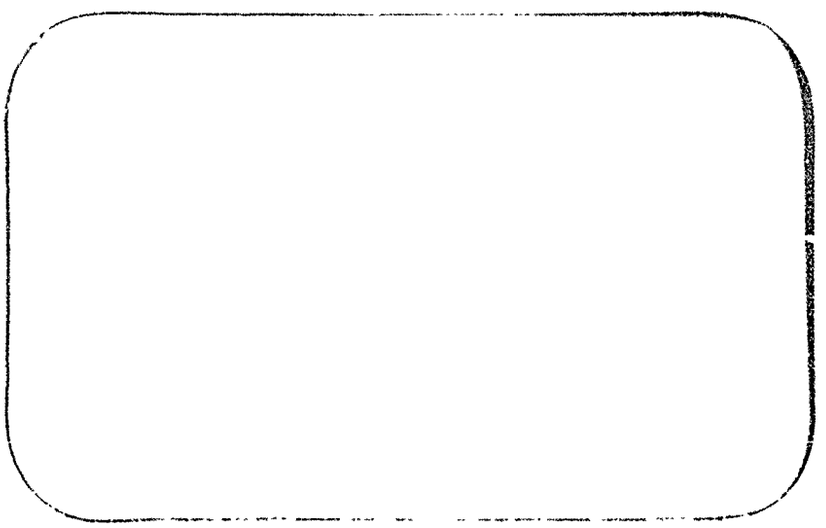
HumRRO



U.S. Army Leadership Human Research Unit
Presidio of Monterey, California

Under the Technical Supervision of

The George Washington University
HUMAN RESOURCES RESEARCH OFFICE
operating under contract with
THE DEPARTMENT OF THE ARMY

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~~Research Memorandum~~
~~Task FIGHTER~~

(1) HUMAN PSYCHOPHYSIOLOGICAL RESPONSE TO STRESS:
SUCCESSFUL EXPERIMENTAL SIMULATION OF
REAL-LIFE STRESSES (2)

(9) Research memo.,

~~by~~

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(11) 29 Dec 59

(12) 47

~~(Material presented at American Psychological Association, 8 September 1959)~~

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U.S. Army Leadership Human Research Unit
Presidio of Monterey, California
29 December 1959

(173 200)

Foreword

This material was presented as a symposium at the American Psychological Association meetings on 8 September 1959, at Cincinnati, Ohio.

Mitchell M. Berkun

Ladies and gentlemen, since submitting this program to Division 3, not only have we had a change in personnel, but we have rearranged the material in a way intended to make a better presentation. This explains why we are not exactly following the printed program.

The plan is to invite questions from the floor after presenting our prepared papers.

It is the purpose of this symposium to present to you certain observations and some preliminary quantitative results of a technique for studying the human response to fairly serious environmental stresses. This technique, which will be described for you in detail, seems to be a departure from conventional methods of study in this area. At least, we were unable to find substantial published material in which such an approach is described as having been used with statistically adequate numbers of subjects and in which were taken objective measures of competence, that is, of behavior relevant to the stressful environment.

But please permit me first to develop for you the context in which we evolved this approach. The United States Army has created, on contract with The George Washington University, the Human Resources Research Office, or HumRRO, whose responsibility is research with the purpose of improving the quality of Army training. It was recognized long ago that merely turning out a better trained soldier is not enough. A soldier in wartime needs something more than the skills and the knowledge required to do a good job; he needs the will to fight. One of the most important battlefield problems has been to get men to <u>use</u> the skills and knowledges they had. HumRRO has been developing a program of training whose ultimate objective might be phrased as imparting the will to fight to men who might otherwise fail on the battlefield. This particular project, identified as Task FIGHTER, began in 1953 with an intensive psychometric study of 300 frontline combat infantrymen who had been in post-battle interviews identified as either extremely effective or extremely ineffective soldiers. Some very important hypotheses emerged from this study: The effective troops were characterized as being more intelligent, more masculine, more experienced in sports, business and other such activities, more socially mature, and as having had a more stable family life. The material was presented to this Association in 1954 and was subsequently published by HumRRO.

Now, with the end of hostilities in Korea, it was determined to attempt to validate, or properly, to cross-validate these hypotheses in experimentally contrived situations which would, ideally, reproduce the stresses of combat. In fact, the emphasis changed away from the psychometric approach to what I might call a psycho-dynamic approach. Remember, Task FIGHTER has as its goal the preparation of soldiers to display under stressful conditions of battle the skills and knowledges acquired in their training. To do this, the staff of Task FIGHTER has attempted to find out exactly what kinds of reductions in quality of performance occur under stress, and why. A successful answer to these questions of what and why would, obviously, be not only a contribution to the Army's motivation problem, but would also have some bearing on the psychopathology of everyday civilian life.

Mitchell M. Berkun

The FIGHTER staff has spent years developing situations which would approximately reproduce the stresses of combat. Elements of combat were carefully analyzed and then simulated so far as safety considerations would permit.

I should like to introduce to you now Dr. Hilton Bialek of our project group, who will recount for you some of these attempts to create stress in experimental subjects by reproducing the physical elements of combat, and who will introduce the concept critical to the approach which we wish to present for your consideration today.

After the Korean study had been completed, it was natural to do a cross-validation study. With the absence of any actual combat, the thought was to simulate combat by having subjects engage in fatiguing and dangerous maneuvers. Before I briefly describe a few of these activities to you, I should say that it was hoped that such a study would provide results which would show that the better performing individual in the simulated situations would be characterized by those qualities identifying the effective combat man in Korea. If this were so, then it might be possible to select those who would be the effective fighters in the advent of another war.

Following is a brief description of these situations:

Subjects were first marched 12 miles and with little sleep were required to run through a sequence of situations which included: combat in cities (where a man ran through a mock village firing at pop-up targets); perimeter defense (a man in a foxhole tries to knock out targets popping up randomly around him while small charges of TNT were set off approximately 10 yards away); paratrooper jump tower (the man has to jump from a 30 foot tower in a harness which stops him before he hits the ground); and a few more such situations all possessing fairly high face validity. All of these situations were training activities accepted and used by the Army. Before starting and between each situation, subjects were administered a battery of stress-sensitive tests such as cancelling C's and verbal output. At the completion of the field tasks, subjects were administered an extensive battery of tests including the predictor variables from Korea. Upon analyzing the results, there was no objective or subjective evidence of stress. It was decided that these Army training activities were not adequate for experimental purposes and so, as a next step, a more concerted effort was made to simulate combat by offering a sequence of acts which were related to each other and would be amenable to greater scrutiny and observation. The situation would have higher military tactic validity and would utilize the fear of height, instability of support, and the sounds and hazards of the battlefield. Here is a brief description:

Ss were told that this was a tactical problem, that there were aggressors in the area firing live ammo at them, that they were to use the live ammo given them to shoot back at any target they thought appropriate. In addition to crawling and concealment, Ss were required to cross two rope bridges, approximately 75 feet long, which were suspended approximately 60 feet in the air. While crossing these bridges and another plank and cable bridge which "dropped" a foot while an S was crossing it, explosions were set off and live rounds fired over their heads. Also, they had to traverse open areas containing barbed wire under fire. Even from this brief description, I think you will agree that the face validity of this situation was very high. No visiting observers thought otherwise.

The post-situation test battery included the Korean predictor variables again in addition to a test battery which, according to the latest literature, possessed high reliability for detecting the effects of stress. This included digit span, digit symbol, dexterity and tremor tests, verbal fluency, and certain Wechler-Bellevue subtests purported to be sensitive to stress or

anxiety. We also tried to include measures of performance within the problem such as recall of a map learned earlier and recall of a verbal message. In addition we had measures of the man's use of his weapon including rate and accuracy of firing and a number of scores indicating the time needed to get from point to point in the problem.

It was while collecting these data that we became acutely aware of a number of seemingly insurmountable problems. Let me describe some of these to you. First: If a subject accepted the "role" of being in combat, was he to be considered the individual who was better able to cope with circumstances, or was his counterpart, the man who realized that this was non-combatant peacetime in California and this was a very elaborate game, the one who sized up situations correctly and responded accordingly? Thus, the latter man can avoid becoming stressed by not accepting the role we experimenters planned for him--is he then to be considered the more competent man, or what exactly can we say about him? At the time we couldn't help but wonder what effect the "role playing" factor had on many of the results presented in the stress literature. Secondly: What performances in the problem are important to measure and what do they mean? Is the man who moves quickly from point to point more effective than the cautious man? Is the man who knocks out targets quickly but can't remember what he's supposed to be doing more effective than his opposite? In a general sense, what are the criteria of effectiveness in peacetime California? Finally, how do you control the motivational level of these subjects? The mere fact that they are given a weapon with live ammo and set out on their own as contrasted to their conventional training probably, we suspected, offset any apprehension they might hold toward the task presented them.

The conclusions from this study had two aspects. Objectively, there was little evidence of an effect of stress on performance. From observations and quantitative self-reports subjects showed no adverse emotional effects; in fact, the majority reported feelings of excitement and enjoyment during the experiment.

We made one more effort in the direction of simulating combat. We exposed a group of soldiers to three days and nights of psychological harassment superimposed on a physical harassment consisting of fatigue, lack of sleep, minimal (and cold) rations. A control group, by contrast, spent three days playing cards, reading, eating and relaxing in comfortable quarters. Both groups were administered the same battery of tests given in the study previously described. What we should have firmly suspected from the beginning happened. Not only were there no measurable differences in performance between groups, but the subjective measures indicated that the controls tended to be more upset than the experimentals. Of course, we recognize the group facilitative effect on that measure, but we ultimately had to accept the conclusion (one that was actually accumulating from the very beginning of our work) that soldiers generally tend to believe that the Army would not expose them to any real harm outside of combat.

At this point we became firmly convinced that if this fact were true--that soldiers will play the game but never perceive a genuine danger--then our strategy of trying to increase face validity was wrong. The solution to our dilemma was to introduce the idea of an apparent disruption or accident

in the normal course of events, the occurrence of which results in a subject's believing that a real and imminent danger exists.

Dr. Berkun will elaborate upon this and introduce the other speakers who will present the results of our work employing this strategy. As it will be shown, this revision in our thinking resulted in a major shift in our measuring procedures. I will discuss this after you have heard a description of our present work.

A clear and apparently unavoidable implication came out of our earlier research. To be valid, our research must be done without a perception by the subject that he is being protected from real danger, or that he is being tested. And, at the same time, we must get objective measures of his competence at handling the danger he perceives. Experimental stimuli, that is, stressful environments, must be constructed which would reproduce the affective stimuli presumably present in combat, rather than the physical stimuli of combat--the noise, the darkness, etc. Our research program, coordinated with the Department of the Army and with local military authorities, was then committed to this goal.

To be of value in our research, a proposed stressful situation would have to meet a complex criterion, a decision function, really, made up of these four elements:

1. It must be judged as stressful by observers.
2. It must be subsequently reported as stressful by the subjects.
3. It must produce an alteration in objectively measured behavior as compared with control conditions.
4. It must produce a transitory physiological response which can be considered abnormal or different from the response under control conditions.

We felt we could label a situation as stressful if it met a specified combination of these criteria. At the same time that subjects were run through a proposed situation for the purpose of assessing its stressfulness, we could study personality correlates of effectiveness and even the qualitative characteristics of effectiveness in it. Then, if, by the independent criteria, we could later label the situation as stressful, that is, as useful for our research purpose, we would have an additional body of data available all from the one operation. There would be an immediate reward in terms of new knowledge of the response to environmental stress.

There were five situations which seemed promising and which were tested formally on 20 to 30 subjects, each, with appropriate control groups of about the same size. One proposed situation was given a preliminary tryout with six subjects. This was it:

A subject from whom a blood sample was to be drawn routinely was informed that an inept medic believed he had accidentally injected air into the subject's blood stream. It soon became clear, however, that within the limits we set ourselves the subjects either could (and did) readily disprove the assertion, or else they failed to perceive its consequences. It is interesting that despite the dramatic nature of this situation, as you hear it described, it was quickly abandoned as insufficiently stressful.

Now, another situation was reported at the Western Psychological Association meetings in San Diego last spring, and so requires only the briefest mention here.

Subjects taken aboard an aircraft presumably to study effects of altitude

were informed that a combination of engine and landing gear trouble made a crash landing necessary. They filled out emergency data forms ostensibly as part of SOP, but these constituted what we call an embedded behavior measure.

The next situation involves the threat from a forest fire. Subjects believe they are participating in an experiment testing new concepts in atomic-age warfare. An isolated individual hears that his position is threatened by fire. Artificial smoke facilitates this illusion. He hears that the "experiment" is terminated and that everyone is to be evacuated, but his position has been lost. At this point his radio transmitter fails, though he continues to receive. He must follow instructions for converting his transmitter to standby operation. Actually, he is in covert contact with his Command Post through hidden wires, which permits scoring his behavior in fixing the radio--this is our performance measure. Then we built a situation around artillery shells.

In the same environment as before, the subject hears that, through an error, artillery rounds are going out of the designated impact area. Shells bursting near him are simulated. As before, his radio transmitter fails, so that he must repair it to report his situation and be evacuated. The same physical set-up presented the subjects with an apparent radiation hazard.

Once again, we have an isolated individual, this time carrying a radiation dose meter because other troops in an adjacent area are being trained in decontaminating radio-active material. A combination of human error and wind change brings the hazard to the subject, according to radio messages he receives and according to his dose meter, whose readings we are able to control artificially. Again, he must repair the defective transmitter in order to be located and evacuated.

The next situation differs from the others in that the subject himself is not threatened with physical harm. The subject, supposedly on a work detail at an isolated place, apparently fails to follow instructions correctly, causing an explosion which (he is told) injures someone. Since he happens to be nearest the only telephone, he is to call for medical aid, but the phone does not work. Again, his behavior in restoring the phone to service is scored objectively.

It was obviously necessary in delicate work of this nature to provide more than the usual complement of safety precautions. Let me review our procedures:

1. As for selection of subjects--only those classified by the Army into its two highest categories of mental and physical fitness were used, and from these we excluded those who do not read English.
2. During the situations we maintained constant auditory and, in most cases, visual monitoring, either being hidden within a few yards of the subject or observing him from a helicopter.

3. At the termination of the stress situation, a detailed explanation of the situation and of the necessity of the research is given to the subject by a senior-level experienced clinical psychologist. The subject is encouraged to express his feelings about it, and reassurance is given if needed.
4. Each evening all subjects run that day participate in a group discussion with the experimenters. This provides more catharsis and more reassurance.
5. After one or two weeks, all subjects are interviewed again, both to provide more research information and to probe for residual effects.
6. At all times during the research we had medical facilities, a medical corpsman, and emergency vehicles immediately available.

I think you can see that the nature of the research requires surprise--that is, no prior information. Therefore, volunteering by subjects was not considered feasible. In addition, of course, exclusive use of volunteers would yield a biased sample which would prevent generalization of results to the population at large.

Perhaps now we can hear a more detailed description of the artillery impact situation, with a preliminary report on results obtained there. Here is Mr. Kan Yagi to report this to you.

Our general approach to designing stress-evoking situations has involved the apparently real development of what is actually a contrived emergency. Responses, instrumental to obtaining relief from the emergency, provide the basis for performance measures.

I'm going to describe an experimental situation which follows this approach. In this study, the crux of the emergency, the threat of bodily harm, was directed at the subject himself. In addition to describing the situation, I will present some preliminary findings from this study. Since subjects were still being run through this situation in August, time has permitted the analysis of only a fragment of the data.

Getting down to the description, this study was conducted in rugged California terrain used for Army field maneuvers. Subjects were transported to this area and established bivouac under the impression that they were to be replacements for simulated casualties in a field training maneuver which was then being conducted. As a part of their orientation a platoon leader informed them that there was live artillery firing going on in an adjoining area. He reassured them that while they could hear it from time to time, they were safely removed from that area and need not be concerned about it.

Subjects were not aware of the location of a Command Post or of the other units which they had been led to believe were participating in this maneuver.

A driver in a jeep picked up an individual replacement from one or another pickup point and took him about one mile over back roads and fire breaks to the mouth of a box canyon. From there they walked about 300 yards up the canyon to a radio outpost. The distance in this semi-wilderness from the bivouac area created an atmosphere of isolation and remoteness. The subjects wore field combat gear, including the steel helmet, at the radio outpost. The driver gave the following instructions:

> "Your job is to spot aircraft flying over your position. Identify them from the pictures in this folder."

And here he indicated it. Then he went on to say:

> "When you see an aircraft, report its type and the direction it's heading. Just call them in on this radio. Your station is Bravo Five. Any questions? Call in now and tell Command Post that Bravo Five is in position."

Communication was then established between Bravo Five and Command Post. When the subject reported being in position, the experimenter at Command Post started a tape recording which contained miscellaneous simulated, but apparently real, radio transmissions dealing with the purported maneuver. This stimulus tape led the subject to believe he could overhear all transmissions being made by Command Post to other stations, as well as his own. After the subject had been in position for a certain time, a helicopter was dispatched to fly over the position so that the subject could report an aircraft.

After approximately 25 minutes at the radio, the subject overheard taped transmissions, to various stations, checking reports of misplaced artillery shells hitting and bursting in the maneuver area. All stations including Bravo Five were directed to report any artillery impacts sighted. A few minutes later a TNT charge was detonated on the side of the canyon in which the subject was located. This charge was the first of six which had been planted by an Army demolitions expert. The demolitions expert was concealed from the subject's view and was located in a foxhole on the rim of the canyon. From his position he had full visual surveillance of the subject at all times and fired the TNT charges upon signal from the Command Post.

The subject's attempt to report the artillery impact met with apparent failure because of his inability to make radio contact. He was told that apparently his transmitter had failed and Command Post was not receiving him. Actually, of course, all of his verbalizations were being monitored and recorded over a hidden wire system. He then heard Command Post's efforts to contact him and their plans to evacuate all personnel in his area because of the misplaced artillery fire. The subject was informed that through some mix-up his exact location was not known, but a helicopter would evacuate him if he could transmit a radio signal as a guide to his position. Since Command Post was supposedly unable to receive Bravo Five, he was directed to follow the emergency instructions to repair his set. The remaining blasts which simulated the impact of artillery shells were set off at fixed intervals over the subsequent 40 minutes of the problem. Intermittent messages during this 40 minutes confirmed for him first, that his radio transmitter didn't work though he could receive; second, that the situation was perceived by Command Post as serious; third, that he should be evacuated; and finally, that his location was lost and that he must resume radio transmission in order to be rescued. At the end of this time a clinical psychologist approached the subject and asked him to choose from a list of words the one which best described how he felt at that time. This list of words is what we call the Subjective Stress Scale, which I will describe shortly. The subject was then thoroughly debriefed and immediately transported to the Command Post where he was interviewed by the same psychologist. This interview, as in other studies we have conducted, had three major purposes. One was to assist the subject in relieving any residual emotional tension which might be present as a result of the experience; second, to thoroughly acquaint the subject with the true nature of the situation he had encountered; and third, to obtain the subject's subjective report of his thought, feelings, and actions while in the emergency situation.

One week later all subjects were returned to our research unit and again interviewed to obtain further information about the individual and to probe for any residual effects of the experience. The interviewers found no evidence of negative residual aftereffects. The men were positive in their feelings toward having served as subjects in the emergency situation.

This study also employed two control groups. These groups received the same treatment as did the experimental group except they did not experience any explosions or parts of the tape containing transmissions regarding artillery impact. The emergency transmissions were replaced with speeches appropriate to the respective control conditions, to control for distractions.

The "Neutral Control" subjects were led to believe that they were part of a field exercise and that it was necessary for them to repair their radio so that they could continue their role-playing in the maneuver in reporting aircraft.

The second control group, the "Rations Control," had to repair the radio in order to be located to receive supplies of food and water. While they may not now be hungry or thirsty the idea was to prevent possible deprivation.

Complete randomization was followed in assigning subjects to the experimental and control conditions.

The data of subjects who reported having realized that the situations were contrived were excluded from the present three groups. There were three experimental subjects, one neutral control subject, and six rations control subjects whose data were excluded on this basis. The data from these subjects are being studied separately for clues regarding their ability to see through the situation.

Now, a description of the performance measures:

1. First, time to begin repair. Plaques on the top and front of the radio set indicated how to operate the set and what to do in case of transmitter failure. The subject was to open the lid on the set, take out a booklet, and follow the instructions in the booklet. The response of opening the lid registered on the experimenter's display panel. An elapsed time score was recorded from the beginning of the situation until the lid was raised to begin repair.
2. Next, time to read instructions and connect wires according to a diagram. This is essentially a visual pursuit task taken from a subtest of the "MacQuarrie Test of Mechanical Ability." A diagram indicated which of 10 numbered plugs should be plugged into which of 10 lettered sockets. When the subject had completed all 10 correctly, he stopped a clock which had been started by opening the lid.
3. Next, time to start work on the cross-over wiring task. The instructions directed the subject to remove an inner panel and follow the instructions found beneath it. The response of removing the inner panel is registered on the experimenter's display board. An elapsed time score was recorded from the beginning of the situation until the inner panel was removed.
4. Last, time to read the instructions and complete the cross-over wiring. When the inner panel is removed, it reveals 20 wires attached to 20 screw terminals. Each wire, in order, is to be removed and then connected to a different terminal on the other side of the board. Completion of the wiring stops the clock which was started by removing the inner panel.

The experimental group was composed of 29 subjects and the combined control groups of 40 subjects.

Despite my remark a few minutes ago about how well the subjects reported feeling after the situation, the indication from these results is that

performance was affected as compared with control subjects. For example, of the 29 subjects exposed to the experimental treatment, ten abandoned their posts and ran away--10 out of 29. There were no runouts among the 40 control subjects. Now, even when the data from these aborted subjects are removed from the analysis, the remaining scores still show an effect. The F test of homogeniety of variance was used to compare the variance of the remaining experimental group with that of the combined control group on each of the four performance measures. The null hypothesis was rejected at, or beyond, the five per cent level for three of the four measures. Only the task of starting the cross-over wiring failed to show any difference. There were no mean differences on these tasks, but the criterion mentioned earlier was met by the effect on the distribution as revealed by the variance comparisons.

As I mentioned earlier, each subject was given the Subjective Stress Scale while still at the radio site and prior to being debriefed. The Subjective Stress Scale, or SSS, consists of 15 words or phrases which describe different degrees of emotional intensity. Each word or phrase in this list carries a scale value of from 1 (positive affect) to 11 (negative affect) arrived at as the result of a standard Thurstone scaling procedure carried out with samples of subjects from the Army population. Six is the indifference point.

In this study the mean SSS rating for the experimental group was 8.2. The combined control group mean was 7.1. There were no mean differences on this measure. Thus, in the experimental group we obtained the elevated SSS rating we expected. However, we also obtained an unexpectedly high SSS score from the control groups. Insights into the factors responsible for this moderate but unexpected emotional arousal of the control group may be contained in the as yet unanalyzed interview data. It is also possible that further enlightenment will come from using an additional control group which performs under a control set, but is not subjected to the rigors of bivouac in a hot dusty environment.

To conclude, preliminary analyses indicate some signs of stress--particularly the rate of leaving the post and an increased variance in performance relative to a control group. However, a subjective self-descriptive checklist failed to show an experimental effect.

Now the next situation to be described in detail for you is different from the others in this very important respect. The physical threat is to another person, not to the subject. Here is Mr. James Berry to lay out the situation and to report the behavioral results. He will be immediately followed by Dr. Kern with a study of the affective responses of the subject.

The experimental subject in this problem is involved in a contrived "emergency" in which another soldier is seemingly injured, and for which he may feel he is held responsible. This occurred in the following manner: The subject--a randomly selected trainee in the Army--was brought to an isolated field installation supposedly as part of a work detail to help the experimenters install some demolition wiring. He was taken to a remote bunker and I would say to him:

> "I'll show you what I want you to do. We're wiring in some explosives down in the canyon below, but we need a remote control circuit up here. We're building a training course there. All I want you to do is match these colored wires with the colored wires that are already on the screws--red to red, blue to blue, and so on. When you get all the wires hooked up, then throw this "change-over switch" so we can use the circuit. I'm going down below now and work on that end of it with the rest of the men. Okay---you understand what to do?"

Then, I would continue:

> "Oh, one other thing, you're the only one up here, so if there should be any calls, answer the phone here---talk into here. If you have to ring the operator, just turn this crank, but there shouldn't be any calls. And if anything comes over the intercom there, just answer into the box. This position is "Upstairs"--so if they call "Upstairs," you talk back into the box. Got it? Okay, when you finish, I'll come back and take you down below with the rest of the men."

Now, that's what I've told the subject. Then, after establishing his isolation, I leave.

In the next three to five minutes, the subject completes the wiring and throws the "change-over switch" as instructed. This sets off a five-pound charge of TNT down in the canyon. The explosion rocks the bunker, sometimes knocking things off the shelves. Suddenly a voice comes over the intercom--it's a tape recording, but the subject doesn't know this. This is what he hears:

> Upstairs, can you hear me? Upst----Listen, if you can hear me, we had an explosion down here and I think someone was hurt. I want you to stay right there. Listen, if you can hear me, wait right there and <u>don't touch anything.</u> Listen, are you sure you did that wiring right?

Silence follows for almost three minutes. After this pause, the subject hears--and I must apologize for failing to reproduce for you the quality of the message as recorded by an actor:

> Listen, Upstairs, we got trouble--bad trouble! Man's been hurt--hurt bad--we don't know exactly how bad. Get on the phone--listen, get on the phone and call Fort Ord. Just ring the operator.

But the phone doesn't work!
He tries repeatedly to reach the operator.

Bear in mind that the subject has, in fact, just completed some wiring and thrown a swtch which did cause the explosion. Incidentally, a qualified demolitions man was monitoring the explosions at all times so that no real accident could occur. The subject, however, believes himself to be completely isolated, in a position known as "Upstairs," with all other personnel down in the canyon. The only vehicle in the area is apparently out of order--- (actually, it was a standby in case of any real emergency). Someone has been hurt as a result of his actions. He is the only one who can help the man by calling an ambulance. He must get the phone to work.

Now he hears---

> Listen, Upstairs, listen. I can't get there to help you with the phone. Listen, there're instructions on the phone. Use another circuit. Open the top of the phone.

Several other messages follow, concerned with questioning the subject's progress on the telephone, the difficulty of keeping the injured man alive, a reference to the fact that the Military Police will want to question the subject, and a final message that someone is on the way up to question him. This information, and instructions to the subject, given about every four or five minutes in the problem, were all pre-recorded. It is also indicated that it is almost impossible to hear him over the intercom, thereby eliminating any need to respond to messages from the subject. Unknown to the subjects, all verbal responses were recorded on tape.

When the subject is relieved after 45 minutes, he is immediately tested for about five minutes, during which time some realization usually dawns that this has been an artificial situation. Then he is thoroughly debriefed, right on the spot, after which he spends at least an hour with one of our senior-level clinically trained psychologists going over his complete reaction to the situation and having his questions answered candidly. The purpose of the research is explained to him, and he is encouraged to express his feelings about having been a subject in an experiment of this nature. For further assurance, each subject returns for a second interview one week later, to establish that there is no residual effect. Incidentally, all our interviews met with cooperation and apparent willingness to discuss private reactions. Dr. Kern will tell more about these interviews later.

The subject, attempting to repair the telephone, follows an instruction booklet found adjacent to the phone, and, in so doing, completes several performance tests. The telephone with which the subject works is actually a modified Army Signal Corps field telephone switchboard, equipped with hidden wires leading to an experimenter's display panel. The subject was in the problem for a total of 45 minutes, and the telephone yielded the following performance measures which you will recognize as having much in common with the radio repair measures, described by Mr. Yagi a few minutes ago.

(1) Time to begin repair---a plaque on the front of the telephone box instructs the subject that, in case of telephone failure, he is to open the lid on top of the box and follow the instructions contained therein. How soon after the explosion he does this is indicated on the display panel and he is scored for <u>time to begin repair</u>.

(2) Time to read and connect wires according to a wiring diagram--this is taken from a visual pursuit subtest of the "MacQuarrie Test of Mechanical Ability," and revised to look like a wiring diagram. The diagram indicates which of ten numbered jack-plugs should go into each of ten lettered jacks. When the subject has completed all ten correctly, a clock which was previously started by his opening the lid is stopped, and a time for this task is taken.

(3) Time to complete a simple motor task calling for manual dexterity. This was labeled "Cross-over Wiring"--The booklet instructs the subject that if the telephone still does not work after completing the previous task, he is to remove an inner panel and change 20 wires over.

(4) Reaction time to an "Excitor light"--This is actually a task involving both vigilance and reaction time. The subject is instructed that if a light on the front of the telephone box labeled "Excitor" comes on at any time, he is to immediately press the "Excitor Rejection Button." Therefore, he must keep his eye on this, despite being involved in the other tasks. A clock is started simultaneously with the light coming on and is stopped when the subject pushes the rejector button to turn the light off. A mean reaction time to several programmed presentations is taken.

We also had constructed a reasoning task that could be timed and scored, but most subjects took so long on the other tasks that they never got to this particular measure.

Now, in addition to the experimental condition already described, where we had an N of 28, two control groups were used. One group (23 cases) believed that they were to call for additional rations, for the whole work party, and the other group (N=20) was told that they were taking a test. The conditions and stimuli for all groups were identical except for those directly involved in motivating the telephone repair.

On the first measure, time to begin repair, the control test group had the shortest mean time, followed by the control rations, and then, longest time, the experimentals. The difference in means for the experimental and control test groups was significant at the .02 level.

On the next measure, time to read and connect according to a wiring diagram, the order was the same; the control test subjects were fastest, followed by the control rations and then the experimentals, slowest. The difference in means for the experimental and control test groups was significant at the .05 level.

The order for speed was exactly the same on measure number three, cross-over wiring, or, time to complete a simple motor task. The control test subjects had the fastest mean time, followed by the control rations and, last the experimentals. The difference in means between the experimentals and the control rations was significant at the .02 level and between the experimentals and control tests at the .001 level.

On measure number four, reaction time to an "excitor light," there were no significant differences among groups.

These subjects also were given the SSS, Subjective Stress Scale, described to you previously. They were asked to choose, from a list, the one word best describing how they had felt. The results were the same: Highly significant differences between groups, with the experimental group choosing words whose scale values were in the "stressed" direction.

To summarize, besides reporting having felt stressed, the men who had an emergency to cope with, the men who had a real reason to perform—these men were the most ineffectual in the situation.

Now, there were emotional effects which, naturally, did not show up in these objective performance scores. Dr. Kern, who interviewed all these men immediately after their exposure to this situation, will present for you a systematic treatment of these subjects' introspective reports. This will be a qualitative analysis of their affective responses as reported in interviews.

It is maintained in many circles that quantitative performance scores may mask a richness of qualitative data on the intervening processes accounting for the performance. To investigate this consideration here is Dr. Richard Kern, who will present a systematic treatment of the subjects' introspective reports as collected in the interview immediately following the exposure to the stressful situation just described.

Richard Kern

My presentation, which is descriptive rather than synthetic, will draw on the interview data and the Subjective Stress Scale ratings which were obtained at the end of the situation in which the subject believed he had caused a personal injury, the one which we have studied in most detail to date.

In general, the explosion followed by the news that somebody had been injured and the allusion to a possible wiring mistake by the subject produced a startled subject whose first feeling was of having done something wrong. The news that someone had been injured tended to reinforce this feeling and elicit new feelings regarding the subject's personal responsibility for this man's injuries.

There was a brief period of time between the initial, somewhat indefinite news that someone had been hurt and the subsequent confirmation of this news along with the direction to get on the phone. During this brief waiting period, subjects report ideation and behavior which appear to have had the goal of reducing the subjects' feelings of guilt and personal responsibility. Some subjects attempted to reconstruct their instructions and either physically or mentally to recheck the wiring and their compliance with these instructions. Other subjects reported attempting to reassure themselves by recalling the previous explosions they had heard during the day and telling themselves that those in charge would not let them perform a wiring job which might set off an explosion and injure somebody.

Still others attempted to reassure themselves by denying they had even set off an explosion. A few rationalized that the explosion and injury reported over the squawk box were merely coincidental with the explosion they had set off. One man carried this even further, and reported convincing himself that the messages coming over the squawk box were not even being addressed to him. Consequently, he simply continued to sit and do nothing even after being directed to get on the telephone.

There are a number of reasons inherent in the design of the situation which explain why the various attempts at self-reassurance were destined for failure. The initial instructions to the subject had purposively been vague. Because of this, subjects were not always positive they had faithfully followed the initial wiring instructions. Most subjects immediately realized they actually had set off an explosion which in itself had been unexpected and alarming to them, and, about this time, the initial news regarding an injured man was confirmed over the squawk box along with the instructions to contact the operator and secure an ambulance.

Based solely upon the subjects' reports, this point in the development of the situation represented one of two major peaks in emotional arousal. At about this point, the subjects described themselves as having felt "scared," "shaking," "nervous," "worried," and as having been plagued with feelings of being somehow responsible for the man's injuries.

Upon being directed to get on the phone and contact the operator, nearly

all subjects immediately responded by picking up the headset, cranking the phone and verbally calling the operator. A few subjects reported initial confusion over locating the ringer on the field telephone; one subject reported confusion over use of the headset, thinking that this was used to receive calls but that there must be another piece of apparatus used to talk out on. Another subject stopped to look up the telephone number of the hospital in a directory which was lying near the telephone. The majority of the subjects had apparently seized upon the immediate goal of contacting the operator and had not stopped to think that they had no means of identifying for the operator the area to which the ambulance should be dispatched.

A placard on the front of the telephone equipment specified that if the usual operating procedure was unsuccessful in obtaining contact with the post operator, then a circuit failure should be assumed, and the instructions affixed to the top of the lid should be followed. In spite of this, subjects generally continued to ring the phone, unsuccessfully attempting to contact the operator, until it was suggested over the squawk box that the phone was out of order, that he was not coming through on the squawk box, and that no one could get up from the canyon to help him with the phone. In short, that it was entirely up to him. On the basis of the subjects' retrospective reports, this appeared to be the second major peak of emotional tension. It was at this point, after lifting the lid of the set and seeing the wires inside, that subjects first reported feelings of wanting to run and seek help. As one man described it: "I immediately had a tremendous inferiority complex 'cause I have no mechanical ability at all. I wanted to fix it but didn't think I could--I was afraid of doing something wrong." While this man did stay and commence work on the phone, a few men actually left with the intention of returning to the tent where they and their buddies had been staying and getting some of their buddies to help them fix the phone.

Feelings of inadequacy when faced with this unfamiliar task of repairing what appeared to most of them to be a complicated piece of electrical equipment were always present to some degree. Subjects' descriptions suggest variations in intensity of these feelings, but these clues become so confused with descriptions of what they tried to do that an attempt to rate these descriptions was abandoned.

As Mr. Berry indicated, men were originally screened by use of a reading test before being accepted as subjects. In addition, Reading Vocabulary scores were obtained from the man's Army Classification test records. Correlation coefficients computed between the Reading Vocabulary scores and the telephone performance measures were not significantly different from zero at the five per cent level. Thus, confusion in reading and interpreting the instructions would appear to be more a function of the subject's emotional state rather than of his normal reading ability.

Most subjects reported difficulty in concentrating on and deriving meaning from the instructions. They report having to read and re-read the instructions while being bothered by thoughts of the condition of the injured man, the necessity for hurrying, fears of being unable to repair the set, concern over their personal responsibility for the accident and the

consequences of either having this on their consciences or, in a few cases, the punishment that would be awaiting them. The resultant confusion was manifested through overlooking items in the instructions, e.g., by failing to carry out major steps in the repair procedure because, as one man stated, "It didn't say anything about it in the instructions." In other instances, it appeared that their feelings of inadequacy overrode the authority of the instructions, e.g., to quote one subject, "It said to take this panel #2 off and change over the wires underneath it, but I found the panel and it was screwed down so I decided I'd better leave it alone."

In still other instances the subject failed to make the usual associations between the activity desired and the nearby tool needed to accomplish the activity, e.g., "I tried to get that inner cover off but it was screwed down and I couldn't get the screws out. There was a screwdriver on the shelf by the set, but I didn't think about using it."

The majority of subjects described this state of confusion as being most prominent during their initial attempts to deal with the instructions and the set. They felt that after the first few minutes, and when they actually started physically working on the set, they tended to calm down some and tended to forget everything but following the instructions and repairing the set. In other words, the goal of repairing the set became dominant and the activities involved aided in suppressing the other anxiety and fear-laden ideation.

Towards the end of the experimental period, the subjects were at various stages of the repair procedure. As time had passed by and they hadn't been able to get through to the operator, the feeling that they would be unable to repair the set began to return. This was the second stage in the situation, when men considered leaving to find help. Retaliatory fears and anxieties also returned. Whatever self-addressed questions there were regarding the bonafide nature of the experience were reported by the subjects as having been mainly concentrated into this period. In many instances, the questions were based on subjects' distortion or [illegible] and hence appear as defensive wish-fulfilling or denial behavior. One rather clear example of this type of defensive distortion of stimuli was described by one man who stated, "Towards the end I began thinking it wasn't real because the guys' voices sounded like they had been through it so many times they didn't care anymore; just the tone of their voices." The tired voices he was referring to were those on the stimulus tape.

In other instances, the questions were based on acute observation of cues which had been present during the greater share of the situation, but which, according to the subjects' reports, had not assumed significance until this late stage of the experience. This latter raises questions regarding the relationship, if any, between the level of emotional intensity and the perception of these cues. Why were the self-addressed questions more apparent at the latter stage of the experience? Is this a result of decrease in emotional tension? Or of increase in tension or motivation to terminate, in some way, this unpleasant, apparently unsolvable, experience?

The final speech on the stimulus tape informed the subject that a man was on his way up to talk to him and ask him some questions. Two to three

minutes later the interviewer entered the room. The physical facilities were such that the subject could not see, and in most instances, did not hear, the interviewer approach until he was actually entering the room.

Upon entering the room, the interviewer handed the subject a clipboard bearing a Subjective Stress Scale form and asked him to circle the word in the list that best described how he felt at that time. As soon as the subject had accomplished this, he was told he would be given instructions over the squawk box, to listen carefully and do just as they directed. This was the cue for the presentation of the standard digit memory span test. Upon completion of this test, the interviewer introduced himself and acquainted the subject with the true nature of the situation.

The interviewer had approximately five minutes for face-to-face observation of the subject prior to informing him of the experiment. This was the time consumed in administering the SSS and the digit span test. It had initially been assumed that the two tests would probably provide the subject with indisputable cues regarding the experimental nature of his experience. At the time of the interviewer's entrance into the room, the subjects were obviously preoccupied with the malfunctioning telephone and the general problem of securing help for the injured man. Tension was apparent in their speech, movements, and facial expressions. Their initial reaction to the interviewer was usually an outburst of speech regarding the injured man and the malfunctioning telephone. They accepted the clipboard, appeared to quickly scan the list of fifteen words, circled one and handed the clipboard back without any apparent break in their preoccupation concerning fixing the telephone and getting help. In the course of the subsequent interviews, only seven of the 28 subjects reported having realized from the Subjective Stress Scale form that the situation was apparently an experiment, seven out of 28. The subjects' usual response during the interview was that they just didn't think anything about it. The digit span test was completed by a few subjects in this same uncomprehending manner; however, most subjects felt they recognized it for what it was and hence decided something was peculiar.

The interviewer's initial statements to the subjects that no one was injured, they had done nothing wrong, were usually met with immediate release of physical and emotional tension. The relaxation in facial and postural tensions was strikingly apparent; subjects became ver- ative and mood was one of exhilaration. Content of these verbalizations centered around how scared, frustrated or miserable they had been feeling and how good it was to know that nothing had actually happened. A few subjects' initial affective reaction appeared more retarded. Instead of the initial exhilarated reaction, they appeared angry but would not express it verbally. Within the course of a few minutes, however, they too exhibited overt signs of release of tension and mood exhilaration. By the time the post-test and interview were completed, all subjects appeared calm and in good spirits. When seen one to two weeks later for a second interview, there were no subjects who reported having experienced unpleasant aftereffects of any type or intensity. They were all favorably disposed toward the experiment and the staff personnel, and reported feeling pleased that they had had the opportunity to participate in the study.

Up to this point, I have been describing the reactions reported by the majority of the subjects. As one might expect, there is considerable variation in individual reactions. In contrast to the majority of the subjects' reactions just described, there were some subjects whose initial emotional response to the traumatic stimuli was more moderate in intensity. The explosion did not alarm them, and they did not have the feeling they had done something wrong. They appeared to be slower than the rest of the subjects in accepting the emergency as a real event. Their reactions were not that this was an experiment, but are better characterized by the statement that in the normal course of events when one follows instructions, accidents do not happen and people do not get injured. This group of men appeared to initiate activity on the telephone with a greater degree of emotional detachment. However, their descriptions of feelings of confusion and anxiety while working on the phone are not noticeably different from the descriptions offered by the other subjects. The SSS ratings obtained from these people just prior to the termination of the situation were not significantly different from the corresponding ratings obtained from the other experimental subjects.

I've attempted to give you a rather broad description of the subjects' retrospective accounts of their reactions while in the explosion situation. One of the major purposes of these data is to broaden our awareness of different qualities in the subjects' reactions. These qualities, in turn, may suggest factors relevant to the state of stress which we are not yet measuring. The present self-report data have pointed to the likelihood of differences in the rate and intensity of initial emotional arousal. The direct or indirect effects of this initial emotional reaction appear to continue to exert an influence on the subject throughout the first half of the situation. We have noted in some individuals a quite marked narrowing of the perceptual field at any given time, as well as a shortening of perceptual span over time. Various personality factors in the form of motive patterns and modes of response are suggested. The challenging task now is that of formulating testable hypotheses regarding the relationship of the more promising qualities noted to the state of stress and to behavior.

The criteria for stressfulness I mentioned included a physiological consideration. Here, to bring you the background of a physiological approach and to present the results of certain of our studies is Mr. Robert McDonald.

Robert D. McDonald

Two general physiological approaches exist: (1) metabolic, (2) autonomic. No single well accepted model exists for interpretation of autonomic response data. It is generally agreed that such measures must be taken during a stress situation. It is impractical to credibly include such measures in our stress situations. A strongly documented model exists for adrenocortical-function data. Most of this is based on the writings of Selye, who observed that a variety of different stresses all produced the same pattern of metabolic response. This pattern is both definite and repeatable.

It was necessary, then, to use metabolic events which were reliable and valid and would not affect the credibility of our stress situations.

It is accepted that hormonal output rate of the pituitary and adrenals increases under stress, though the precise mechanisms whereby the hormonal secretions of these glands are physiologically effective remain obscure. We were interested in measures of physiological "cost" to the organism in the maintenance of homeostasis in the face of a stressor. An indirect and necessarily crude approach may be had by studies of metabolic events as reflected in the body fluids such as blood and urine.

A single measure was selected in the blood--the highly controversial eosinophil count. Selye points out that a decrease in number of circulating eosinophils is a highly sensitive and constant sign of the "Alarm Response." Forsham and Thorn initiated quantification of the eosinophil count as a test for adrenal cortical insufficiency. Countless studies indicate that an eosinopenia--that is, a decrease in number of circulating eosinophils--follows physical or psychological stress and the administration of ACTH, epinephrine or adrenal cortical hormones. This eosinopenia is maximal in three and a half to four hours. Interpretation of the specificity or interrelationship of these drugs or hormones is still controversial. It is interesting to note that while well over 1700 articles on this leucocyte have been published, its function is still unknown.

In urine, the following measures were selected: (1) gross measures--output rate (ml/hr), pH, specific gravity, qualitative glucose and bilirubin; (2) quantitative measures--we were concerned with electrolytic balance, protein metabolism and the steroids. To perform these analyses, we made the following assumption: under rigidly controlled conditions, a metabolic measure taken at a specific time on day "X" is directly comparable to the same measure taken at the same time on day "Y".

What are these factors which must be so tightly controlled so as to compare scores on day "X" with day "Y"? The work of Redfearn and his associates in England on sources of variability in the eosinophil count are worth noting:

1. Individual variation in general level; that is, all people are different
2. Effect of physical exertion
3. Effect of emotional stress
4. Dietary factors

5. Allergies; that is, foreign protein sensitization
6. Diurnal pattern
7. Day to day variation
8. Counting error
9. Unassignable causes--in Redfearn's extensive analysis, variance due to assignable causes was less than three per cent of total error

A word on our population pool: These Ss had what the Army calls an A or B physical profile and had been in the service for a few weeks. They were in excellent physical condition and they also displayed a high level of motivation as regards the experimental restrictions. In short, they were most cooperative.

In the study involving the rope bridges which Dr. Bialek has discussed, 23 of these Army trainees were examined physiologically. Collection of physiological specimens was accomplished in accordance with a rigid schedule and in conjunction with strict dietary control. Immediately prior to entering the problem, the S was voided. Three and a half hours later a venous blood sample and urine were collected.

Direct eosinophil count and gross analysis of urine were immediately performed; two two-ounce specimens of urine with thymol were quick-frozen for subsequent microanalysis. Each subject was his own physiological control on a day no sooner than one week following the experiment. These baseline data were collected at the same scheduled times and under the same dietary conditions as the experimental. An eosinopenia ($p < .01$) had occurred. Gross urine analysis, experimental versus baseline, indicated output of urine in ml/hr was significantly higher on the baseline ($p < .01$). Specific gravity was significantly lower on baseline day ($p = .05$); pH was not significant. Quantitative analysis indicated that excretion of K, Phos and 17-Ketosteroids was significantly higher on baseline day ($p = .01$) than on experimental day. The 17-hydroxycorticoids decreased on baseline day ($p = .05$) while Cl excretion increased on baseline day ($p = .05$). Unfortunately, the psychological stress of the swaying bridges seems to have been confounded with fatigue.

It became necessary then to develop stress situations which minimized physical exertion. If this could be done, then we felt we had attained reasonable metabolic control and could speak with some confidence about physiological "cost" to an organism in encountering a stressor.

I should like to discuss the physiological aspects of the experiment already described by Mr. Berry, in which the subject apparently causes a personal injury, and point out that this type of rigid diet and control applies to all our studies. Forty-one male subjects, in excellent physical condition by Army standards, were randomly assigned to one of three groups and subjected to the experimental situation.

Each subject voided immediately prior to entering the experimental situation. Liquid intake was rigorously controlled with no liquid permitted until after the experimental treatment. Approximately 15 minutes after the

termination of the experimental condition, subjects received 20 ounces of unsweetened fruit juice. An hour before urine collection another 20 ounces of fruit juice were given. The time which elapsed between the initiation of the experimental treatment, that is, voiding, and the collection of urine for analysis approximated 4 hours $\pm$ 30 minutes. Time was accurately recorded, and rate of output in ml/hr computed. Solid food intake was controlled, each subject having C-type meat and cracker ration between 11:30 a.m. and 12:30 p.m. Two 2-ounce specimens of urine with thymol were quick-frozen for later analysis.

Immediately upon subject's removal from the experimental situation, a direct eosinophil count was made on peripheral blood (finger puncture) using essentially the Randolph technique. A 20:1 dilution was made with eosinophil stain; the diluted sample was shaken vigorously by hand for 5-10 seconds, then placed for 25-30 minutes on an electric pipette shaker. After expelling several drops of solution, a standard Fuchs/Rosenthal counting chamber was loaded and allowed to stand for 25 minutes. Number of circulating eosinophils was examined in .2 cubic milimeters blood per subject. Ten randomly selected sections in each of the two major divisions of the chamber were counted. Magnification was such that 625×10^{-6} cubic milimeters of blood completely occupied the field. With such high magnification counting error is minimal.

Approximately one week after the initial blood and urine samples were collected, a baseline sample was taken. Each baseline sample was taken at the same time of day $\pm$ 10 minutes as the initial sample and under the same rigid dietary controls.

The group subjected to the severe stress, that is the group termed experimental, demonstrated a significantly lower count ($p \leq .05$) in number of circulating eosinophils per cubic milimeter, compared to both of the control conditions as determined by the Mann-Whitney rank sum test. The experimental group itself shifted significantly from the test day to the baseline day ($p = .01$). The control groups indicated no significant shift in circulating eosinophils from test to baseline days. In 15 of 16 cases in the stressed group an eosinopenia had occurred.

Gross measures of urine indicated no statistically significant change either within or between groups. We are still awaiting quantitative evaluation of the urine.

It is interesting to note that this significant eosinopenia occurred after approximately 30 minutes of "stress." The literature points out that 3-4 hours are necessary for maximal eosinopenia.

We were concerned with the possibility that although the S was confined to a small physical space he might have fatigued himself by the flexing or general movement of various muscle groups. To check the possible confounding of our psychological stress with physical fatigue, six sophisticated Ss--including myself--subjected themselves to a physical exertion test which lasted approximately 30 minutes to a criterion of acute apparent exhaustion. Direct number of circulating eosinophils was determined at regular intervals throughout the day.

A week later baseline samples were taken on the same schedule. Twenty minutes after severe physical exertion an eosinophilia, that is, an increase in circulating eosinophils ($p=.01$) had occurred, followed several hours later by a sharp decrease in count. This exertion-eosinopenia corresponds in time to that found in the aforementioned rope bridge study. It was apparent then that any purely physical effects we had encountered in confining our subjects in the experiment involving explosives had been more than cancelled out by the psychological stress.

In other words, it appears that short term effects of psychological stress and physical exertion are "subtractive," while long term effects of these variables are "additive."

Now that you have heard a description of our research to date, here is Dr. Bialek again with a discussion of some theoretical considerations in dealing with the problem of measurement.

We have presented only two of a series of situations we have completed. These two, however, are typical and suffice as being representative of our efforts.

As you have gathered, we in no way jeopardized the life or limb of any of our subjects, yet we feel nevertheless that we have successfully elicited stress in a field setting. The criteria which we applied to assess the presence of stress indicated that these situations were far more successful than any of our previous efforts in which we actually confronted the subject with physical danger. The principle, to repeat, is to feed information to the subject which forces him to believe that some unforseen accident, mix-up, or mistake has occurred. When assessing the acceptability of any given situation we no longer ask, "Is the situation stressful?", but rather, "Does the subject accept the information he receives as true?" If he does, which is determined by the action he takes, we are satisfied that the situation is suitable for our experimental purposes.

But all is for nought unless we can measure. Note that the two examples you just heard have in common the fact that the measures are embedded securely in the situation--that is, subjects are not aware that they are subjects being tested. The subject finds himself in some predicament. As in any situation, he engages in some type of instrumental activity, the purpose usually being to alleviate this condition. We are able to obtain measures of this natural response unbeknown to the subject. For experimental purposes, of course, we define the choices of activities he has available to him, but within the range we can obtain measures which are "clean" in the sense that we have minimized the extrinsic motives connected with test-taking. An extension of this claim is the freedom we have in obtaining behavioral measures during the stress reaction rather than using the more conventional post-situation measures.

For emphasis, I would like to digress for a moment. We have already explained that we began revising our thinking about stress research partly through our inability to generate genuine stress conditions in the field. We were also motivated by our dissatisfaction with the kinds of stress measures available to us and with the paradigms under which such measures are obtained. Specifically, we weren't happy over having to test our subjects only after they completed the experiment; and furthermore, at that point in the design we didn't consider such activities as flicker fusion, hand trembling, cancelling Cs relevant to our needs. The only other alternative available from searching the literature was to impose a test of some sort on the subject while he was engaged in the problem, and I have already told you of the limitations we feel this strategy imposes. Our solution, to repeat, was to have the subject pursue some activity which would provide a solution to his dilemma, and which could not be perceived by him as a test or as an activity isolated from the functional behavior required in the situation.

Feeling, then, that we had hit upon a unique opportunity for obtaining

measures of ongoing behavior under stress, we have become most anxious to exploit it. The next step is to face squarely the question, "What kinds of behavior are we interested in measuring?" I would like to spend the rest of my time discussing this question.

Turning to the specific measures which were described to you by Mr. Yagi and Mr. Berry--they are essentially conventional psychometric devices, the only difference being that they are embedded in the total context and are not perceived as tests by the subjects. I am both pleased and critical about this point. I am pleased for the reasons just covered; we're getting a cleaner measure of a particular behavior than if we presented the task as a test. I am critical because there are many kinds of behaviors which are not amenable to conventional psychometrics, and if we actually wish to measure these, we have to display even more ingenuity than that required to just transpose a measure into a given context. It is not that the measures described to you in the two reports are not meaningful--it is only that to answer my question, "What kinds of behavior are we interested in measuring?", we must confess that psychomotor performance, and following written and verbal instructions, do not encompass the range of behavior thought relevant to combat or any other stress situation. To be more precise, at the risk of publicly criticizing our own work, I should say that the aforementioned measures supply quantitative differences but cannot reveal qualitative differences. Although I cannot prove it here, I would say that the characteristics of behavior which distinguish the effective man from the ineffective man under stress are essentially qualitative, and unless we can design measures which reveal this dimension, I feel that our efforts will always be somewhat limited. As a rudimentary example of what I mean: From the material Mr. Yagi presented, we can observe whether--in face of adversity--a man runs from or stays at his post; if he runs, we have what I consider a very valuable measure in itself concerning this man's behavior; if he stays, does he engage in what, for contrast, we would call mal-adaptive or relief-oriented behavior? I leave it to you to judge whether this example tells one more or less about behavior under stress than does mechanical dexterity. The apparent drawback is that we can obtain a more rigorous measure of mechanical skill than we can of the more encompassing response of running-staying, but we are all familiar with this qualitative-quantitative dilemma. Perhaps I am merely saying that personality characteristics are crucial variables and also that an individual's mode or style of response is as important as what the response is itself. I can assure you that we are concerned about this, as Dr. Kern's talk demonstrated.

Keeping in mind now the type of experiments and measures we have adopted, I would like at this time to outline some ideas as to what kinds of behaviors I think can be investigated and need to be investigated for a full understanding of the effects of stress.

On what might be called a primitive level, we would like to study activities I shall label as vigilance behavior. By that term I mean the "what" in the environment that a man responds to and what interpretations or meanings he places on what he has selected. Experimentally, this means

feeding specified cues into the situation and seeing first of all whether it is these or extraneous cues (those not specifically fed in) to which the subject responds. In terms of measurement, these cues can at least be categorized beforehand along any dimension one is interested in; i.e., threatening-nonthreatening, personal-impersonal, goal directed-non-goal-directed. The assumption here is that stress results from the perception and then interpretation of cues, and that individuals will differ in the selection and in the way they perceive and interpret specified cues. Experimental conditions should be such that selection of certain cues leads to response X; selection of other cues to response Y. Responses can likewise be categorized along such dimensions as correct-incorrect, functional-nonfunctional, adaptive-nonadaptive by means of some judgment procedures.

Another facet of vigilance that should be studied concerns the degree of structuring fed to the subject. To date, most of our situations have been highly structured--a specified set of cues of a threatening nature is initially presented and reiterated with increasing intensity over time--what happens where we let our subject do his own structuring? This means we simply present the cues and see what the subject makes of them. Does the effective man interpret the situation as threatening or doesn't he? To us, the individual who fails to respond with fear to a specified group of cues is of as much interest as the individual who responds to weak cues with a strong fear reaction. How many cues are needed? How long does it take to come to a decision? To date we've been telling our subject there's an emergency. There is no reason why we can't make him tell us.

Once our subject has given a meaning to the situation in relation to himself, we then ask what types of response he might elicit. Here, for convenience, we distinguish at least four classes: psychomotor, perceptual, cognitive, and decisional.

Ideally, conditions should be such that a subject, once he has attached significance to the events occurring, has a choice of doing nothing or running away as opposed to doing something. This is a very crude dichotomous measure, but we feel it is a significant one in terms of combat effectiveness. We know of no reported experiments in which subjects have this freedom of action.

The things available for our subject to do would fall into one of the four classes of response just described. I will briefly describe examples of each which could be embedded into the total situation and which are amenable to measurement. Mr. Berry and Mr. Yagi have presented the prototype of a psychomotor measure. We feel that the variations of this type of measure that we could introduce to fit a given situation are almost unlimited. Perceptual responses could include estimations of size and distance, and perception of others as friendly or hostile. Such responses would naturally lead into investigation of perceptual distortions as an effect of motivation. In the third class, cognitive, I include reasoning and intellectual factors in general. Also, Mr. Berry referred to a reasoning or problem-solving task wherein the sequence of decisions leading to success or failure can be accurately recorded and measured. The final

class, those I have described as decisional responses, refers primarily to choices involving the basic value system of the individual.

To conclude, what I have said today certainly ignores many important dimensions of stress. However, if one considers the number and the complexity of interactions between the four types of behavior I have mentioned, psychomotor, perceptual, cognitive and decisional, and the three levels on which we can measure, subjective, behavioral and physiological, it become apparent that we have only begun to tap the experimental possibilities which present themselves to us because of our approach to the design of stress-eliciting situations, and to the measurement of the behavior that goes on naturally in them.

The staff of Task FIGHTER has reviewed for you today its past and its current research on the psychophysiological response to stress. It is clear that a large block of data now exist on this research problem to which so much research attention is being paid by psychologists and by physiologists. This material will be thoroughly analyzed and in time reported to the profession. We would like to feel that we have demonstrated for you the feasibility of an approach that permits collection of quantified data on substantial numbers of cases, which data represent the response to real emergencies, those that strike anywhere without warning. From these data it is possible to understand more of the internal dynamic processes determining the success of an individual's attempt to cope with stress.

Now to discuss certain aspects of this research, here is our Director of Research at the Monterey Unit of HumRRO, Dr. Howard H. McFann.

Several points already covered in the previous discussion seem to me to warrant emphasis in summarizing the FIGHTER methodology.

In judging the stressfulness of any situation to be used in the FIGHTER study, we have found that we cannot rely on face validity alone as a criterion of stress. Dr. Bialek has described the simulated combat situation which all observers judged to have high face-validity as a stressor. He has also described the factors which contributed to the rejection of this as the sole criterion.

Revising our strategy leads to the added criteria enumerated by Dr. Berkun: The situation must be judged stressful by the subject; it must produce an alteration in objectively measured behavior as compared with control conditions; and the situation must produce a transitory physiological response which can be considered abnormal or different from the response under control conditions. The decision as to whether the situation under study is adequately stressful now becomes a weighted decision as to whether it is acceptable on the basis of the criteria described.

Another requirement for the FIGHTER situations is that they must permit isolation of various factors. For example, isolating physical stress from psychological stress becomes a vital issue if you are dealing with endangered troops who are, for the time being at least, physically rested and comfortable. What is the difference between their performance and that of troops who are bone-weary, wet, and physically miserable, but in no perceived danger; and what happens to the performance of troops who are both physically and psychologically stressed? FIGHTER's strategy is directed at studying fear of bodily harm or injury isolated as much as possible from such additional factors as fatigue. This in no way is meant to discount other factors interacting with psychological stress. Instead, it is an attempt to obtain an understanding of the dynamics of psychological stress in isolation prior to attempting to relate psychological stress with more complex phenomena.

Further, we have found through experience that the subject must perceive the stressful situation as real. As was pointed out, a game or, in FIGHTER's case, a simulated combat or emergency problem in which the subject is aware that he is playing a role, may be stimulating and exciting but it does not produce stress. This discovery led to the rejection of our original direction of situation development and to the development of the present type of experiment. It follows that if the subject is to consider the situation real, he must perceive no testing atmosphere. The experimenters cannot be recognized as such, and no apparently non-relevant performance measures can be introduced. This problem challenges the ingenuity of the experimental designer, needless to say, and you have heard today how we have contrived to overcome this methodological problem.

Now, once we have developed an acceptable situation and the subject is tested without recognizing the fact of his being tested, what outcomes do we expect? In other words, what direction do we expect the change in performance to take? It is conceptually premature to hypothesize a specific response. On the face of it, mean decrement might seem to be the logical direction; but the facilitative effects still require investigation.

In summary then, in our methodology we have attempted to create situations which meet our criteria of acceptability. This involves the use of contrived emergencies during which an opportunity to measure behavior is achieved unbeknown to the subject.

Some of the results of this testing have been discussed by the panelists. The analyses they have described are initial and necessarily fragmentary. It will be noted, however, that we are employing an interdisciplinary approach; that is, clinical, performance, and physiological behaviors were studied simultaneously.

To put the development of the above situations into context, let us look for a moment at the long-range goals of the research program. Eventually we would like to develop treatments which would serve a facilitative function in each of the specific situations under study. Then comes the vital problem of determining whether such treatments are generalizable across various dimensions of stress to a common general treatment: in other words, whether stress reactions are situation specific or general to a wide class of situations.

Should the hypothesis of a generalized response common to all of our experimental stress situations--whatever the nature of the stressor--be validated, we will undertake further testing. The nature of the subsequent study will be to ascertain whether new and conceptually different situations cause a similar stress response which is amenable to the same treatment. If the general treatment technique proves to be effective in these new situations, we will feel justified in assuming that we have succeeded in contributing toward an understanding of stress and toward the possibility of mitigating its decremental effects upon performance--including combat performance.

In conclusion, let me say that as a military researcher, I feel that this is an ideal instance of a long-range applied problem which deals both with a significant military problem and with a significant psychological problem, as well. It is a unique and profitable marriage which deals with stress--but does so in a manner harmonious to both parties.