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# PSYCHOLOGICAL EFFECTS OF CHEMICAL DEFENSE ENSEMBLE IMPOSED HEAT STRESS ON ARMY AVIATORS


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20. ABSTRACT:

Psychological testing was conducted with six Army aviators before and after flights in a UH-1H helicopter while wearing standard flight suits, US or UK aircrew chemical defense ensembles. Additional testing on non-flight days was conducted to provide a baseline for evaluation. Tests consisted of encode/decode problems, math problems, logical reasoning problems, target detection problems, and a four-choice reaction time test.

Tests were scored for number attempted, percent correct, reaction time of correct and incorrect responses. Self reports of mood were also taken and scored. The results of the study indicated that various levels of ensemble-imposed heat stress caused orderly changes in psychological function and extended the results of laboratory investigations to the aviation setting. In addition, reaction time data showed changes in the pilot's ability to deal with "error" situations as a function of imposed heat stress and that self reports of mood were unreliable indicators of severe heat stress.

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# INTRODUCTION

Army aviation is currently increasing its emphasis on Chemical Defense (CD) training. In fact, Interim Change I01 (23 Dec 1981) to the Aircrew Training Manual (TC 1-135) makes in-flight training in full Mission Oriented Protective Posture (MOPP) IV mandatory. Training in MOPP IV will place a burden upon pilots because the ensembles are physically restrictive and degrade sensory inputs. In particular, breathing through the charcoal filter of the mask is fatiguing and protective masks distort vision. The gloves reduce manual dexterity and degrade sense of touch. Concomitant with these effects is the problem of reduced convective cooling and an increased susceptibility to heat stress.

Heat stress has been shown to impair not only individual physiology but also psychological function. Reviews of the effect of heat stress upon psychological function (Grether, 1973; Poulton, 1976; and Wing, 1965) have demonstrated that psychological function is impaired prior to reaching physiological overload. Figure 1 (from Figure 2 of Wing, 1965) illustrates not only the relationship between Effective Temperature (ET) and exposure duration upon mental function but also the relationship between recommended and marginal (ready-to-drop) physiological thermal tolerance and exposure durations. This plotting of relationships allows estimates of duration of unimpaired mental performance to be made simultaneously with estimates of physiologic tolerance. For instance, if a person were to be exposed to an ET of 34°C (left hand Y-axis), the recommended physiological exposure limit of just under 120 minutes would be predicted, and impaired mental function would be expected at approximately 60 minutes. If the relationships plotted are reasonably accurate, impaired mental performance can be expected well before physiologic limits are reached. The extent and importance of the impairment will be peculiar to the specific situation.

The heat stress and psychological decrements which might occur while wearing CD ensembles are exacerbated by the high ambient temperatures periodically encountered in rotary wing aircraft. Moreland and Barnes (1970) recorded cockpit temperatures of 43.9°C in flight in an Army light observation helicopter (OH-6) and Breckenridge and Levell (1970) recorded temperatures of 56.7°C in an AH-1G attack helicopter. The purpose of this study was to compare cognitive function and psychomotor performance in pilots wearing the US Army aircrew CD ensemble, the United Kingdom aircrew CD ensemble, and the standard US Army flight suit. Each subject wore each ensemble during hot weather and during identical 4-hour flight profiles of a UH-1H utility helicopter.

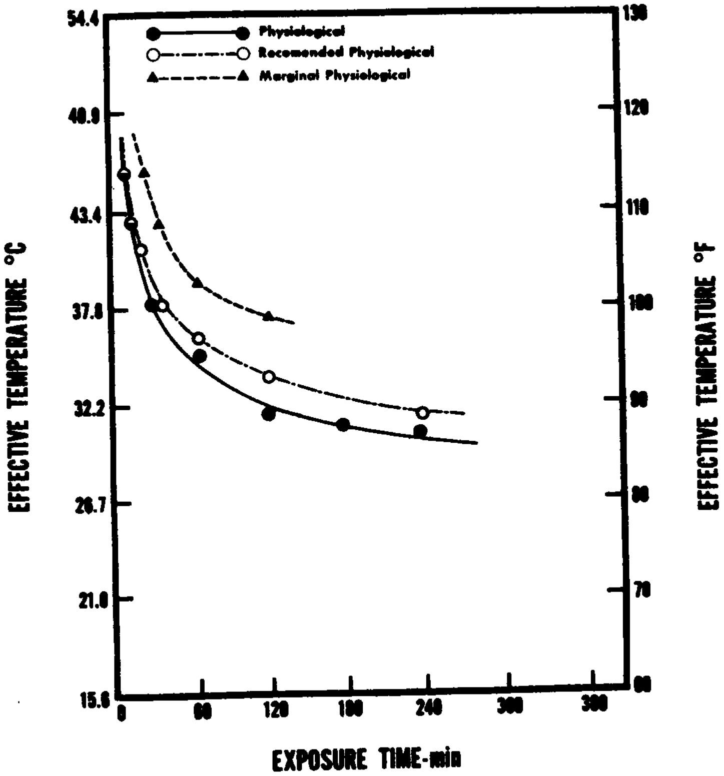


FIGURE 1. Comparison of the Thermal Tolerance Limit for Unimpaired Mental Performance with Both the Recommended Physiological Limit and the Marginal Physiological Limit. (Wing, 1965)

## METHOD

### SUBJECTS

The subjects were six male US Army Warrant Officers. All were recent graduates of the Army's Initial Entry Rotary Wing Class and had similar training and flight histories. All were acclimated to the local environment, in good physical condition, and between the ages of 20 and 37 with a mean age of 29. All subjects were informed of the nature and hazards of the experiment and each had signed an informed consent statement (Appendix A).

### APPARATUS

All flights were conducted in the US Army Aeromedical Research Laboratory's (USAARL) JUH-1H utility helicopter with USAARL research aviators as safety pilots. In-flight physiological data and flight performance information were collected by means of an on-board Helicopter In-flight Monitoring System (HIMS II, Figure 2) modeled after the one described by Huffman, Hofmann, and Sleeter (1972). Psychological and psychomotor tests consisted of subtests selected from the Psychological Assessment Battery (PAB) developed by the Division of Neuropsychiatry, Walter Reed Army Institute of Research (WRAIR).

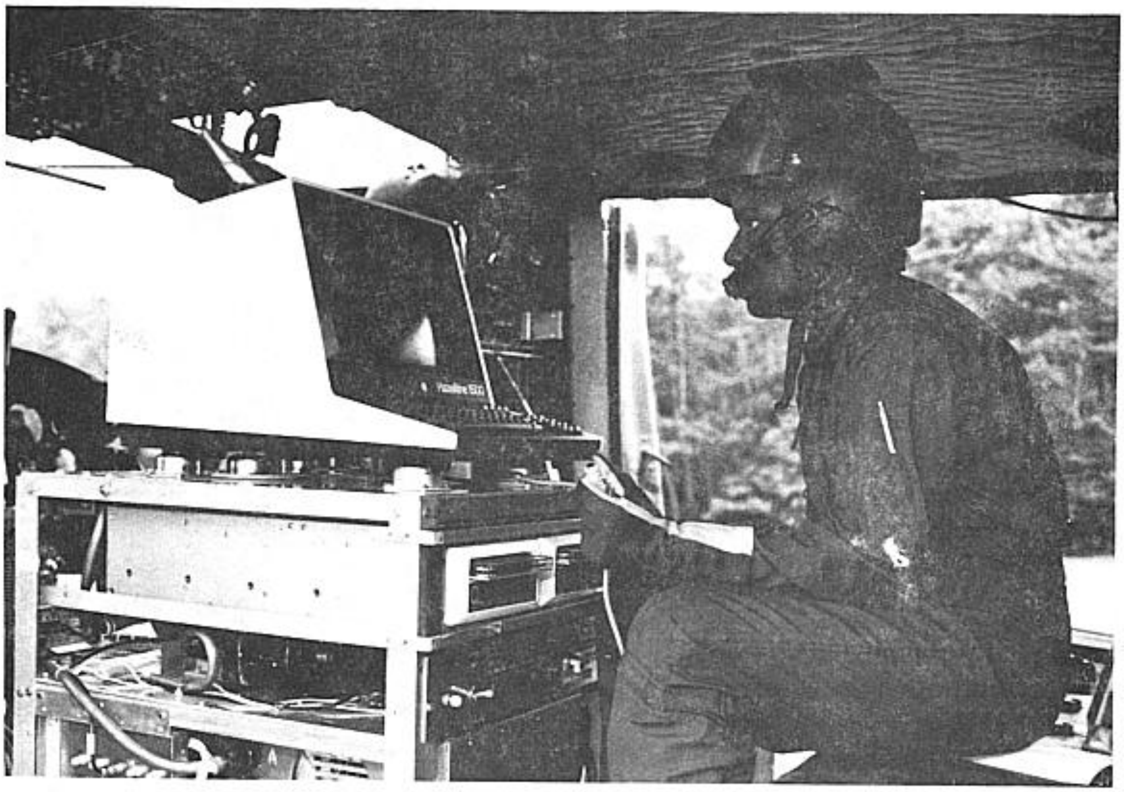

FIGURE 2. Helicopter In-Flight Monitoring System (HIMS)

**PROCEDURE**

Subjects were billeted at a stagefield (Figure 3) located south of Fort Rucker, Alabama. They lived in an air-conditioned research facility while participating in the experiment. Subjects flew on Mondays, Wednesdays, and Fridays. Each subject wore one of three possible ensembles on each flight day with the order of wear of ensembles randomized so that each subject wore the ensembles in a unique sequence. The three ensembles worn were the US Army aircrew CD ensemble (Figure 4, A), the United Kingdom aircrew CD ensemble (Figure 4, B), and the standard US Army flight suit (Figure 4, C). All flights were conducted during July, 1981. Mean ambient cockpit Wet Bulb/Globe Temperature (WBGT) during the flights was 29.05$^{\circ}$C ($\pm$1.11$^{\circ}$C SD).

<u>Flight profile</u>

Subjects flew a maximum of 4 hours (2 consecutive 2-hour flights) on each flight day. During each flight they were asked to fly repetitively a series of maneuvers. The series consisted of a 50-foot hover, a lateral hover, and a precision flight profile. The series took about 40 minutes to complete and was repeated until 4 hours of flight had elapsed or the subject exceeded established heat and/or safety criteria (heart rate exceeding 140 beats per minute for 10 minutes, core temperature above 38.5$^{\circ}$C, or mean skin and core temperature converging to within 0.5$^{\circ}$C). Subjects were not responsible for

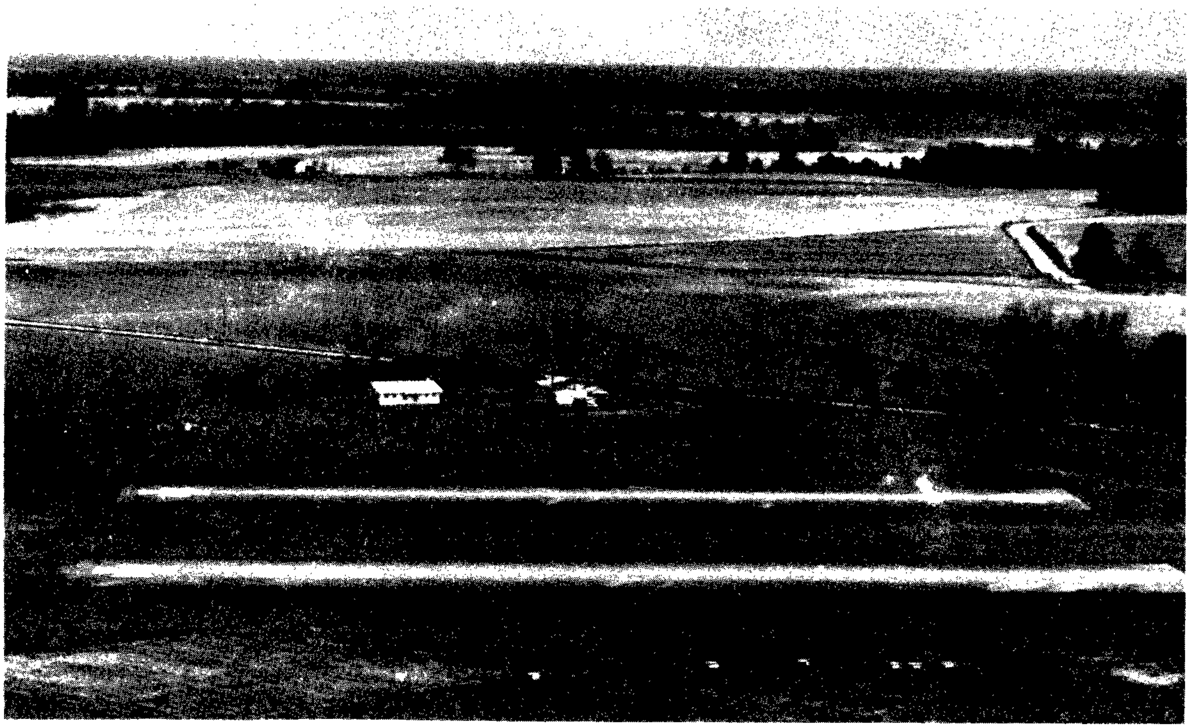

FIGURE 3. Highfalls Stagefield, Ft. Rucker, AL.


FIGURE 4. Flight Ensembles Worn During Testing. A, United States Army aircrew chemical defense ensemble; B, United Kingdom aircrew chemical defense ensemble; and C, United States Army standard flight suit.

pre/postflight inspections of the aircraft and sat in the shade during refueling operations. Water was provided ad libitum at hourly intervals.

Physiological data

Subjects were monitored for heart rate, mean skin temperature, and core temperature. These data were recorded by a medical observer and by the HIMS II. The medical observer was constantly monitoring vital signs and temperatures and would terminate the flight if heat and/or safety criteria were exceeded.

Psychological Data

Subjects were administered a battery of psychological and psychomotor tests prior to suiting up for flight and as soon after flight as possible. The need for the subjects to remove the ensemble, be seen by a flight surgeon, and be weighed before taking the posttest resulted in unavoidable delays of 20 to 30 minutes. PAB was scored by WRAIR, without knowledge of the actual experimental conditions. The following subtests of PAB were used.

Mood Scale: Subjects were asked to rate their agreement to 65 mood descriptors (such as "anxious") on a 1 (none) to 5 (extreme) scale. The presentation order was randomized on each presentation with some words repeated as controls.

Feeling/Tone (Pearson and Byars, 1956): Subjects were asked to rate their current level of fatigue by stating whether or not they felt "BETTER THAN," "SAME AS," or "WORSE THAN" the activity level descriptor (such as "peppy").

Encode/Decode (Haslam, 1981): Subjects were given an arbitrary coding system which related letters to two-digit numbers and were asked to encode or decode purported map coordinates according to a set of simple rules. They were to do as many as possible in 7 minutes.

Target Recognition (Folkard, Knauth, Monk, and Ruten, 1976): Subjects were given two target letters and asked to determine if both letters occurred in a string of 30 letters or if one or both letters did not occur in the string. They were to do as many as possible in 7 minutes.

Logical Reasoning (Baddeley, 1968): Subjects were given a sentence which claimed to describe the order of the two letters (AB or BA) which followed the sentence. Their task was to determine if the order described was the same as that given. They were to complete as many as possible in 7 minutes.

Serial Math (Wever, 1979): Subjects were asked to watch a briefly presented (approximately .25 second per character) string of characters. The first two were numbers in the range of zero to nine with the third character being an add or subtract sign. The task was to perform the operation on the numbers and either to add or subtract 10 from the result if the results met certain criteria. The resulting number was then entered and scored. Subjects were to complete as many problems as possible in 7 minutes.

Reaction Time (Wilkinson and Houghton, 1975): Subjects were presented with a four-choice reaction time task. This task presented the subject with four lights arranged in a square pattern. The subject's task was to determine which light was illuminated and press the button in the corresponding position as fast as possible. The task was presented repetitively for 8 minutes.

## RESULTS

Subtests of PAB were scored by computer for the number attempted, percent correct, reaction time to correct response (RTcor), and reaction time to an incorrect response (RTerr). Information on mood was converted into mean score in the categories of mood (good to bad), hostility (friendly to hostile), happiness (happy to unhappy), and depression (in-the-dumps to on-top-of-the-world). Since performance is susceptible to circadian changes (Klein and Wegmann, 1980) as well as to individual differences, direct comparison of the data is difficult to interpret. In order to control for these outside influences, the raw data were converted into percent of change from baseline (pretest) using the formula (A-B)/B where B was the pretest score and A the posttest score. In this manner, any one experimental manipulation was represented by a percent of change score which was the composite of the pretest and posttest scores. Positive scores indicate increases in posttest scores over pretest scores. Evaluation of this number required reference to either control or experimental data dependent upon the comparison desired.

Statistical significance was determined by means of a Randomized Block ANOVA with Replicates (Edwards, 1960). The factors used were percent change from baseline on control days, standard flight suit days, UK CD ensemble days, and US CD ensemble days. None of the subtests of PAB exceeded the $p=.05$ value and it was concluded that there were no statistically significant effects associated with any of the factors. Similarly, self-report of mood failed to show any significant differences across factors.

The purported stressor in this study was heat. Analysis of the physiological data revealed that subjects showed markedly different physiological responses to the experimental conditions. Therefore, experimental data were divided into three categories irrespective of suit and based solely upon physiological response. The three categories selected were slight, moderate, and severe heat stress. Placement into a category was determined by a physiologist who had no knowledge of the outcome of the psychological testing and was given only the category titles, "slight," "moderate," and "severe," without specific placement criteria. The convention adopted was that subjects withdrawn from an experimental condition because they exceeded heat and/or safety criteria would be judged as severely heat-stressed subjects, those with consistently elevated heart rates or temperatures but less than the heat safety criteria would be judged as moderately heat-stressed, and the remaining would be judged as slightly heat-stressed. Accordingly, three instances of severe heat stress, seven instances of moderate heat stress, and six instances of slight heat stress were identified. (Two flights were not flown because of inclement weather.)

The data for these groups as well as for the control days were averaged and are presented by subtest. These arbitrary groupings crossed the original group bounds and left three groups which were composed of partial replicates of unequal size, and generally violated most assumptions concerning population homogeneity. The results are, therefore, trends without statistical confirmation.

## LOGICAL REASONING

Table 1 presents the percent of change data for the logical reasoning test. Again, positive percentages indicate increased posttest scores relative to the pretest and negative percentages indicated decreased posttest scores relative to the pretest. The number of questions attempted showed a 2 percent increase in the control group, the slight heat stress group showed a 5 percent increase, and the moderate group evidenced a 3 percent increase. The severely stressed group showed a 2 percent increase or no difference from the control data. A similar up-down trend was seen in the percent correct data as controls showed a 2 percent decrease, the slightly stressed group evidenced a 4 percent increase, with a 1 percent increase in the severely stressed group. The reaction time to correct response (RTcor) showed no change between the control group and slightly stressed group while moderately stressed group decreased to -11 percent. The severely heat stressed group demonstrated only a -3 percent decrease. The original pattern of low, high, and then return to low was seen in the reaction time to error (RTerr) data. It should be noted that the absolute difference between the RTerr for the slightly heat stressed group (or normal flight) and the severely stressed group was 33 percent. Checking the actual RTs revealed that the baseline of RTerr and RTcorr did not differ; that is, the changes seen were differences due to the intervention and not idiosyncratic changes in baseline reaction times.

## TABLE 1

## PERCENT CHANGE IN LOGICAL REASONING TESTS

| | NUMBER ATTEMPTED | PERCENT CORRECT | RT CORRECT | RT ERROR |
|---|---|---|---|---|
| CONTROL | 2.0 | -2.0 | 1.0 | -17.0 |
| SLIGHT | 5.0 | 4.0 | 0.0 | 20.0 |
| MODERATE | 3.0 | 3.0 | -11.0 | -9.0 |
| SEVERE | 2.0 | 1.0 | -3.0 | -13.0 |

RT = Reaction time

### TARGET RECOGNITION

Subjects showed a slight increase in the percent change in the number attempted from 5 percent to 7 percent between the control and slightly stressed group (Table 2). This increase disappeared and, in fact, decreased in the moderate (2 percent) and severe (-3 percent) groups. There was an absolute difference of 10 percentage points between the slightly stressed and severely stressed group. The percent correct data showed a similar slight increase and subsequent decrease between the various groups but the difference between the slightly and severely stressed groups was only 7 percentage points.

## TABLE 2

## PERCENT CHANGE IN TARGET RECOGNITION TESTS

| | NUMBER ATTEMPTED | PERCENT CORRECT | RT CORRECT | RT ERROR |
|---|---|---|---|---|
| CONTROL | 5.0 | -1.0 | -2.0 | -29.0 |
| SLIGHT | 7.0 | 2.0 | -9.0 | -29.0 |
| MODERATE | 2.0 | 3.0 | -7.0 | * |
| SEVERE | -3.0 | -5.0 | -6.0 | 20.0 |

* Not computable
RT = Reaction time

RTcor displayed an opposite pattern. It started at -2 percent, decreased to -9 percent during slight stress, then rose to -6 percent in the severely stressed group. Since RT deals with speed of response, negative percent change scores indicate increases in speed and should be considered as improved performance. From this standpoint, RTcor behaved similarly to number attempted and percent correct. RTerr, on the other hand, started at -29 percent during control conditions. Subjects made responses terminating in errors in the posttest condition on control days that were considerably quicker tnan their RTcor. Relative to the pretest responses, the posttest reaction times were short. This trend persisted during slight stress conditions. Due to the fact that errors were not made by a large number of the moderately stressed subjects during posttesting, RTerr could not be computed; however, RTerr increased to 20 percent during severe stress conditions. An absolute difference of 49 percentage points existed then between control or slight stress conditions and the severe stress condition. After severe stress, subjects were taking considerably longer to make responses which ultimately proved to be in error.

## SERIAL MATH

Table 3 presents the results of the serial math test. The percent change score in the number of problems attempted went from -2 percent during control conditions to 10 percent during severe stress. The percent correct changed from -1 percent to 6 percent (slight to moderate), and to 4 percent in the severe stress condition. RTcor went from -5 percent during control conditions to 5 percent during slight stress and then to -19 percent during severe stress. This is an absolute difference of 24 percentage points between slight stress (or normal flight) and severe stress in the direction of more rapid responding. RTerr decreased from 51 percent during control conditions to 7 percent during severe stress conditions.

TABLE 3

PERCENT CHANGE IN SERIAL MATH TESTS

| | NUMBER ATTEMPTED | PERCENT CORRECT | RT CORRECT | RT ERROR |
|---|---|---|---|---|
| CONTROL | -2.0 | -1.0 | -5.0 | 51.0 |
| SLIGHT | 1.0 | 6.0 | 5.0 | 23.0 |
| MODERATE | 5.0 | 6.0 | -7.0 | 10.0 |
| SEVERE | 10.0 | 4.0 | -19.0 | 7.0 |

RT = Reaction time

ENCODE/DECODE

The data for the Encode/Decode test are summarized in Table 4. The percent change scores for the number attempted stayed fairly constant across conditions (8 percent) with the exception of the severe heat stress condition in which it decreased to -5 percent. The percent correct increased from a -1 percent during control conditions to 6 percent during slight stress and dropped to -2 percent during severe stress conditions. RTcor rose slightly from the -7 percent control level to the -4 percent level during severe stress. Due to a tendency to make perfect scores on the pretest, RTerr scores were not computable.

TABLE 4

PERCENT CHANGE IN ENCODE/DECODE TESTS

| | NUMBER ATTEMPTED | PERCENT CORRECT | RT CORRECT | RT ERROR |
|---|---|---|---|---|
| CONTROL | 8.0 | -1.0 | -7.0 | * |
| SLIGHT | 9.0 | 6.0 | -6.0 | * |
| MODERATE | 7.0 | 4.0 | 4.0 | * |
| SEVERE | -5.0 | -2.0 | -4.0 | * |

* Not computable
RT = Reaction time

REACTION TIME

Table 5 presents the reaction time data. The percent change score for number attempted during control conditions was -3 percent. The slightly stressed group exhibited similar behavior while the moderate and severe stress groups showed decreases in the number attempted. There was no change evident in the percent correct scores across the conditions. RTcor went from -3 percent during control and slight stress to 3 percent during severe heat stress. RTerr started at 10 percent and decreased according to the severity of the stress until it reached a -10 percent level in the severely stressed group. This represents an absolute difference of 16 percent from the slight stress (or normal flight) condition and 20 percent from control in the direction of shortened reaction times despite a 3 percent increase (or slower reaction time) in RTcor scores.

## TABLE 5

## PERCENT CHANGE IN REACTION TIME TESTS

| | NUMBER ATTEMPTED | PERCENT CORRECT | RT CORRECT | RT ERROR |
|---|---|---|---|---|
| CONTROL | 3.0 | 0.0 | -3.0 | 10.0 |
| SLIGHT | 2.0 | 0.0 | -3.0 | 6.0 |
| MODERATE | 0.0 | 1.0 | -1.0 | 0.0 |
| SEVERE | -2.0 | 0.0 | 3.0 | -10.0 |

RT = Reaction time

## MOOD

Mood data were idiosyncratic and varied independently of the stress encountered. Figure 5 presents the activation and mood scores for the three subjects in the severe stress group. As can be seen, some subjects reported changes while others reported no changes. All subjects seemed to be less active ana in a worse mood after the severe heat stress condition, but by widely differing amounts.

```
                      ACTIVATION
LETHARGIC                               FULL OF ENERGY
  +----+----+----+-A--+B---+----+----+----+----+
-4+----+----+----+----+A--B+----+----+----+----+4
  +----+----+----+-A--+----+-B--+----+----+----+

                         MOOD
GOOD                                           BAD
  +----+--B-+A---+----+----+----+----+----+----+
-4+----+--BA+----+----+----+----+----+----+----+4
  +-B--+---A+----+----+----+----+----+----+----+

                     B (Before)
                     A (After)
```

FIGURE 5. Scaled Self-Reports of Mood of Severely Heat-Stressed Subjects. B represents the preflight report, A the postflight report, and N no change.

## DISCUSSION

The results of this study can not support the position that psychological/psychomotor function varied systematically as a function of the type of CD ensemble worn while flying. However, if the grouping of subjects into the arbitrary classes of slightly, moderately, and severely heat stressed is accepted, then trends emerge which the authors believe are systematic and confirm the applicability of laboratory investigations of heat stress to the aviation setting.

The data reported here suggest that slight heat stress increases performance over control levels (cf Poulton, 1976) and that this improvement is eliminated by more severe heat stress (cf Epstein, Keren, Moisseiev, Gasko, and Yachin, 1980). These results are probably conservative due to the intervention of an unavoidable recovery period between exposure and posttesting. Without arguing the significance of changes in performance (number attempted and percent correct) or their operational significance, the effect upon reaction time which terminated in error (RTerr) was clearly anomalous. During one test (target detection), subjects spent a great deal more time than expected working on the solution without being able to find the correct answer. Other tests (e.g., logical reasoning) showed that subjects made errors without working on the problem for as long as expected. In other words, when subjects were severely heat-stressed they either could not provide the correct answer despite extra effort or could not recognize that additional consideration was necessary. The conclusion that subjects failed to adequately consider the problem at hand is based upon the fact that response latencies were shortened without a concomitant increase in error rates. The possibility that subjects chose not to answer a particular question and in that fashion shortened response latencies could not be ruled out. This result has previously been reported by Colquhoun and Goldman (1972, p. 628).

Interestingly, subjects who had spent the day in isolation with little to do (control) showed changes in performance similar to those subjects who were severely heat stressed. Whether it is appropriate or not to say that aviators are stimulated to perform above normal levels during typical flights or that a day of isolation and inactivity depresses psychological function is not clear from the present study and is the subject of current research at USAARL.

Self-report of mood varied widely across the severely heat stressed subjects. This lack of consistency between self-report and heat stress is not unusual. When describing their behavior, people follow rules which are more in keeping with their social environment than their internal state (Poulton, 1976). Some people will follow the rule that states that the effect of exposure to heat is to slow response times and reduce performance levels. Others follow the rule that a "can do" attitude is important to maintain regardless of the situation. This type of rule-following results in a dissociation between level of cognitive function and reported mood.

## CONCLUSIONS

This study supports the hypothesis that the effect of heat stress is insidious. While it may not greatly affect an aviator's psychomotor performance level, it may affect his ability to recognize error situations or make correct responses when unsure of himself. The data is consistent with previous observations that subjects may not recognize potential areas of impairment and may report that they are as ready as ever to conduct a mission.

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## APPENDIX A

## VOLUNTEER PARTICIPATION AGREEMENT

VOLUNTEER PARTICIPATION AGREEMENT

I, ____________________________________________, SSN ________________, having attained my eighteenth (18th) birthday, and otherwise having full capacity to consent, do hereby volunteer to participate in a research study entitled: "Physiological Assessment of the Aircrew Chemical Defense Clothing," under the direction of the US Army Aeromedical Research Laboratory.

The implications of my voluntary participation; the nature, duration, and purpose; the methods and means by which it is to be conducted; and the inconveniences and hazards which may reasonably be expected have been explained to me by Bruce E. Hamilton, Ph.D., Principal Investigator, and are set forth on the attachment of this Agreement, which I have initialed. I have been given an opportunity to ask questions concerning this investigational study, and my questions have been answered to my full and complete satisfaction.

I understand that I may at any time during the course of this study revoke my consent and withdraw from the study without prejudice. However, I may be required to undergo further medical examinations, if in the opinion of the attending physician such examinations are necessary for my health or well-being.

____________________ __________
Signature Date

I was present during the explanation referred to above as well as the Volunteer's opportunity for questions and hereby witness his signature.

____________________ __________
Signature Date

VOLUNTEER AGREEMENT
(ATTACHMENT)

PURPOSE

You are being asked to participate in a research program entitled: "Physiological Assessment of the Aircrew Chemical Defense Clothing," to assess the biomedical and physiological feasibility of using the United Kingdom (UK) Aircrew Chemical Defense (CD) Ensemble in the US Army aviation environment. Prior to your participating in the study, you will be given a physical examination by a flight surgeon and will be asked to fill out a medical history questionnaire.

PROCEDURE

You will be asked to fly rotary wing aircraft performing the following maneuvers: (1) 50 feet OGE hover, (2) hover course, and (3) instrument flying course. As an experimental subject, you will be asked to fly approximately 4 hours of flight/day with each of two chemical defense ensemble and 4 hours of flight in the standard flight suit. You will be connected via three chest electrodes, five skin temperature electrodes and a flexible rectal thermometer to physiological monitoring equipment which will monitor heart rate, respiratory rate, skin temperature and core temperature. Additionally, your psychomotor coordination and cognitive functioning will be tested intermittently during the course of the experiment.

The aircraft safety pilot will be in standard US flight clothing. A medical observer will be on board during all flights as a member of the research team. A Flight Surgeon will be on call by radio to provide rapid advice to the medical observer and flight crew, if necessary, and at the stagefield with complete resuscitation equipment and an emergency medical team.

RISKS

The medical risks associated with this project are that of heat-related injuries; i.e., heat exhaustion, heat stroke, and heat pyrexia. An explanation of these injuries follows:

Heat Exhaustion

This disorder can be broken down into two areas: a water-deficient heat exhaustion or dehydration and salt-deficient heat exhaustion.

Water-Deficient Heat Exhaustion

It is an effect of excessive exposure to heat and becoming water-depleted due to inadequate replacement of water losses caused by prolonged sweating.

Signs and symptoms: thirst, fatigue, giddiness, oliguria, pyrexia, and in advanced stages, delirium and death.

Salt-Deficient Heat Exhaustion

It is an effect of excessive exposure to heat in which salt depletion occurs due to inadequate replacement of salt lost through prolonged sweating. Signs and symptoms: fatigue, nausea, vomiting, giddiness, muscle cramps, and in late stages, circulatory failure.

Prevention and Treatment

Prevention of heat exhaustion requires an adequate supply of water easily accessible while working in hot climates or conditions both during and after working hours. The treatment consists essentially of rest in bed in a cool environment with a high intake of fluids. The preferable method of intake is by mouth unless the person is unconscious, then fluid replacement needs to be given intravenously. Also, the person should be kept cool until his thermoregulatory system is back in balance.

Heatstroke

A state of thermoregulatory failure with sudden onset following exposure to a hot environment with a high body temperature > 40.6°C (105°F) characterized by an absence of sweating and disturbance of the central nervous system. It is frequently fatal.

Hyperpyrexia

The same symptoms as a heatstroke except the patient is conscious and may be sweating. The rectal temperature will be slightly lower than that of heatstroke. Signs and symptoms: euphoria, headache, dizziness, drowsiness, numbness, restlessness, purposeless movements, incoordinated movements, aggressiveness, mania, suicidal tendencies, mental confusion, and sudden onset of delirium or coma in heatstroke.

The following are some definitions of some terms which we have used above with which you may not be familiar:

Oliguria - Secretion of a diminished amount of urine in relation to the fluid intake.

Pyrexia - A fever, or a febrile condition; abnormal elevation of the body temperature.

Psychomotor - Pertaining to motor effects of cerebral or psychic activity.

Cognitive Functioning (Cognition) - The operation of the mind by which we become aware of objects of thought or perception, including understanding and reasoning.

Mania - Excitement manifested by mental and physical hyperactivity, disorganization of behavior, and elevation of mood.

It is expected that you will experience some degredation of performance due to heat stress. The safety pilot will be instructed to observe your performance and will not allow you to progress to unsafe levels of degredation.

You will be stressed and uncomfortable during this study, but we have established safety limits and the experiment will not be allowed to proceed if any of these limits are reached. By monitoring your heart rate, respiration, skin and rectal temperature and comparing these parameters with established limits, we will be able to terminate the experiment at a point which will minimize the risk to you.

________________ Initials     ________________ Date

## PRIVACY ACT STATEMENT

The information solicited in this questionnaire will be used for research and statistical analysis of the problem of Army aviator fatigue/stress in wearing chemical defense ensembles. It will be kept confidential and names will not be used in any reports, published or unpublished, of this data. Participants will be identified only by randomly assigned project identification numbers.

Disclosure is voluntary; however, failure to do so will seriously limit the usefulness of other data obtained from the individuals in this project.

I have read and understand the above statement and consent to the use of this information as described.

________________________ ____________
Signature Date

DEPARTMENT OF THE ARMY
U. S. ARMY AEROMEDICAL RESEARCH LABORATORY
FORT RUCKER, ALABAMA 36362

UNCONDITIONAL CONSENT FOR USE OF PICTURE AND SOUND

The United States Government is granted the right to use, to the extent and for the purpose it desires, any pictures (still, motion, those transmitted via TV or recorded on video tape or otherwise) and sounds (vocal, instrumental, or otherwise) whether used together or separately, taken or recorded by or on behalf of the Aeromedical Research Laboratory.

(DATE) (SIGNATURE)

(HOME ADDRESS)

(MILITARY ADDRESS)

Above consent obtained by:

(SIGNATURE)