Continued)

Weather Mission

(Numbers in parentheses refer to elapsed time of the 30-minute mission)

(5.0') "You are doing a nice job so far."

(9.0') "Your scores look pretty good -- keep at it!"

(11.5') (After the second heavy shock): "Now I want to emphasize that you are still doing relatively well. Don't be discouraged."

(12.5') (After 3rd heavy shock): "Keep at it, you are handling it nicely. Your scores show that you are taking things in your stride."

(18.5') (After 4th heavy shock): "I like the way you recover yourself. I'm pleased with the way you are handling this. Keep up the good work."

(22.5') "You have done very nicely so far and your scores show good improvement."

(28.0') "Your scores are looking good. I think you both are doing very well."

Between the Weather and Reconnaissance Missions, subjects would be given the opportunity to ventilate their feelings and problems. The experimenter would listen and make non-directive comments where appropriate.

Reconnaissance Mission

(6') "Things are going nicely now. You are getting better all the time."

(7.5' Heavy Shock) "Don't let that faze you! You are doing well!"

(8.0' Heavy Shock, No comment)

(8.5' Heavy Shock) "I like the way you keep going in spite of distractions. It's very encouraging to see someone handle this this well."

(14.5' Mild Shock) "That's the way -- keep after it -- you are making real progress!"

(17.0' Heavy Shock) "Nice going! You took that well!"

(17.5' Heavy Shock, No comment)

(17.8' Heavy Shock) "Let me say again, that it is extremely satisfying to see you handling these situations so well -- keep up the good work."

(20.0') "Your scores are looking good. Nice going!"

(22.0' Heavy Shock) "Keep aiming at further improvement. Just try to ignore these little rough spots."

(22.5' Heavy Shock) "That's the way to go, you're handling yourself very well."

(24.5' Heavy Shock, No comment)

(25.0' Heavy Shock) "Very Good! You are actually continuing to improve in spite of everything! Very Good!"

(28.0' Mild Shock) "Keep it up! Things are looking very good now!"

Hypothesis #2. Good Buddy

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: Encouraging comment from a crew member, who also receives the consequences of the subject's performance, will reduce performance impairment.

Data Source: Largely theoretical. However, the experimenters observed some tendency for the comments of one subject to affect the behavior of another.

Implementation: Two persons will be hired as dummy subjects to sit at separate desks and be the respective "crew members" for the two subjects. Each dummy subject will have electrodes attached to him and each real subject will be led to believe that his "crew member" is going to be shocked according to his (real subject's) performance. During the course of the experiment each "crew member" (dummy subject) will read a script to his "pilot" containing encouraging and supportive comments. At the same time they will actually record the responses of the subjects. It is planned that these two "crew members" be chosen from among prior subjects and that the same two be used for all of the subjects used in the test of this hypothesis. Of course they will not be shocked.

Each buddy or crew member will speak privately to his pilot, the subject. Each buddy will use the same script and make the same comments. These comments will be made so that each subject will hear only his own buddy.

It is felt that this type of situation has a counterpart in Air Force situations where the pilot must fly the plane and the crew must depend upon his performance. In addition, the "buddy system" itself has considerable popularity in the military services.

Crew Member's Script: (The numbers in parentheses refer to elapsed time, in minutes of the 30-minute mission).

Weather Mission

(2') "That's the way! You're doing swell."

(5' Mild Shock) "Never mind that, we're okay, you're doing fine!"

(9') "Boy, you are really making that thing hum. We are going to do all right with this."

(11.2' Heavy Shock) "Well, that wasn't so bad. That won't even slow us up."

(11.5' Heavy Shock) "Never mind, I'm right with you, you're doing fine."

(12.0' Heavy Shock) "If it doesn't get any worse than that, I think we'll handle it okay. I just wish I could help more."

(14' Mild Shock) "Nice going! You sure got us out of trouble that time."

(20' Heavy Shock) "Just a little slip up. Don't worry about me, I think I'm beginning to get used to those, (chuckles) at least a little bit."

(22') "Looks like you've managed to get us out of the bad weather, Able. Good work."

Hypothesis #2. Good Buddy (Continued)

(25' Mild Shock) "Don't worry about those little ticklers! We've got this thing licked now!"

(29' Mild Shock) "I think we've got it made now."

(30' End) "Whew! Nice going! I'm glad I was riding with you. It wasn't so bad but it could have been a lot worse if you had goofed up."

Reconnaissance Mission

(At the beginning) "Okay, boy, here we go again. Remember I'm with you all the way."

(4' Mild Shock) "I think you are really getting the hang of this. You're getting us out of most of the rough ones now."

(7.5' Heavy Shock) "Don't worry about me, I'll be O.K. Just stay with it. I'm right with you."

(8.0' Heavy Shock) "That's the way to go. Boy! You have really got it to ride through like you're doing."

(8.5' Heavy Shock) "That one was kinda rough, but you begin to get used to them after a while. We're doing fine."

(11.0' Mild Shock) "Huh, they must have run out of juice! You know, I think we can take anything they've got."

(14.5') "You're getting better on all of the tasks now."

(17.5' Heavy Shock) "Steady, boy, that was just a little slip up."

(17.8' Heavy Shock, No comment.)

(18.0' Heavy Shock) "Well, we've taken the worst they can give us now and we're still here. We'll show 'em."

(22' Heavy Shock) "You know, I think we can get to the place where we don't notice these shocks so much. That one didn't seem bad at all."

(22.5' Heavy Shock) "See, you recovered yourself and went back to it much more quickly than you used to. I'll bet you have gotten us out of more than half of these tight spots."

(24.5' Heavy Shock) "Huh, that one wasn't worth worrying about."

(25.0' Heavy Shock) "You're doing okay, we'll outlast 'em yet."

(26.5' Mild Shock) "Looks like you've gotten us out of trouble again."

(28.5' Mild Shock) "You sure have learned how to handle that stuff."

(30.0') "Nice going buddy, we made it, thanks to you."

Hypothesis #3. Panicky Buddy

(Hypothesis for Increasing Performance Impairment)

Hypothesis: The performance of a person may be unfavorably influenced by exposing him to panicky, unnerving comments from one of his companions.

Data Source: When one subject of a pair yelled, the other subject of the pair tended to yell. Similarly, if one subject of a pair decremented, the other tended to decrement.

Implementation: In addition to Able and Baker, the subjects, an assistant ostensibly a subject, would also present himself for the experiment. Able and Baker would be appointed to the booths and Charley, the assistant, designated to fly as crew member. In order to test the effects of the panicky behavior of a buddy unconfounded by strict dependency, Able would be told that Charley would receive consequences according to Baker's performance, and that he would be Baker's crew; while Baker would be told that Charley would receive the consequences of Able's performance as a member of Able's crew. Charley would then make panicky remarks according to a script and time schedule out of phase with the shock time schedule. Charley's comments would really be made via taped recording.

Script for Examiners:

(In addition to the regular training, the examiners would have to instruct Able and Baker as to Charley's function.)

"(Aside to Able) Now, Able, on these next missions you are going to be flying wing for Baker in a single-seat aircraft. Charley is going to be Baker's crew man, and will record his answers to the problems and his reports on his instruments and windows. I will record this information for you, myself. Since Charley belongs to Baker's crew, whatever happens to Charley depends on what Baker does. What you do does not affect Charley at all. Is that clear? Let me repeat. Charley is Baker's crew man. He gets shocked along with Baker whenever Baker gets into trouble. You have no crew. Therefore your performance has no effect on what happens to Charley or Baker -- just what happens to you."

(The same script is repeated in an aside to Baker, interchanging the names of Able and Baker.)

Charley's Script: (Numbers in parentheses refer to elapsed time in minutes for a 30-minute mission)

Weather Mission

(2') "Hey! That's too strong!"

(6') "Come on, turn it down, that's burning me."

(9') "Unhaggh! Oooh! My arm -- it's paralyzed! Come on, fellow, work those things -- it's your fault I got hurt bad!"

Hypothesis #3. Panicky Buddy (Continued)

(11') "How about it? Fix that thing will you?"

(13') "Aghhhhh! (Moans) Oh, Oh, Oh! That really hurt me!"

(15') "Come on, get those things going so I don't get any more of this!"

(17') "Yooohhh! Ooh, give me a break, will you -- I must be getting all of it -- I can't take it so strong."

(21') "Noooo (Moans) Not any more."

(23') "Ohhh (Moan)"

(26') "Aahhhh! (pleading) Please turn it down -- give me a break -- I -- ah -- I'm -- please stop it."

(28') (Moan)

(30') "Thank the Lord it's over!"

Reconnaissance Mission

(0') "Now, this time please do better than you did before -- I was really suffering!"

(3') "Oooh! Fix the adjustment! That's too strong to last so long."

(7') "Ooahhh! Ahhhh! (shaky) Come on will ya! That's hurting me -- really!"

(8') "Ahhhhh! Stop it I can't take that: I can't even move any more!"

(9.5') (Yells, screams) "Oooh all that current - hurts - I give up - I can't do it -- (Moans, sobs)"

(13') "Uuhh (Moans, sobs)"

(16') (Screams, yells) "Let me go -- I'm through, I've had too much -- pleeease let me go -- you're (sob) hurting me (sobs)."

(17') (Sobs for next minute or so.)

(20') (Screams then sobs) "Have pity on me -- please!" (sobs)

(23') (Screams then sobs)

(25') (Screams then sobs)

(26') (Moans, sobs each ½ minute through rest of test)

Hypothesis #4. Understanding -- Aural Reminder

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: The insertion of an aural reminder into the man-machine system, combined with training to understand the nature of impairments and training in self-pacing will reduce performance impairment.

Data Source: Subjects reported being unaware of much of their impairments. Their scores showed that they had concentrated more on the psychomotor tasks than on the time-shared tasks.

Implementation: Subjects would be trained as to the nature of expected impairments. They would be given suggestions for establishing a self-paced routine. Finally, they would be instructed in the use of an aural reminder occurring every 20 seconds.

Sample Script:

"One way to avoid these shocks in the missions that you are about to fly is to perform well. Now, we can help you do well. We have been testing men like you for some time now. We have found that if you understand where you are likely to get poorer, you can work harder on those tasks. By working harder you can do enough better so that you will avoid getting hurt, at least to some degree. We have found - and this is important to both of you - that practically everyone falls down on three particular tasks when he is put into a tough situation. First of all, he fails to report some of the dials that are out. Second, he doesn't get all the mountains, airplanes, and cities that pass by. Finally, he does not get as many math problems correct; in fact, he doesn't even see many of them or try to solve them. Almost everyone has the same trouble, largely because he does not realize what is going wrong. There are three reasons that he has these troubles. One is that he just forgets to look around when he is under pressure. You must remember to look around. The other is that he somehow gets the idea that these three tasks don't matter as much as the other tasks. That is not true - all tasks count equally in determining what will happen to you. You must try to do well on each task. Don't neglect one in favor of another. The third reason that you may have troubles is that you spend so much of your time thinking about what may happen to you that a lot of your energy goes into that rather than into the tasks. We have found that the people who do best are those who force themselves not to think about what may happen to them, but try to do the best job possible. Now let's go over this."

(Experimenter rehearses subjects)

"A second way that we can help you is this. We have found that you do much better if you try to develop some routine of operations. You should try to follow at least some of the suggestions I am going to make. Of course these suggestions do not include all possibilities and you may substitute other steps or other routines if they seem better for you.

Hypothesis #4. Understanding -- Aural Reminder (Continued)

The important thing is to establish a routine of operations of some kind. Here are the suggestions:

1. Always look around whenever you change from one task to another.
2. Check your windows and dials regularly.
3. Glance at math problems as soon as they appear, fix the problem in your mind, work it out as you continue to fly. You can report the answer later.
4. After a shock grab something to work on as soon as possible.
5. Try to become aware of the passage of time. Time will pass more rapidly than you think and you must look around more often and try to remain aware of the passage of time.

"Now I'll repeat these suggestions. (Does so.) Now let's go over them and give them to me. (Rehearses subject)

"Finally, we are going to give you a reminder to look around. We have found that one of the things that happens to a guy when he gets into a tight spot is that he forgets to look around and see what is happening inside and outside of his airplane. So that you won't forget to look around, we have installed a chime which will sound periodically to remind you to look around. It sounds like this. (Demonstrate) When you hear the chime, look around -- no matter what you are doing, look around, especially at the windows, dials, and math box.

"Now of course you may look around <u>any</u> time -- but always look when the chime sounds. Remember, however, the chime can't work the machines for you so you must continue to try hard on every task.

"Now tell me what you are to do when the chime sounds. (E prompts if necessary)

"Now let's sum this up. Now that you understand what you are likely to do wrong, I'm sure that you will remember to look around, that you will remember that all tasks count equally and that you must not waste time worrying about what might happen. You should also remember that you should try to develop some routine of operations so that you can keep track of time and so that you won't forget to do things on time. The chime will help you to keep track of time. Don't forget to pay attention to this reminder. Remember to look at your windows, dials, and math box whenever the chime sounds.

"Finally, if you should get shocked, remember that there is no relationship between getting shocked and the particular task you are performing on at the time of the shock, since there is a lag in the equipment, and scores on different tasks accumulate to the point where you may be shocked."

(Between W and R Missions, E repeats earlier summary statement.)

Hypothesis #5. Shock Regardless

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: Performance impairment will be reduced if the individual believes that he has no control over what happens to him in the situation.

Data Source: Subjects who did not believe that the shock they received was related to displays (including level of performance) on the Stress Programmer exhibited significantly less performance impairment than those who did. In addition recent experiments have shown that of two monkeys stressed by shock, the one with some control over the situation develops the ulcer.

Implementation: Just before beginning the two stress missions, subjects will be told that being shocked is not related in any way to performance in the situation.

Examiner's Script:

"The Air Force is interested in finding out how people perform in various situations. One type of situation which occurs frequently in the Air Force is one where the pilot cannot escape the danger no matter how well he performs. Now, this afternoon you will be shocked according to a prearranged schedule. You will have no control over when and how often you will be shocked. Remember, however, you must continue to perform your best at all times.

"Let me explain this situation once more. There are times when what happens to you depends on circumstances outside of your control. This afternoon is one of those times. You will receive a certain number of minor annoyances in the form of shocks no matter what you do on the tasks. You must keep up your performance on all tasks, however, because the Air Force needs to know that it has men who can disregard minor and inconvenient irritations and still continue to carry out their missions in a superior way."

(Examiner rehearses subjects)

Hypothesis #6. Placebo - Suggestion

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: Anxiety can be reduced by suggesting to subjects that it will be reduced; and performance will in turn be impaired less.

Data Source: Subjects appear to have been and reported having been anxious. This appears to have contributed to performance impairment.

Implementation: Experimenters would suggest to subjects by means of a script containing reassuring statements that they were doing well and were capable of handling the situation. In addition subjects would be given a (placebo) pill described as something to make them less anxious.

Sample Script:

(after the sample shock): "Well, you both have done very well so far. I know that this hasn't been easy so far, but I imagine that you both can remember having been in tough spots before in your life, can't you? (E should pause here and expect affirmation and possibly comments from subjects.) You know, one of the things that has been found from wartime experience is that everybody gets anxious sooner or later in tough situations. Actually, getting anxious or even scared is a normal reaction.

"One of the things we are interested in is finding out more about how people behave in a rough situation in which they are anxious or afraid. More exactly, we want to see how they perform on the tasks we have in our airplane. We know already from the work that we have done that people do make mistakes or slow down when they become upset. Our job is to prevent that from happening, both to you and to airmen who find themselves in a similar fix.

"What does all this mean to you? It means first of all that we're going to have to put you into some pretty rugged situations this afternoon - situations which other people have found tough. However, we want to do everything possible to see to it that you do well and are not afraid in these situations.

"There are two things in favor of you both. First of all, you have both done very well this far and made good progress. We know that those people who make as good progress as you have so far do well in the tough situations and do not get as afraid as those who do poorly. However, just to make sure that you are not hindered by getting too anxious in this situation, we are going to ask you to take two of these pills. They have been developed by Air Force research especially for people who know that they are going to be in tough situations. Here's how they work: In about 10 minutes you will notice a sort of relaxing, calming effect. It will be hard for you to worry about the tough situation because you will be calm and actually more efficient. Of course, you will have no physical or mental after effects since they wear off in a couple of hours, they will carry you through the rest

of the afternoon though. The main point is that they will help you do especially well because you will be calmer in the face of a tough situation. (E gives pills to subjects with water.) Now of course these pills can't work the machines for you. You'll still have to work very hard, but at least you'll be more calm and efficient as you work. I'm sure that these, together with your basic ability, should give us very excellent scores during the rest of the afternoon."

After Weather Mission, subjects again are told: "You are doing well - keep working hard -- the pills are helping you very much."

Hypothesis #7. Overload Training

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: Training under task overload will broaden the field of attention and thus reduce performance impairment.

Data Source: Most of the observed performance impairment occurred on the time-shared tasks and seemed to be a function of a sort of narrowing of the attention to one thing at a time.

Implementation: For the purposes of training under task overload, the subjects would have two non-stress missions followed by the Weather and Reconnaissance missions. The first training mission would be done exactly as in the past. The training on additional tasks and procedures would then be inserted and followed by the second training mission during which the subject would be required to use the extra tasks. Following that, the extra procedure would be dropped for the Weather and Reconnaissance missions.

Two of the suggested extra tasks consist of extra reports to make, while the third is an extra task to be performed during performance on the Complex Coordinator and/or the Motor Judgment Test. This third task, developed by Brozek, consists of a small vertical pipe with a net below it and a counter on it. The subject is required to pick up a ball-bearing from the net, drop it through the pipe, pick it up again and drop it through again, etc. The number of passages through the pipe per unit of time is considered a measure of manual speed and dexterity. The task can be done without looking after a short period of training, and can be done with either the left or right hand.

Script:

"Now we have some other things for you to learn. Don't worry about having too much to do, but just keep plugging away. You are to perform several other tasks while you fly the airplane. These are as follows:

1. "In the net on the apparatus we have just placed in your booth you will find a ball-bearing. The object of the task is to drop the ball-bearing through the pipe as many times as possible. Go ahead and try this. (Experimenter rehearses subjects.) Now, you will do this task whenever you are working on the white discs and pointer or the airplane controls. You must try to do both at the same time, you may not stop working on one to do the other and of course you must still watch for patterns, out-of-tolerance conditions, and problems. Now let me repeat. (Does so.) Now we will have a two-minute practice period on this task. (Does so.)

"In addition to this extra task, you must also attend to two other extra tasks.

2. "You must keep track of and report the number of occurrences of each pattern, airplanes, cities, and mountains, in your windows every

5 minutes. A pad and pencil are provided for you.

3. "Every time you see an airplane you must report to your leader on the radio: This is Able (or Baker) to Charley Leader, this is Able (or Baker) to Charley Leader, Mig's at two (10) o'clock high (low)."

* * * * * * *

The E would then repeat the three extra tasks and rehearse the subjects on what to do. When it became evident that the subject understood each of the three additional training tasks, the second training mission would be run using these tasks. Afterwards subjects would get the Stress Programmer Training and shock.

Before beginning the Weather Mission, the subjects would be told that they might omit the extra tasks for the next several missions. They would be rehearsed on which tasks they should omit.

Hypothesis #8. Identification

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: An individual's performance will be impaired less if he feels his work is important to a group or cause with which he is strongly identified.

Data Source: Observations by the experimenters suggested that some empathy with the situation was necessary for good performance. In addition, it has been observed in combat situations that those groups with more group identification perform better.

Implementation: Subjects will be told by the examiners or perhaps an AFROTC officer that a recent redistribution of military funds makes it necessary to curtail some of the AFROTC program. They will be told that one of the detachments in the Washington area will be de-activated and that the purpose of the present project is to aid in determining which of the five is to be deactivated.

Script:

"Now, men, before we continue with your work this afternoon, I am going to have Captain _____ explain to you why we are here. Captain _____."

Captain _____ : "As you may have heard, there has recently been a redistribution of funds available to the Air Force. Some programs, such as missile development, are to receive more emphasis, and others are to be cut back somewhat. Unfortunately, the ROTC program is one that is to be cut back.

"As you may know, there are five Air Force ROTC detachments in the Washington area. Air Force ROTC Headquarters has decided that the best way to carry out the necessary cut back in ROTC operations is to de-activate a certain number of detachments across the country. One of the five detachments in this area is to be de-activated.

"I'm sure you realize what a difficult decision it will be to decide which of these five detachments to de-activate. Many factors will be considered of course. However, headquarters AFROTC feels that one of the most important factors to be considered is the ability of the men in these detachments. The purpose of these testing sessions is to measure the ability of the men in the ("Z") detachment, and to those of you who take these tests falls the responsibility of seeing to it that the ("Z") detachment is not to be de-activated.

"Let me repeat this information so that I may be sure that you understand it. Due to fund cuts for the Air Force ROTC program, one of the detachments in this area must be de-activated. In order to decide which unit to de-activate, headquarters AFROTC has decided to test the ability of the men in the various detachments. These tests will form a very important basis for deciding which detachment is to be de-activated. Only a few of the men

in each detachment can be tested, and it is up to them to represent their detachments. Specifically, you and a few others will be largely responsible, by your performance this afternoon, for the future of the ("Z") detachment. I hope that you will respond to this responsibility to the best of your ability.

"Now I'll let Dr. _____ get started with the remainder of the testing session."

Dr._____ : "Thank you Captain _____! Now that you are aware of the importance of your work this afternoon you will of course want to do your very best work on all of these tasks."

(Continues with standard program.)

(Between Weather and Reconnaissance Missions, subjects are reminded briefly of the importance of their work.)

Hypothesis #9. Aural Blip

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: The installation of an aural signal into the man-machine system will significantly reduce performance impairment on time-shared activities.

Data Source: Apparent overconcentration or "tunneling" on the psychomotor tasks resulted in ignoring the time-shared tasks such as math and vigilance.

Implementation: Subjects would be informed that vigilance tasks and math suffer in tight spots and that an auditory signal would be supplied every 20 seconds to remind them to attend to these tasks.

Sample Script:

"Now you probably thought that sample shock was pretty rough, didn't you? (pause) Well, naturally you'll want to avoid those shocks if at all possible. Of course the best way to do that, as we have just said, is to perform better on all of the tasks. Now, we can help you. We have found that one of the things that happens to a guy when he gets into a tight spot is that he forgets to look around and see what is happening inside and outside of his airplane. So that you won't forget to look around, we have installed a chime which will sound periodically to remind you to look around. It sounds like this. (Demonstrate.) When you hear the chime, look around -- no matter what you are doing, look around.

"Now of course you may look around any time -- but always look when the chime sounds. Remember, however, the chime can't work the machines for you so you must continue to try hard on every task.

"Now tell me what you are to do. (E prompts if necessary)

"Now, I think the chime will help you. Just remember -- look around whenever you hear the chime and see if anything is happening either inside or outside the airplane."

(after the Weather Mission): "I think the chime is helping you. Remember to check your windows, dials and math box whenever you hear the chime."

Hypothesis #10. Understanding

(Hypothesis for the Reduction of Performance Impairment)

Hypothesis: The training of individuals to understand the nature of their performance impairments and the opportunity to talk about them would reduce performance impairment.

Data Source: It appeared that much of the impairment that occurred was unknown to the subjects. Therefore, little corrective action could be taken.

Implementation: Subjects will be told what kinds of impairments they are likely to make. After the first stress mission, they will be given the opportunity to discuss them.

Script:

"Now you probably thought that sample shock was pretty rough, didn't you? As we have already told you, one way to avoid these shocks in the missions that you are about to fly is to perform well. Now, we can help you do well. We have been testing men like you for some time now. We have found that if you understand where you are likely to get poorer, you can work harder on those tasks. By working harder you can do enough better so that you will avoid getting hurt, at least to some degree. We have found - and this is important to both of you - that practically everyone falls down on three particular tasks when he is put into a tough situation. First of all, he fails to report some of the dials that are out. Second, he doesn't get all the mountains, airplanes, and cities that pass by. Finally, he does not get as many math problems correct; in fact, he doesn't even see many of them or try to solve them. Almost everyone has the same trouble, largely because he does not realize what is going wrong. There are three reasons that he has these troubles. One is that he just forgets to look around when he is under pressure. You have got to look around. The other is that he somehow gets the idea that these three tasks don't matter as much as the other tasks he is working at. That is not true - all tasks count equally in determining what will happen to him. You must try to do well on each task. Don't neglect one in favor of another. The third reason that you may have troubles is that you spend so much of your time thinking about what may happen to you that a lot of your energy goes into that rather than into the tasks. We have found that the people who do best are those who force themselves not to think about what may happen to them, but try to do the best job possible.

"Now, stand by Baker, while I talk to Able."

(E asks Able to repeat what he has just said.)

"Now, stand by Able, while I talk to Baker."

(E asks Baker to repeat what he has just said.)

(During this feedback from the subjects, E makes any comments or asks any questions necessary to help S get a better UNDERSTANDING of what will happen to his performance under stress.)

"Remember where you are likely to fall down in your performance. You must still keep up on the other tasks, of course. Try to forget about what may be coming, and just try to do a good job."

After the Weather Mission and before the Reconnaissance Mission, the S's are given a chance to ventilate their feelings and rehearse their understanding of the likely impairments while E comments non-directively on feelings and aids the S's to develop their understanding of the situation.

2. Rating Sheet and Instructions

Each of the accompanying ten hypotheses is to be evaluated in terms of the reduction in performance impairment which might be expected from its use in conjunction with the standard situation. As is indicated in the Abstract, the experimental subjects averaged about one standard deviation of impairment in their overall decrement scores. We are asking for an educated guess about how much of this impairment would remain if the hypotheses are implemented as indicated.

These ratings are to be made in terms of standard score points where -10 points equals one standard deviation below the control mean of zero. For example, if you feel that hypothesis number 1 would result in a half standard deviation of performance decrement your rating would be -5. If you feel that the proposed procedures would not affect the amount of overall decrement, your rating would be -10 (mean experimental decrement). An increase in expected decrement of three-fifths of a standard deviation might be indicated as -16, while reduction of impairment to normal or control group level would be indicated by a zero rating.

On the attached sheet is a graphic illustration of the scale to be used showing the location of the standard control and experimental groups on a standard score scale of overall decrement. Minus scores indicate decrement and plus scores indicate increment as compared to control group performance. Please place your rating for each hypothesis, corresponding to its expected position on the given scale, in the place provided. Please indicate the primary reasons for your rating.

In addition, please indicate below your ranking of all hypotheses (except Number 3) according to judged success in reducing overall performance impairment. Thank you.

Rankings

Hypothesis #	Ranking	Hypothesis #	Ranking
1	_____	7	_____
2	_____	8	_____
4	_____	9	_____
5	_____	10	_____
6	_____		

Rating Scale

-15 -10 -5 0 +5

Experimental Group Control Group

Ratings

1. Suggestion - Reassurance. Rating: ___

Reasons:

#2. Good Buddy. Rating: ___

Reasons:

3. Panicky Buddy. Rating: ___

Reasons:

#4. Understanding -- Aural Reminder Rating: ___

Reasons:

5. Shock Regardless. Rating: ___

Reasons:

#6. Placebo - Suggestion. Rating: ___

Reasons:

#7. Overload Training. Rating: ___

Reasons:

#8. Identification. Rating: ___

Reasons:

#9. Aural Blip. Rating: ___

Reasons:

#10. Understanding. Rating: ___

Reasons:

Appendix B

Materials Used to Implement Hypotheses

1. Hypothesis D: Examiner's Script
2. Hypothesis E: Examiners' Script
   Crew Members' Script
3. Hypothesis G: Procedures

1. Hypothesis D: Examiner's Script

(After sample shock): "How are you doing so far Able? (Waits for answer) Baker? (Waits for answer) Well, I realize that was a little rough, but you both have one strong point in your favor. That is that according to our observations you have both done very well so far -- better than you may think -- and we are pleased.

"Now this afternoon we are interested in finding out how people, and you in particular, behave in a situation which makes them anxious or afraid. One of the things we have found from our wartime experiences is that everyone gets anxious sooner or later if the situation gets tough enough. Actually getting anxious or even scared is a perfectly normal reaction.

"We are also interested in finding out how people carry out their jobs in these situations. More exactly, we want to see how you perform on the tasks we have in our airplane. We know already from the work that we have done that people do make mistakes or slow down when they become upset. Our job is to prevent that from happening, both to you and to airmen who find themselves in a similar fix. We want to do everything possible to see to it that you continue to do well even though you may become somewhat anxious.

"One big factor in favor of you both is this: you have both done very well thus far and made good progress. Not everyone who takes these tests does as well as you have, and we know that those people who make as good progress as you have so far, do well in the tough situations and continue to do well and to improve.

"Now in addition to all the ability and progress you have shown, I think that we can help you do even better. We have been testing men like you for some time now. We have found that if you understand where you are likely to get poorer, you can work harder on those tasks. By working harder you can do enough better so that you will avoid getting hurt, at least to some degree. We have found - and this is important to both of you - that practically everyone falls down somewhat on three particular tasks when he is put into a tough situation. First of all, he fails to report some of the dials that are out. Second, he doesn't get all the mountains, airplanes, and cities that pass by. Finally, he does not get as many math problems correct; in fact, he doesn't even see many of them or try to solve them. Almost everyone has the same trouble, largely because he does not realize what is going wrong.

"There are three reasons that he has these troubles. One is that he just forgets to look around when he is under pressure. You must remember to look around. The other is that he somehow gets the idea that these three tasks don't matter as much as the other tasks. That is not true - all tasks count equally in determining what will happen to you. You must try to do well on each task. Don't neglect one in favor of another. The third reason that you may have trouble is that you spend

so much of your time thinking about what may happen to you that a lot of your energy goes into that rather than into the tasks. We have found that the people who do best are those who force themselves not to think about what may happen to them, but try to do the best job possible. Now let's go over this."

(Experimenter rehearses subjects)

"Now let me sum this up for you. The first thing to remember is that you have both demonstrated conclusively that you have the ability to do well in a tough situation -- all that you need to do is keep working hard and remember the advice we have just given you. That is that you are likely to fall down on the dials, the windows and the math so you must work extra hard on these. Remember, too, that all tasks count equally, that you must look around, and that you should not waste your time worrying about what may happen. I'm sure that you are both going to do a bang-up job on this next mission! Ready?" (Starts Weather Mission.)

Weather Mission

(Numbers in parentheses refer to elapsed time of the 30-minute mission)

(6.0') "You are doing a nice job so far."

(9.0') "Your scores look pretty good -- keep at it!"

(11.5') (After the second heavy shock): "Now I want to emphasize that you are still doing relatively well. Don't be discouraged."

(12.5') (After 3rd heavy shock): "Keep at it, you are handling it nicely. Your scores show that you are taking things in your stride."

(18.5') (After 4th heavy shock): "I like the way you recover yourself. I'm pleased with the way you are handling this. Keep up the good work."

(22.5') "You have done very nicely so far and your scores show good improvement."

(28.0') "Your scores are looking good. I think you are doing very well."

Between the Weather and Reconnaissance Missions, subjects would be given the opportunity to ventilate their feelings and problems. The experimenter would listen and make non-directive comments where appropriate.

Reconnaissance Mission

(6.0') "Things are going nicely now. You are getting better all the time."

(7.5' Heavy Shock) "Don't let that faze you! You are doing well!"

Hypothesis D: Examiner's Script (Continued)

(8.0' Heavy Shock, No comment)

(8.5' Heavy Shock) "I like the way you keep going in spite of distractions. It's very encouraging to see someone handle this this well."

(14.5' Mild Shock) "That's the way -- keep after it -- you are making real progress!"

(17.0' Heavy Shock) "Nice going! You took that well!"

(17.5' Heavy Shock, No comment)

(17.8' Heavy Shock) "Let me say again, that it is extremely satisfying to see you handling these situations so well -- keep up the good work."

(20.0') "Your scores are looking good. Nice going!"

(22.0' Heavy Shock) "Keep aiming at further improvement. Just try to ignore these little rough spots."

(22.5' Heavy Shock) "That's the way to go, you're handling yourself very well."

(24.5' Heavy Shock, No comment)

(25.0' Heavy Shock) "Very good! You are actually continuing to improve in spite of everything! Very good!"

(28.0' Mild Shock) "Keep it up! Things are looking very good now!"

2. Hypothesis E: Examiners' Script
Crew Members' Script

Examiners' Script:

"Now, men, before we continue, Dr. _____ has stopped in this afternoon. You probably remember him from our meeting at the beginning of the semester when he explained the project to you. In addition to being Director of this project, Dr. _____ is also a full colonel in the Air Force Active Reserve, and Chief of the Research Advisory Board. It is in his capacity as Chief of the Research Advisory Board that he is here today. He has something to tell you which I think will be of interest to you."

"Thank you, Dr. _____. You men may be interested to know that as I was driving over here from the Pentagon, there was an announcement on the radio that as of 1:40 this afternoon, we have a new "Explorer" in space -- apparently in good orbit.

"These sorts of developments are happening almost every day now. Actually, this is one of the reasons I am here. There has, of course, been a redistribution of funds within the Air Force. Some programs, such as missile development are to receive greater emphasis. Consequently, others will have to be cut back somewhat.

"I have just come from a meeting at the Pentagon at which it has been decided that the Air Force ROTC program is one that is to be cut back.

"As you may know, there are five Air Force ROTC detachments in the Washington area. Air Force ROTC Headquarters and the Research Advisory Board have decided that the best way to carry out the necessary cut back in ROTC operations is to de-activate a certain number of detachments across the country. Two of the five detachments in this area are to be de-activated.

"I'm sure you realize what a difficult decision it will be to decide which detachments to de-activate. Many factors will be considered of course. However, headquarters AFROTC feels that one of the most important factors to be considered is the ability of the men in these detachments to do the kinds of things Air Force men do today. The purpose of these tests as of this afternoon is to measure the ability of the men in the ("Z") detachment. On those of you who take these tests falls the responsibility of seeing to it that the ("Z") detachment is not to be deactivated.

"Now of course, since ROTC here at ("Z") is required, you would be transferred to the Army ROTC unit. You would then be subject to induction by the Army and not the Air Force.

"Let me repeat this information so that I may be sure that you understand it. Due to fund cuts for the Air Force ROTC program, two of the detachments in this area must be de-activated soon. In order to decide which unit to de-activate, headquarters AFROTC and the Research Advisory Board have decided that these tests will form a very important basis. Only a few of the

2. Hypothesis E (Continued)

men in each detachment can be selected for testing, and it is up to them to represent their detachments. Specifically, you, this afternoon, and a few others will be largely responsible, by your test performances, for the future of the ("Z") detachment. I hope that you will respond to this responsibility to the best of your ability.

"Now I'll let Dr. _____ continue with the testing."

Dr. _____ : "Thank you Colonel _____ ! Now that you are aware of the added importance of your work this afternoon you will of course want to do your very best work on all of these tasks.

"Now on these next few missions, Able, you will be the pilot of a two-seater aircraft and Charley back here will be your observer-recorder. It will be your job to fly the plane, doing all of the things you have done during the last training mission. Charley, you will be the crewman in Able's plane and you will record all of Able's reports of dials, windows and math problems.

"Baker, you and Dog, will be a similar team. Baker is the pilot and will perform all the duties he has done before during the training mission and Dog will be his crewman, recording all of his reports.

"Now let me make one thing clear. Able and Baker, you are the pilots. What happens to you and your crewman depends on you. Nothing that Charley or Dog does will affect what happens to you. Able, everytime you get hurt, Charley does too, and Baker, everytime that you get hurt, Dog does too -- just like the real situation where if a pilot goofs, all of his crewmen suffer with him. Now, Able repeat the instructions. Baker? Charley? Dog?" (Rehearses subjects)

Crew Members' Script: (The numbers in parentheses refer to elapsed time, in minutes of the 30-minute mission.)

Weather Mission

(2.0') "That's the way! Able (Baker), you're doing swell."

(5.0' Mild Shock) "Never mind that, we're okay, you're doing fine!"

(9.0') "Com' on boy! Our unit's got nothing to worry about."

(11.2' Heavy Shock) (Give a grunt)

(11.5' Heavy Shock) "Never mind, I'm right with you."

(12.0' Heavy Shock) "I just wish I could help you."

(14.0' Mild Shock) "Nice Going!" "You kept that one off us!" (Afterwards)

2. Hypothesis E (Continued)

(19.0' Heavy Shock) "Don't worry about me, just work those things!"

(22.0') "It won't be us that gets de-activated, Able. Good work."

(25.0' Mild Shock) "Aw, we don't worry about those little ones!"

(29.0' Mild Shock) "I think we've got it made now."

(30.0' End) "Whew! Nice going! It could have been a lot worse if you had goofed up."

(Between missions subjects are reminded of the importance of their work.)

Reconnaissance Mission

(At the beginning) "Okay, boy, here we go again. Remember I'm with you all the way."

(4.0' Mild Shock) "I think you're getting us out of most of the rough ones now."

(7.5' Heavy Shock) "Don't worry about me. Just stay with it."

(8.0' Heavy Shock) "Never mind that! We'll make it!"

(8.5' Heavy Shock) "That one was rough, but I'm beginning to get used to them. You're doing fine."

(11.0' Mild Shock) "Huh, they must have run out of juice! You know, I think we can take anything they've got."

(14.5') "I think you're doing better on everything now. Those other detachments had better look out."

(17.0' Heavy Shock) "Steady, boy, that was just a little slip up."

(17.5' Heavy Shock, No comment.)

(17.8' Heavy Shock) "Well, we've taken the worst they can give us now and we're still here. We'll show 'em."

(22.0' Heavy Shock) "Come on, man, work those things."

(22.5' Heavy Shock) "You are going back to it much more quickly than you used to."

(24.5' Heavy Shock) "Huh, that one wasn't worth worrying about."

(25.0' Heavy Shock) "You're doing okay, we'll make it yet."

(26.5' Mild Shock) "Looks like you've gotten us out of trouble again. I'll bet you have gotten us out of more than half of these tight spots."

(28.5' Mild Shock) "You sure have learned how to handle that stuff."

(30.0') "Nice going buddy, we made it, thanks to you."

3. Hypothesis G: Procedures

a. After the training mission, the talk by the "colonel" was given.

b. The experimenter then gave the Hypothesis D script prefaced by "Since our testing session today has assumed this added significance, I'm going to take the time to tell you some of the things that we found out in the past. Listen carefully, I think this will help you to do better."

c. There was a pause while the examiner apparently addressed the "buddies" with similar remarks.

d. The crew members' (buddies) comments were made as before.

e. All but five of the examiner's comments were omitted and those were directed toward all four subjects.

f. Between the Weather and Reconnaissance Missions, the subjects were encouraged by the "buddies" to ventilate their feelings.

g. Finally, the ventilation was followed by brief reassurance by the examiner and rehearsal in the "understanding" material.

Scripts:

All scripts were the same as before except the examiner's script during the two stress missions which was vastly reduced in order to avoid conflict with the periodic comments of the "buddies." This script was as follows:

Weather Mission

(Numbers in parentheses refer to elapsed time of the 30-minute mission)

(8.5') "You are doing a nice job so far."

(20.0') (after 4th heavy shock): "I like the way you recover yourself. I'm pleased with the way you are handling this. Keep up the good work."

Reconnaissance Mission

(9.5' Heavy Shock) "I like the way you keep going in spite of distractions. It's very encouraging to see someone handle this this well."

(20.0' Heavy Shock) "Let me say again, that it is extremely satisfying to see you handling these situations so well -- keep up the good work."

(25.5' Heavy Shock) "Very Good! You are actually continuing to improve in spite of everything! Very Good!"

Appendix C

Subject and Experimenter Checklists

1. Subject Adjective Checklist (keyed)
2. Subject Questionnaire
3. Experimenter Form

(1. Subject Adjective Checklist-keyed)

Project AIRTRAIN Checklist

Directions

Check as many of the words below as describe how you feel:

About the Equipment or the Test

-	alarming	-	frustrating	+	stimulating
-	awful	-	impossible	-	stupid
-	boring	+	impressive	-	tiring
-	crazy	+	instructive	-	tricky
-	dangerous	+	interesting	-	unfair
-	demanding	-	phoney	-	unrealistic
-	difficult	+	realistic	-	useless
+	easy	+	safe	+	valuable
+	enjoyable	+	scientific	+	wonderful
+	fair	-	sneaky	+	worthwhile

About Yourself

-	abandoned	-	disorganized	-	puzzled
+	adequate	-	dissatisfied	+	relaxed
-	alarmed	+	efficient	+	satisfied
-	angry	-	fearful	+	successful
-	awful	+	great	-	tense
-	betrayed	-	helpless	-	trapped
+	calm	-	lonely	-	unhappy
+	confident	-	miserable	+	useful
-	desperate	-	nervous	-	worried
		+	pleased		

(2. Subject Questionnaire)

PROJECT AIRTRAIN QUESTIONNAIRE

Please answer the following questions to the best of your ability:

1. Which task(s) did you find especially difficult? (check as many as apply)

   a. Airplane controls ___
   b. Switching ___
   c. Rotating discs ___
   d. Cities, mountains, airplanes ___
   e. Dials ___
   f. Math ___
   g. None ___

2. On which of the tasks listed above do you think your performance was most affected by the shock?

   a. ___
   b. ___
   c. ___
   d. ___
   e. ___
   f. ___
   g. ___

3. How did the shocks affect your ability to perform?

   a. Helped me perform better ___
   b. Had no effect at all ___
   c. Interfered slightly ___
   d. Interfered greatly ___

   Why?_____

4. a. Were you ever afraid of what might be coming?

   Yes ___ No ___

   b. If you answered yes, have you ever been as afraid before in your life?

   Yes ___ No ___

   c. If yes, when?_____

5. a. Do you think the anticipation of what was coming affected how well you did?

   Yes ___ No ___

   b. If you answered yes, did the anticipation:

   Slow you down? ___ Increase your accuracy? ___

   Make you work faster? ___ Decrease your accuracy? ___

6. Did you get more used to the shocks as time went on?

   Yes ___ No ___

Subject Questionnaire (Continued)

7. a. How much attention did you pay to the displays on the situation box?

A great deal _____ Quite a bit _____

Paid little attention to any _____

b. Rank the display from 1 (most attention paid) to 5 (least attention paid):

Seriousness	_____	Performance	_____
Odds of Harm	_____	Time	_____
Effect of Performance	_____		

8. a. Did you believe that what happened to you was related to the displays on the situation box?

Yes _____ No _____ Sometimes _____

b. Did you believe that what happened to you was related to what you did?

Yes _____ No _____ Sometimes _____

c. Describe the relationship _____

_____

_____

9. Did you feel that you didn't know why you were being shocked?

Yes _____ No _____ Sometimes _____

10. a. Did you feel that you knew what to do to avoid being shocked?

Yes _____ No _____ Sometimes _____

b. What do you think you should have done? _____

_____

11. Did you ever feel that you wanted "out" - that you could no longer take part in the experiment?

Yes _____ No _____

12. Did you ever get angry at the experimenters?

Yes _____ No _____

13. Would you go through this test again under the same conditions?

Yes _____ No _____

14. Do you think that this experiment has succeeded in creating apprehension similar to that which might be found in Air Force Flying?

Yes _____ No _____ Don't Know _____

15. We are very much interested in your feelings and impressions during the course of the experiment. Please complete the following sentences.

a. While you were teaching me to operate the equipment I _____

_____

b. After the first training (non-shock) mission, I felt that I _____

_____

c. My first reaction to the sample shock was that I _____

_____

d. During the Weather Mission, I felt that _____

_____

e. During the Reccnnaissance Mission, I _____

_____

f. During the last training mission, _____

_____

g. When it was all over, I thought that _____

_____

h. At times during the testing, _____

_____

16. Remarks: Please comment on any feelings, changes in feelings, or aspects of the situation not covered above which you think may have affected your performance. Suggestions for improving the situation or any other general comments would also be welcome.

AIRTRAIN Membership Card Number ____ ____

Name _____

3. EXPERIMENTER FORM

S _____ Code Name _____

E _____ Date _____

EXPERIMENTER:

Any prior knowledge? Yes ____ No ____

Debriefing ____ Airtrain card ____ Bloods taken and properly labeled? ____

What was S's general emotional response?

Fear ____ Anger ____ Other (specify) _____

Do you think that S was truly "stressed?" Yes ____ No ____ ? ____

Describe any unusual physical, oral or performance symptoms: _____

_____

Estimate of ability to grasp training: Poor ____ Average ____ Good ____

Cooperativeness: Poor ____ Average ____ Good ____

Post-test attitude: Pleasant ____ Indifferent ____ Withdrawn ____ Hostile ____

PGR	Initial	S	W	R	Final
Able	____	____	____	____	____
Baker	____	____	____	____	____

General Evaluation

Experimenter Form (Continued)

Unusual or Recurrent Movement

Action	Part	S	P	W	R	Rec
Breathing						
Non-func. act						
Slump						
Tic						

Unusual Symptoms:

VERBAL

Action	What	S	P	W	R	Rec
Code Name:	Omit					
	Wrong					
Invects, abuses						
Reports, form changes:	Math					
	V					
Talks:	To self					
	faster, slower					
Yells, sobs						

Unusual Remarks:

COMPLAINTS

Action	Where	S	P	W	R	Rec
Can't control equipment						
Headache, eyes						
Mask						
Pain						
Refuses to go on						
Says can't stay in						
Says how much longer						

Unusual Complaints:

PERFORMANCE

Action	What	S	P	W	R	Rec
Abuses equipment						
Dazed after sh.						
Performs during sh.						
Works:	Faster					
	Slower					

Unusual performances:

Appendix D

Variance Analyses

Variance Analyses

Tests of Significance for Raw Score Variances
by Task and Mission for Control and
Standard Experimental Groups

Task and mission		Controls "X" vs. "Z" (N=28) (N=16)	Controls "Y" vs. "Z" (N=13) (N=16)	Experimentals "X" vs. "Z" (N=28) (N=12)	Combined Groups E's vs. C's N=40 N=57
CC	T_1				
	W^1				
	R				
	T_2				
DCT(R)	T_1				
	W^1			S_Z	
	R				
	T_2				
DCT(E)	T_1				
	W^1				
	R		S_Z		
	T_2			S_Z	S_E
MJT	T_1				S_E
	W^1	S_X	S_Y		
	R				
	T_2		S_Y	S_X	
V_I	T_1				
	W^1				
	R				
	T_2				
V_O	T_1				
	W^1				
	R				
	T_2				S_E
M	T_1				
	W^1				
	R				
	T_2				

Note. All significances are at the 2% two-tail level or better. Subscripts identify the group with the larger variance. There were no significant differences between "X" and "Y".

Variance Analyses (Continued)

Tests of Significance for Raw Score Variances for the Hypothesis Groups Vs. the Standard Experimental Group (N=40) by Task and Mission

Task and Mission		D	E	F	G	H First Test	H Second Test
CC	T_1						S_E
	W					S_E	S_E
	R						
	T_2						S_E
DCT(R)	T_1						
	W						
	R						
	T_2						
DCT(E)	T_1						
	W						S_C
	R		S_H			S_E	
	T_2	S_E		S_E	S_E		
MJT	T_1						
	W		S_E				
	R		S_E				
	T_2						
V_I	T_1						S_E
	W						
	R						
	T_2						
V_C	T_1						
	W						
	R						
	T_2				S_E		
M	T_1						
	W						
	R					S_C	
	T_2						

Note. All significances are at the 2% two-tail level or better. The subscripts indicate the group with the higher variance.

Variance Analyses (Continued)

Tests of Significance for Delta Score Variances for the Hypothesis Groups Vs. the Standard Experimental Group (N=40) by Task

Task and Mission	D	E	F	G	H
CC					
DCT(R)					
DCT(E)	S_H	S_H			
MJT	S_H				
V_I					
V_O					
M					
Overall					

Note. All significances are at the 2% two-tail level or better. Subscripts indicate whether the experimental or hypothesis group had the higher variance.