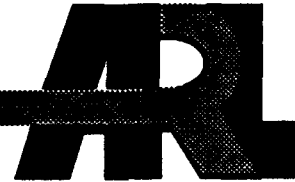# AD-A280 113

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Evaluation of Stress Experienced by Soldiers Wearing Chemical Protective Clothing During Varying Work Loads in Desert or Tropical Environments

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13. ABSTRACT *(Maximum 200 words)*

A stress evaluation was conducted in a laboratory test in which the physiological and psychological reactions of soldiers were monitored while they wore either the standard battle dress overgarment (MOPPI) or the full complement of chemical protective clothing with mask (MOPPIV) and worked at low, moderate, or high work loads in simulated desert (hot and dry) or tropic (hot and humid) environments. The psychological instruments indicated greater stress responses for soldiers wearing MOPPIV than wearing MOPPI and for soldiers working at a high work load than working at a low work load. There was no indication of different stress responses to the desert and tropic environmental conditions. Stress level evaluation techniques indicated moderate stress for MOPPI conditions and high stress for MOPPIV conditions; moderate stress for low workload conditions and high stress for both moderate and high work load conditions; and moderate to high stress for both desert and tropic environmental conditions. Soldiers' abilities to endure the test conditions were inversely related to the stress they perceived in those test conditions.

14. SUBJECT TERMS

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EVALUATION OF STRESS EXPERIENCED BY SOLDIERS WEARING CHEMICAL PROTECTIVE CLOTHING DURING VARYING WORK LOADS IN DESERT OR TROPICAL ENVIRONMENTS

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EXECUTIVE SUMMARY

This stress evaluation was one in a series conducted by the Human Research and Engineering Directorate of the U.S. Army Research Laboratory (ARL) to provide the ARL Stress and Performance program with validation data important to developing improved methodologies for the assessment of psychological responses to stress. It was conducted in association with a test protocol conducted by the U.S. Army Research Institute of Environmental Medicine (USARIEM) and sponsored by the Army's Physiological and Psychological Effects of Nuclear, Biological, and Chemical Environments and Sustained Operations on Systems in Combat (P^2NBC^2) program. This evaluation supplements the USARIEM test report and provides the P^2NBC^2 program with data it requires about the psychological stress effects of operations in chemical protective clothing.

The test protocol was conducted in an environmental test chamber at the U.S. Army Natick Research, Development, and Engineering Center, Natick, Massachusetts. Soldiers' physiological and psychological reactions were monitored while working at low, moderate, or high work loads, in simulated desert (hot and dry) or tropic (hot and humid) environments, while wearing either the standard battle dress overgarment (MOPPI) or the full complement of chemical protective clothing with mask (MOPPIV).

The psychological instruments employed indicated greater stress responses for soldiers when wearing MOPPIV than when wearing MOPPI and when working at a high work load than when working at a low work load. There was no indication of a different stress response to the desert and tropic environmental conditions. Stress level evaluation techniques developed at ARL indicated moderate stress for MOPPI conditions and high stress for MOPPIV conditions; moderate stress for low work load conditions and high stress for both moderate and high work load conditions; and moderate to high stress for both desert and tropic environmental conditions. Soldiers' abilities to endure the test conditions were inversely related to the stress they perceived in those test conditions.

The results of this stress evaluation reflected the psychological costs associated with wearing chemical protective clothing during varying work loads in simulated desert or tropic environments.

EVALUATION OF STRESS EXPERIENCED BY SOLDIERS WEARING CHEMICAL PROTECTIVE
CLOTHING DURING VARYING WORK LOADS IN DESERT OR TROPICAL ENVIRONMENTS

INTRODUCTION

During 1992, the stress and performance team of the U.S. Army Research
Laboratory (ARL) undertook a series of stress evaluations during several tests
funded by the Army's Physiological and Psychological Effects of Nuclear,
Biological, and Chemical Environments and Sustained Operations on Systems in
Combat (P^2NBC^2) Program. The evaluations were undertaken to provide the
P^2NBC^2 program with data about the psychological effects of operations in
chemical protective clothing and to provide the ARL stress and performance
program with data important to the development of improved methodologies for
the assessment of psychological responses to stress. This manuscript reports
the results of the first of those evaluations, which was conducted in
association with a U.S. Army Research Institute of Environmental Medicine
(USARIEM) test protocol titled "Heat Tolerance During Exercise in Chemical
Protective Clothing: Effects of Metabolic Intensity and Environment"
(Cadarette, 1992).

At the foundation of the stress and performance program is a postulated
interactive model of stress in which different kinds and levels of stress
interact with person variables (e.g., personality, experience, knowledge) to
yield unique response profiles as evidenced by psychological, physiological,
and performance measures (Hudgens, Chatterton, Torre, Fatkin, & King, 1990).
Since this model predicts different response patterns to be elicited by
situations differing in some critical ways, it has been important for the
program to identify and validate the utility of a variety of measures that are
differentially affected by a wide variety of stress-provoking situations. To
this end, the present evaluation, like the others in this series, affords the
opportunity to obtain response profiles from soldiers exposed to a variety of
situations characterized by (a) enclosure in chemical protective clothing
which tends to constrain test subjects, to isolate them visually and
auditorily, and to prevent proper maintenance of body temperature; (b) varying
levels of mental and physical work load; and (c) a broad range of exposure
times to these taxing conditions. The definition of stress adopted by this
program states that stress is "...a relationship between the person and the
environment that is appraised by the person as taxing or exceeding his or her
resources and endangering his or her well-being" (Lazarus & Folkman, 1984).

In this evaluation and the others in this series, the psychological
instruments constituting the ARL stress battery were used to evaluate the
stress experienced by subjects in several test conditions which were
anticipated to represent times of relatively high and low (control) perceived
stress. Previous investigations have demonstrated the utility of this battery
and its associated procedures for evaluating stress levels experienced in
various military settings: soldiers in marksmanship competition (Fatkin,
Hudgens, Torre, King, & Chatterton, 1991); soldiers firing TOW missiles during
range and realistic training conditions (Hudgens, Malto, Geddie, & Fatkin,
1991); soldiers experiencing a rigorous 3-week evaluation to be selected for
Army Special Forces training (Hudgens, Malkin, & Fatkin, 1992); and soldiers
in chemical decontamination training in MOPP clothing, in simulated and toxic
agent environments (Fatkin & Hudgens, 1994).

In addition to providing those concerned about the effects of operations
in chemical protective clothing with information about stress effects, the
present investigation expands the range of stress conditions contributing to

the data base for the ARL stress battery. This investigation provides data about soldiers conducting operations in chemical protective clothing for as many as 3 hours during conditions of varying work load in both simulated desert and tropic environments. These conditions exposed the subjects to both physical stress (work load and heat buildup) and psychological stress (encapsulation and uncertainty about abilities to perform according to expectations and to persist during the stressful conditions).

The specific objectives of this evaluation were to (a) compare the relative stress experienced by the subjects during the various conditions of the USARIEM investigation; (b) evaluate the degrees of stress obtained by applying recently developed procedures; and (c) provide the stress and performance program with data valuable to the validation of the procedures.

METHOD

Subjects

Subjects were 7 male soldiers (mean age = 20.7 years), recruited from the U.S. Army Natick Research, Development, and Engineering Center (NATICK) test platoon, who were screened for medical problems and who volunteered to participate in the study. Data for an eighth subject were too incomplete to be included.

Apparatus

The protocol for the USARIEM investigation specified the following:

Wearing apparel: either MOPPI, which consisted of the battle dress overgarment (BDO), T-shirt, shorts, socks, combat boots, and helmet, or MOPPIV, which consisted of the BDO, T-shirt, shorts, socks combat boots, overboots, butyl hood, M17 protective mask, helmet, glove liners, and butyl gloves.

The NATICK tropic chamber facility, which provided controlled test conditions simulating both desert (43° C, 20% relative humidity) and tropic (35° C, 50% relative humidity) environments; wind speed was 2.2 m/s.

A treadmill with variable speed and grade controls that were adjusted to provide each subject with an exercise work load of approximately 250, 425, or 600 watts.

For the evaluation of the stress experienced by the subjects, four instruments from the ARL stress battery were employed.

1. The state form of the State-Trait Anxiety Inventory (STAI), Form Y-1 (Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983) consists of 20 statements that assess how the respondents feel "right now" or how they felt during an event. The essential qualities evaluated by the STAI are feelings of apprehension, tension, nervousness, and worry.

2. The Multiple Affect Adjective Check List-Revised (MAACL-R), Today Form (Zuckerman & Lubin, 1985). This state form consists of five primary subscales (Anxiety, Depression, Hostility, Positive Affect, and Sensation Seeking) derived from a one-page list of 132 adjectives. An overall distress score, the Dysphoria or Negative Affect subscale, is calculated by

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adding the Anxiety, Hostility, and Depression subscale scores. The respondents are instructed to check all the words that describe how they feel "right now" or how they felt during an event.

3. The Specific Rating of Events scale (SRE) is a measure designed for the ARL stress program, in which the subjects rate (on a scale of 0 for "not at all stressful" to 100 for "most stress possible") how stressed they feel "right now" or how stressful an event or time period was to them.

4. The Life Events Form-II is administered once on each day of testing at the same time as the pre-session state measures and asks subjects to rate the amount and type of stress they have experienced within "the last 24 hours."

Procedure and Methodology

The USARIEM protocol called for subjects to participate in a 7- to 10-day heat-acclimation program then to be tested during 12 conditions based on simulated desert and tropic environments, MOPPI and MOPPIV wearing apparel, and work loads of low, moderate, and high intensity. The subjects were tested first during the six MOPP by work load by desert conditions, then during the six MOPP by work load by tropic conditions. Subjects were aware that they would be tested during desert conditions during the first half of the investigation; they learned which MOPP condition they would be in when they reported to the test facility each test day before completing any questionnaires; but they did not learn which work load condition they would experience each test day until they entered the test chamber after completing pre-session questionnaires. Within the desert and tropic sequences, the order of the six conditions was randomized, and subjects were allowed at least one day of rest between test days. The subjects walked on the treadmill each test day until 180 minutes elapsed, their core temperature reached 40° C, their heart rate reached the lower value of 200 beats/min or 95% of maximum heart rate, they chose to withdraw themselves, or they were withdrawn by a medical monitor for any combination of reasons. The actual time each subject was on the treadmill during each session was designated the "session duration." Two questionnaires were administered to the subjects as part of this protocol. The Military and Personal History Survey (an unpublished 37-item demographics questionnaire by Banderet, Munro, Lussier, & Rauch; reported in Blewett, Redmond, Popp, Harrah, & Banderet, 1992) was administered once at the start of the study. Following each test session, subjects completed the Situation Appraisal Survey (a 36-item questionnaire designed to assess the degree to which several variables such as sleep, test conditions, and interactions with other subjects may have influenced task performance, by Banderet, Dauphinee, Toyota, & Seymour, 1992).

Questionnaires used for the stress assessment were administered shortly before and after each of the 12 test sessions (the Life Events Form-II was administered only during the first pre-session period). They are also generally administered once before initiation of test conditions to familiarize subjects with their content and to obtain relatively non-stress baseline data. In this investigation, they were administered once during the training week following a training session. Thus, the subjects were familiarized with the questionnaires, but the data were not obtained for a non-stress period and could not serve as baseline data. A summary of those data is shown in Table A-1 in Appendix A.

Instructions for the questionnaires administered shortly before each session indicated that the questions were to be answered according to how the subjects were feeling "right now." The pre-session battery was administered when the subjects were appropriately dressed for each test condition and just before beginning the test session.

Instructions for the questionnaires administered after each session indicated that the questions were to be answered according to how the subjects felt during "the last 15 minutes you were exercising on the treadmill." The post-session battery was administered as soon as the subjects were sufficiently recovered from the test session. For this investigation, the subjects were considered sufficiently recovered when they had removed the test apparel, showered, and redressed in either their normal military uniform of the day or in civilian clothing (usually within 15 minutes of the end of the test session).

Experimental Design

The within-study design was a completely within-subject (repeated measures) design with 12 data-collection sessions. There were two levels of the test environment variable (simulations of desert and tropic conditions), two levels of the wearing apparel variable (MOPPI and MOPPIV), and three levels of physical work load (low, moderate, and high). Pre-session and post-session measures were obtained for each of the 12 sessions. The several stress indices are considered a dependent vector of measures. Analysis of the effects of the test variables on the stress indices was accomplished by multivariate analysis of variance (MANOVA). Specific post hoc contrasts were performed using the CMATRIX command following MANOVA in the MGLH module of SYSTAT (Wilkinson, 1990). These analyses yielded indications of the relative stress experienced by the subjects during each of the test conditions.

To further clarify the degree of stress experienced by the subjects during this investigation, the state data were compared with either pre-stress or post-stress data for several referent groups. Previous stress evaluations have demonstrated the utility of such comparisons for estimating the relative stress experienced in a given situation (Fatkin et al., 1991; Hudgens et al., 1992). The referent protocols for the present evaluation were as follow:

ONCOSURG (N = 25) - men visiting a hospital on a day when their wives were facing cancer surgery.

ABDMSURG (N = 17) - men visiting a hospital on a day when their wives were facing abdominal surgery under general anesthesia.

WREXAM (N = 26) - third year male medical students taking a written examination required for completion of the clerkship portion of their medical training.

SSCOMP (N = 40) - male soldiers representing elite units in marksmanship competition.

INDCNTRL (N = 23) - men investigated during normal work days when they were experiencing no unusual stress.

These group comparisons were accomplished using MANOVA and Dunn's multiple comparison procedure (also known as Bonferroni t statistic; Kirk,

1968) with $\alpha = .01$ for each of the five *a priori* comparisons with referent groups for an overall $\alpha = .05$.

RESULTS

Psychological State Responses During USARIEM Investigation

The state data were analyzed by MANOVA using the SYSTAT MGLH module (Wilkinson, 1990). Because data were obtained for only 7 subjects in this investigation, it was necessary to perform separate analyses for each scale (or subscale) in a MOPP x Environment x Work load x Pre/Post design. For specific post hoc comparisons, α was set at .05. Significant effects are summarized in Table 1 and described in the paragraphs that follow.

Table 1

Summary of Significant Psychological State Effects
During USARIEM Investigation

State measure	Effect		Qualification
MAACL-R Anxiety	Post-session	> Pre-session	
	MOPPIV	> MOPPI	Desert environment only
MAACL-R Depression	MOPPIV	> MOPPI	Post-session only
	Post-session	> Pre-session	MOPPIV only
MAACL-R Hostility	Post-session	> Pre-session	
MAACL-R Dysphoria	MOPPIV	> MOPPI	Post-session only
	Post-session	> Pre-session	
MAACL-R Positive Affect	Post-session	< Pre-session	
	MOPPIV	< MOPPI	Low work load only
	High & Mod	< Low work load	MOPPI only
STAI Anxiety	MOPPIV	> MOPPI	Low and moderate work loads only
	Post-session	> Pre-session	
	High > Mod	> Low work load	MOPPI Post-session
	Mod	> Low work load	MOPPIV also
SRE stress rating	Post-session	> Pre-session	
	High & Mod	> Low work loads	MOPPI only

MAACL-R Anxiety Subscale

Over the 12 test conditions, post-session anxiety (mean score = 64.9) was significantly elevated over pre-session anxiety ($\bar{X}$ = 54.5) (F = 21.02; df = 1, 6; p = .004). The Environment x MOPP interaction effect was also significant (F = 18.95; df = 1,6; p = .005). During desert conditions, mean anxiety while wearing MOPPI was 57.6 and while wearing MOPPIV was 65.9 (F = 14.81; df = 1,6; p = .008); during tropic conditions, the means were 56.9 and 58.4, respectively (F = 1.58; df = 1,6; p = .255).

MAACL-R Depression Subscale

Depression scores were significantly higher when the subjects wore MOPPIV apparel ($\bar{X}$ = 79.2) than when they wore MOPPI apparel ($\bar{X}$ = 66.1) (F = 17.28; df = 1,6; p = .006). A significant MOPP x Pre/Post interaction (F = 16.57; df = 1,6; p = .007) indicated that depression was significantly higher post-session than pre-session for MOPPIV ($\bar{X}_{pre}$ = 65.6; $\bar{X}_{post}$ = 92.9; F = 13.39; df = 1,6; p = .011) but not for MOPPI ($\bar{X}_{pre}$ = 61.1; $\bar{X}_{post}$ = 71.0; F = 4.00; df = 1,6; p = .093).

MAACL-R Hostility Subscale

An overall pre/post main effect was obtained for expressed hostility ($\bar{X}_{pre}$ = 53.5; $\bar{X}_{post}$ = 69.3; F = 18.03; df = 1,6; p = .005). No other effects were significant.

MAACL-R Dysphoria Subscale

Significant main effects were obtained for the MOPP and pre/post factors. Dysphoria scores were significantly higher for MOPPIV ($\bar{X}$ = 72.1) than for MOPPI ($\bar{X}$ = 63.8) (F = 13.83; df = 1,6; p = .01) and were significantly higher post ($\bar{X}$ = 77.9) than pre-session ($\bar{X}$ = 58.0) (F = 38.63; df = 1,6; p = .001). A MOPP x Pre/Post interaction effect (F = 16.74; df = 1,6; p = .006) indicated that expressed dysphoria was significantly greater for MOPPIV than for MOPPI post-session (F = 25.20; df = 1,6; p = .002) but not pre-session (F = 0.59; df = 1,6; p = .473).

MAACL-R Positive Affect Subscale

Expressed positive affect decreased significantly from pre ($\bar{X}$ = 51.3) to post-session ($\bar{X}$ = 45.8) (F = 11.61; df = 1,6; p = .01). A significant MOPP x Work Load interaction effect was obtained (univariate F = 7.28; df = 2,12; p = .009; Wilks' λ = 0.125; multivariate F = 17.43; df = 2,5; p = .006). For low work load, the expressed positive affect scores were for MOPPI, $\bar{X}$ = 52.5, and for MOPPIV, $\bar{X}$ = 47.2; for moderate work load, they were for MOPPI, $\bar{X}$ = 49.0, and for MOPPIV, $\bar{X}$ = 46.3; and for high work load they were for MOPPI, $\bar{X}$ = 47.9, and for MOPPIV, $\bar{X}$ = 48.6. This interaction effect can be viewed as showing different MOPP effects at the levels of tested work load: Positive affect was significantly higher for MOPPI than for MOPPIV at low work load (F = 8.96; df = 1,6; p = .024) but not at moderate (F = 1.57; df = 1,6; p = .257) or high work load (F = 0.40; df = 1,6; p = .548). Alternatively, it can be viewed as showing different work load effects for each MOPP condition: Positive affect was significantly higher at low work load than moderate (F = 6.38; df = 1,6; p = .045) and high work load (F =

33.71; $df = 1,6$; $p = .001$) for the MOPPI condition. No other work load comparisons for either MOPPI or MOPPIV showed any significant differences.

STAI Anxiety Scale

Significant main effects were obtained for the MOPP, work load, and pre/post factors. STAI Anxiety was significantly higher when the subjects wore MOPPIV ($\bar{X} = 51.3$) than when they wore MOPPI ($\bar{X} = 48.4$) ($F = 31.46$; $df = 1,6$; $p = .001$). Over all other conditions, STAI Anxiety was significantly higher post ($\bar{X} = 57.1$) than pre-session ($\bar{X} = 42.6$) ($F = 39.77$; $df = 1,6$; $p = .001$). The subjects expressed increasing anxiety over the range of increasing work load ($\bar{X}_{low} = 47.0$; $\bar{X}_{mod} = 50.7$; $\bar{X}_{high} = 52.0$; $F = 13.40$; $df = 2,12$; $p = .001$). A significant Work Load x Pre/Post interaction effect ($F = 15.67$; $df = 2,12$; $p = .000$) indicated that this was a post-session effect. Pre-session anxiety levels were $\bar{X}_{low} = 42.3$, $\bar{X}_{mod} = 42.9$, and $\bar{X}_{high} = 42.6$; post-session levels were $\bar{X}_{low} = 51.6$, $\bar{X}_{mod} = 58.5$, and $\bar{X}_{high} = 61.3$. While none of the pre-session anxiety differences between work loads were significant, all the post-session differences were significant (low-mod: $F = 46.99$; $df = 1,6$; $p = .000$; low-high: $F = 48.39$; $df = 1,6$; $p = .000$; and mod-high: $F = 10.48$; $df = 1,6$; $p = .018$). The MOPP x Work Load interaction effect was also significant ($F = 10.52$; $df = 2,12$; $p = .002$). When the subjects wore MOPPI their anxiety levels at the three work loads were $\bar{X}_{low} = 44.6$, $\bar{X}_{mod} = 48.1$, $\bar{X}_{high} = 52.5$ (low-mod: $F = 24.50$; $df = 1,6$; $p = .003$; low-high: $F = 37.12$; $df = 1,6$; $p = .001$; mod-high: $F = 11.12$; $df = 1,6$; $p = .016$). When they wore MOPPIV their anxiety levels were $\bar{X}_{low} = 49.3$, $\bar{X}_{mod} = 53.2$, $\bar{X}_{high} = 51.4$ (low-mod: $F = 11.04$; $df = 1,6$; $p = .016$; low-high: $F = 2.66$; $p = .154$; mod-high: $F = 1.34$; $p = .291$). When the interaction effect is viewed as showing differences between anxiety levels for MOPP conditions at different work loads, MOPPIV STAI Anxiety was significantly higher than that for MOPPI at low work load ($F = 38.56$; $df = 1,6$; $p = .001$) and at moderate work load ($F = 16.10$; $df = 1,6$; $p = .007$) but not at high work load ($F = 1.36$; $df = 1,6$; $p = .287$).

SRE Stress Scale

A significant pre/post main effect reflected the higher stress reported post session ($\bar{X} = 73.1$) than pre session ($\bar{X} = 20.0$) ($F = 31.03$; $df = 1,6$; $p = .001$). The MOPP x Work Load interaction effect was also significant ($F = 8.04$; $df = 2,12$; $p = .006$). When subjects wore MOPPI, reported stress increased with increased work load ($\bar{X}_{low} = 35.0$; $\bar{X}_{mod} = 44.8$; $\bar{X}_{high} = 52.5$; low-mod: $F = 14.76$; $df = 1,6$; $p = .009$; low-high: $F = 17.88$; $df = 1,6$; $p = .012$; mod-high: $F = 4.70$; $df = 1,6$; $p = .072$). When they wore MOPPIV, differences between means were not significant.

Psychological State Comparisons With Other Protocols

To estimate the degree of stress experienced by the subjects during the various test conditions, data from the current investigation were compared with data for the ONCOSURG, ABDMSURG, WREXAM, SSCOMP, and INDCNTRL referent groups. Multiple MANOVAs were conducted comparing the referent groups' pre-session and post-session data with those for each session of this investigation. To compensate for the high probability of obtaining statistically significant differences when such a large number of analyses are conducted, only overall group differences in which $p < .001$ were considered significant.

For each significant analysis involving five a priori comparisons with
referent group data, Dunn's multiple comparison procedure (Kirk, 1968) was
employed with $\alpha = .01$ for each contrast for an overall $\alpha = .05$.

Figures 1 through 14 present the pre-session and post-session data for
the present investigation as compared with those for the referent groups for
each of the seven state measures employed. In the figures, each bar is
labeled to indicate either the referent protocol condition or the combination
of conditions from the present investigation providing the data. The first
five bars to the left are the referent protocols as previously described:
ONCOSURG and ABDMSURG (considered to represent relatively high stress), WREXAM
and SSCOMP (considered to represent relatively moderate stress), and INDCNTRL
(considered to represent no to relatively low stress). The next 12 bars are
for the present investigation, which are abbreviated to indicate the
environment (DES = desert; TRP = tropic), the MOPP apparel (MP1 = MOPPI; MP4 =
MOPPIV), and the work load (LO = low; MD = moderate; and HI = high work load).
The tables associated with each of the figures indicate for each session mean
which referent means differ significantly ($p \leq .01$) and the direction of the
difference (> = test $\overline{X}$ > referent $\overline{X}$; < = test $\overline{X}$ < referent $\overline{X}$).

MAACL-R Anxiety

Figure 1 shows mean MAACL-R Anxiety pre-session scores for the
subjects during 12 conditions in the present investigation compared with those
for the five referent groups. Inspection of the figure and accompanying table
shows that pre-session anxiety in this study was never significantly higher
than that for the INDCNTRL group and that it was significantly below that for
the ONCOSURG group for 7 of 12 conditions, 5 of which were desert conditions.

Figure 2 shows the means for MAACL-R Anxiety post-session data.
Again, the mean anxiety levels for 7 of 12 conditions in this study were
significantly lower than those for the ONCOSURG referent grou. However, the
post-session anxiety levels for these subjects during the two : ghest work
loads in MOPPIV in a desert environment were elevated significantly over the
INDCNTRL group level; for the high work load condition, the elevation was
significant relative to the WREXAM group anxiety mean.

It is noteworthy that these two figures and most that follow show
large increases in response variability, that is, larger standard error of the
mean (SEM) bars, for means associated with MOPPIV and the higher work load
conditions.

MAACL-R Depression

Figure 3 shows mean pre-session MAACL-R Depression scores for this
study relative to referent groups. The subjects in this study showed great
response variability for this measure. However, during the higher work load
conditions, their pre-session depression was generally significantly elevated
over that for the SSCOMP group which had the lowest referent level. During
the desert x MOPPIV x moderate work load condition, their pre-session
depression was significantly elevated over that for the INDCNTRL, SSCOMP, and
WREXAM referent groups.

Figure 1. Comparison of mean pre-session (± SEM) MAACL-R Anxiety scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

		Test condition											
		Desert environment						Tropic environment					
		MOPP I			MOPP IV			MOPP I			MOPP IV		
Referent protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<	<	<	<		<	<					<
ABDMSURG													
WREXAM													
SSCOMP													
INDCNTRL													

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

Figure 2. Comparison of mean post-session (± SEM) MAACL-R Anxiety scores for
subjects in 12 test conditions of the present protocol with those
for subjects in five referent protocols. (Differences between
means that achieved statistical significance at $p < .01$ are
indicated below.)

		Test condition											
		Desert environment						Tropic environment					
Referent		MOPP I			MOPP IV			MOPP I			MOPP IV		
protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<	<		<			<	<		<		<
ABDMSURG		<						<					
WREXAM							>						
SSCOMP													
INDCNTRL						>	>						

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

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Figure 3. Comparison of mean pre-session (± SEM) MAACL-R Depression scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

| | | Desert environment | | | | | | Tropic environment | | | | | |
| | | MOPP I | | | MOPP IV | | | MOPP I | | | MOPP IV | | |
Referent protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG													
ABDMSURG													
WREXAM						>							
SSCOMP					>	>					>	>	
INDCNTRL						>							

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

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Figure 4 shows that post-session depression was affected by conditions in this study relative to referent groups. For 5 or 6 of 12 conditions generally representing combinations of MOPPIV and higher work load conditions, post-session depression was significantly elevated over that for the INDCNTRL, SSCOMP, and WREXAM referent groups. During des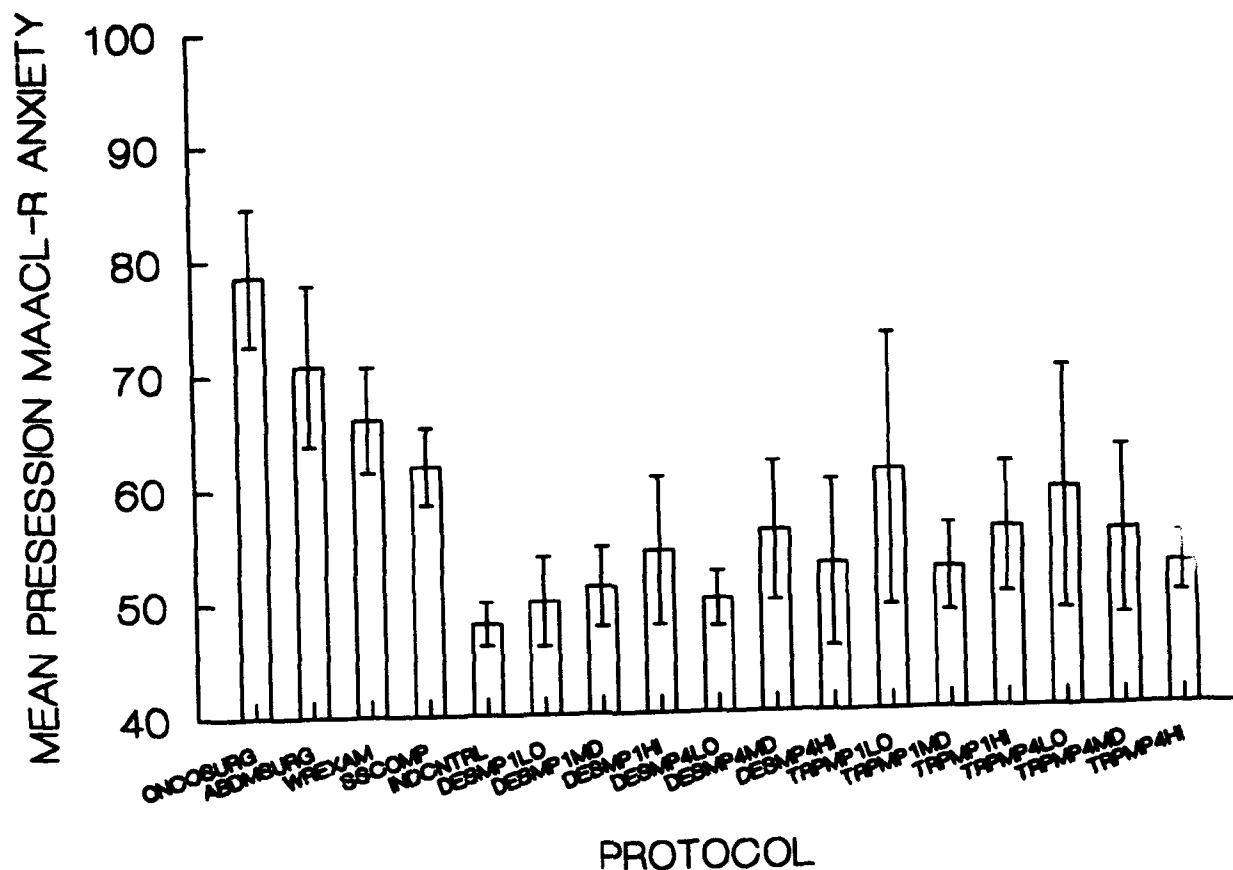ert conditions, post-session depression was elevated significantly over that for the ONCOSURG group for 3 of 6 conditions and over that for the ABDMSURG group (the highest referent level) for the MOPPIV x moderate work load condition; none of these four highest elevations involved the high work load condition.

MAACL-R Hostility

Figure 5 shows that no significant differences between conditions in this study and those for referent groups were obtained for the pre-session hostility measure.

Figure 6 shows that post-session hostility was significantly lower during the desert x MOPPI x low work load condition than for the SSCOMP group. Post-session hostility was significantly elevated over the low levels of the INDCNTRL group for 6 of 12 conditions and ABDMSURG group for 8 of 12 conditions generally associated with MOPPIV and higher work load.

MAACL-R Dysphoria

Figure 7 shows that the pre-session dysphoria scores, which are composite negative affect (anxiety + depression + hostility) scores, did not differ significantly among the study and referent groups.

Figure 8 shows that post-session dysphoria for subjects in this investigation was significantly elevated over that for the INDCNTRL group for 6 of 12 conditions, generally those involving MOPPIV and higher work load. The subjects' dysphoria was significantly higher than that for the WREXAM group for desert x MOPPIV x moderate and high work load and that for the ABDMSURG group for desert x MOPPIV x moderate work load. The subjects' dysphoria was significantly below that for the ONCOSURG group only for the desert x MOPPI x low work load condition.

MAACL-R Positive Affect

Figure 9 shows that no significant differences between conditions in this study and those for the referent protocols were obtained for the pre-session positive affect measure.

Figure 10 shows that post-session positive affect was significantly reduced for subjects in this study relative to that for the INDCNTRL group for all conditions except those involving MOPPI x low work load. Their positive affect was also significantly reduced relative to that for the ABDMSURG group for 4 of 12 conditions involving either MOPPIV or high work load conditions.
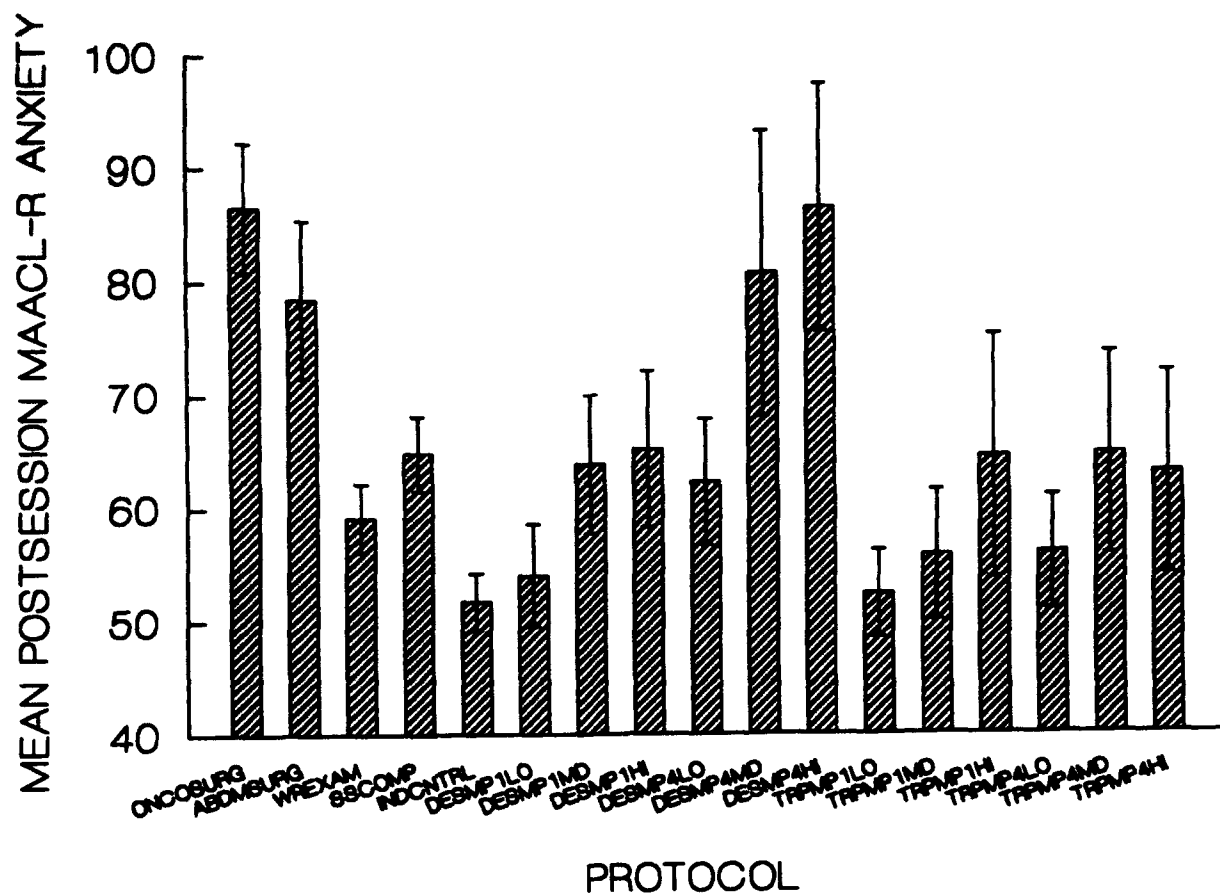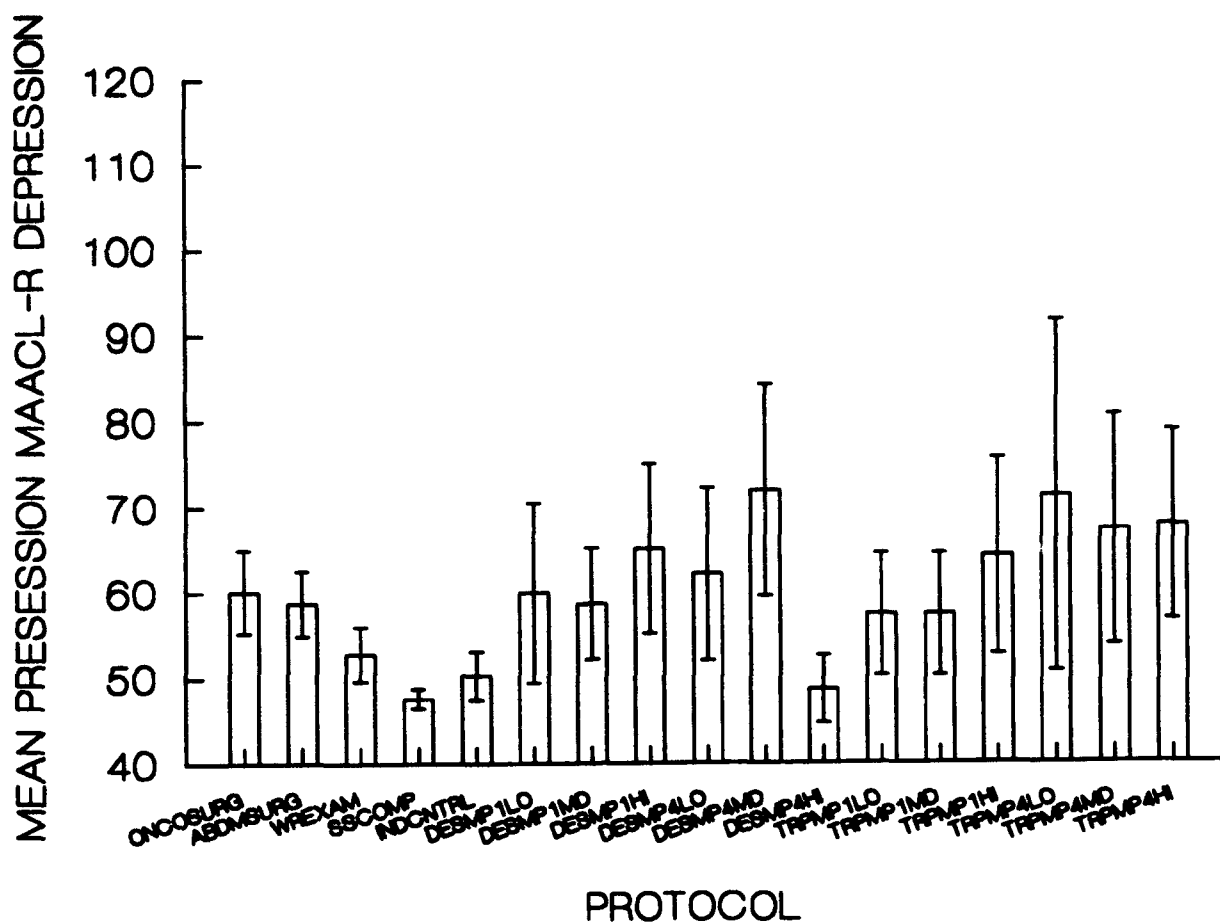
Figure 4. Comparison of mean post-session (± SEM) MAACL-R Depression scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

		Test condition											
		Desert environment						Tropic environment					
		MOPP I			MOPP IV			MOPP I			MOPP IV		
Referent protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG			>		>	>							
ABDMSURG						>							
WREXAM			>		>	>	>						>
SSCOMP			>		>	>	>					>	>
INDCNTRL			>		>	>	>					>	>

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

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Figure 5. Comparison of mean pre-session (± SEM) MAACL-R Hostility scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (No differences between means achieved statistical significance at $p < .01$.)

18
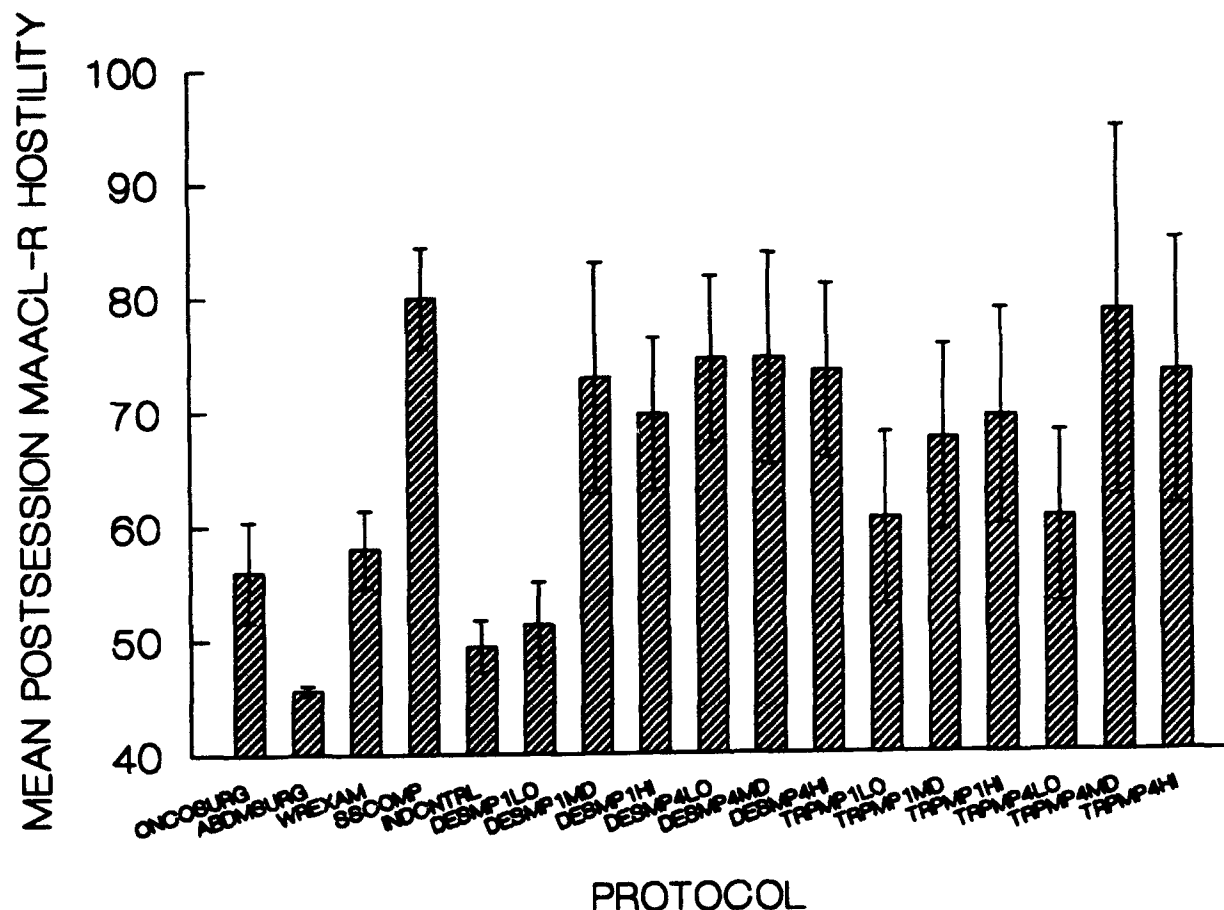
Figure 6. Comparison of mean post-session (± SEM) MAACL-R Hostility scores
for subjects in 12 test conditions of the present protocol with
those for subjects in five referent protocols. (Differences
between means that achieved statistical significance at $p < .01$
are indicated below.)

		Desert environment						Tropic environment					
		MOPP I			MOPP IV			MOPP I			MOPP IV		
Referent protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG													
ABDMSURG			>	>	>	>	>			>		>	>
WREXAM													
SSCOMP		<											
INDCNTRL			>		>	>	>					>	>

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

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Figure 7. Comparison of mean pre-session (± SEM) MAACL-R Dysphoria scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (No differences between means achieved statistical significance at $p < .01$.)
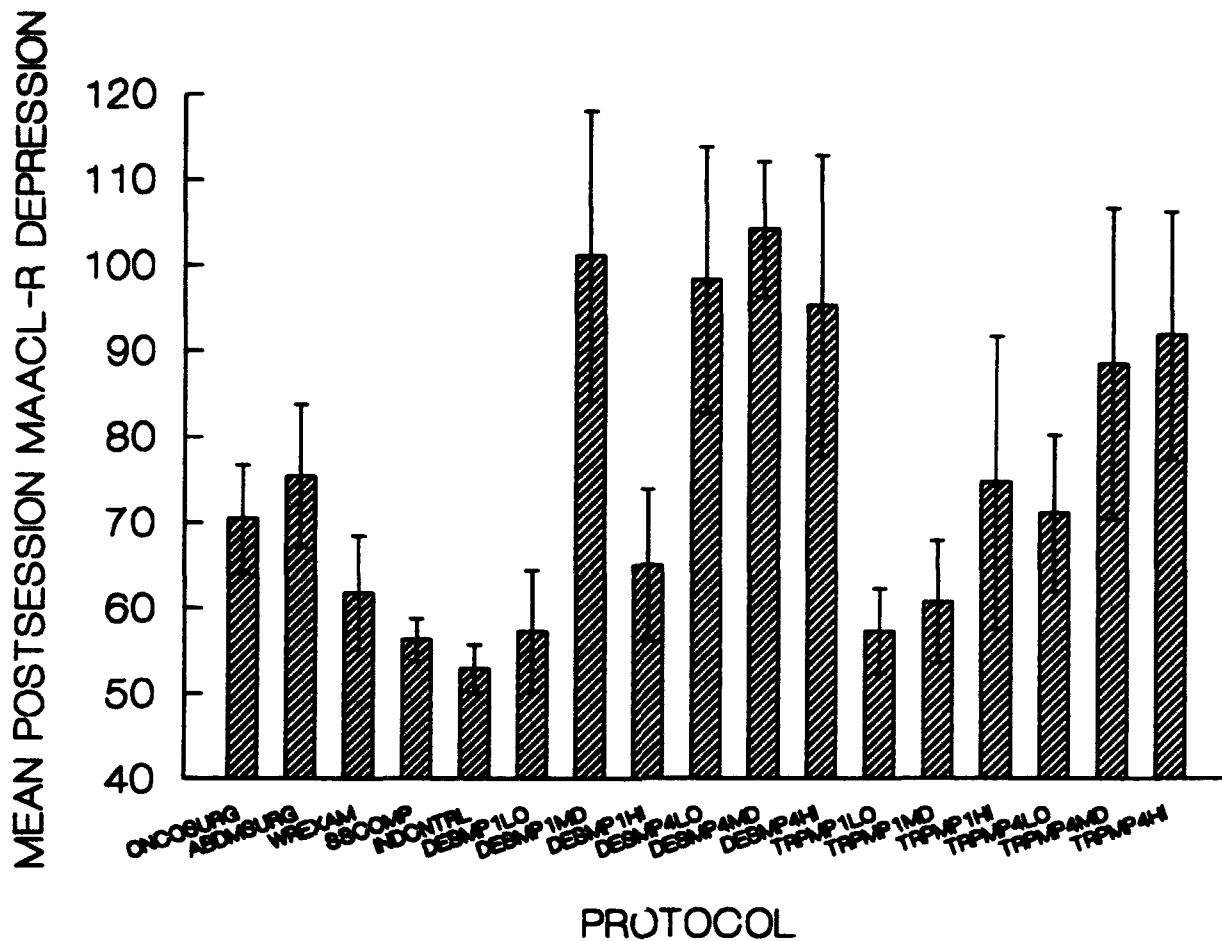
Figure 8. Comparison of mean post-session (± SEM) MAACL-R Dysphoria scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

		Test condition										
		Desert environment						Tropic environment					
Referent		MOPP I			MOPP IV			MOPP I			MOPP IV		
protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<											
ABDMSURG						>							
WREXAM						>	>						
SSCOMP													
INDCNTRL		>		>	>	>						>	>

< = test mean significantly less than referent mean
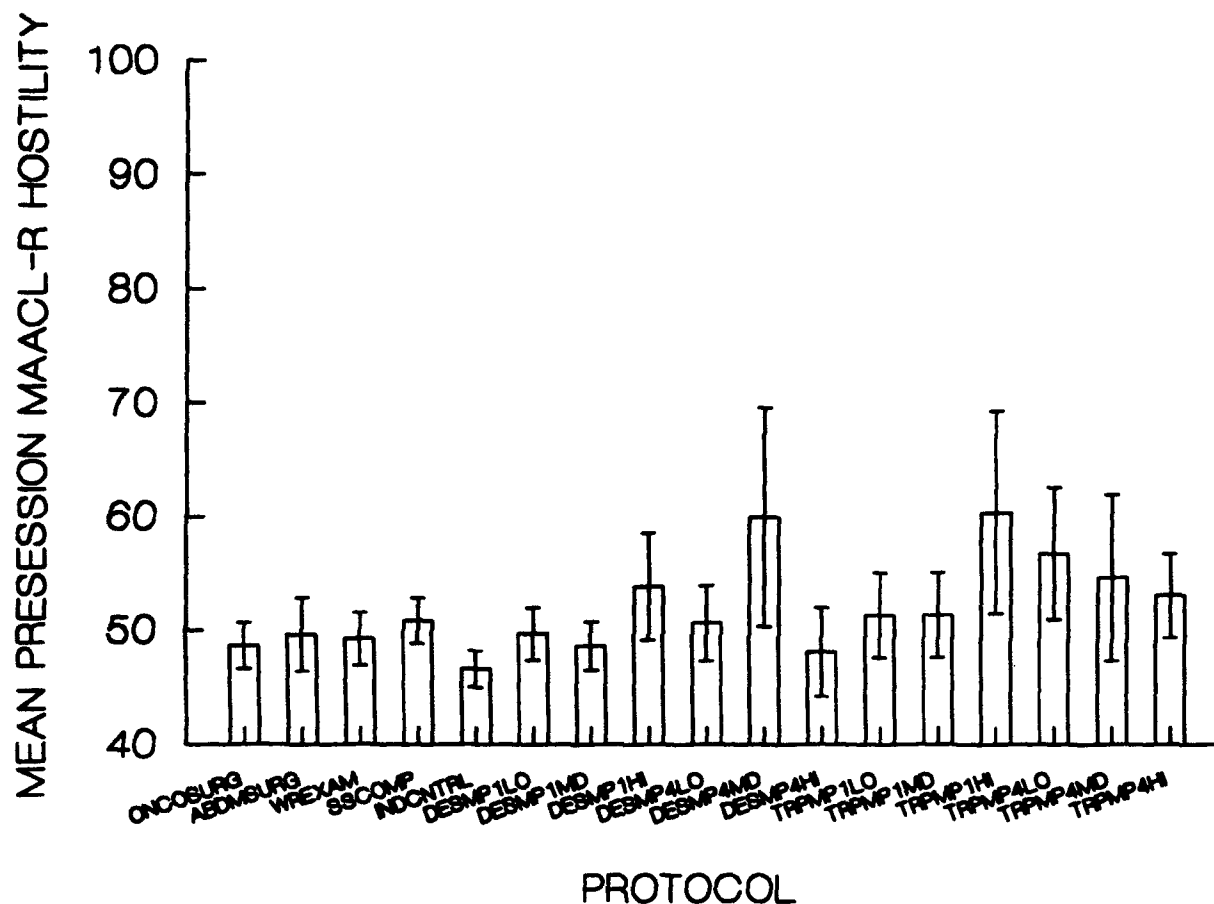> = test mean significantly greater than referent mean

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Figure 9. Comparison of mean pre-session (± SEM) MAACL-R Positive Affect scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (No differences between means achieved statistical significance at p < .01.)

Figure 10. Comparison of mean post-session (± SEM) MAACL-R Positive Affect scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

Referent protocol	Work load:	Desert environment MOPP I			Desert environment MOPP IV			Tropic environment MOPP I			Tropic environment MOPP IV		
		LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG													
ABDMSURG							<		<	<			<
WREXAM													
SSCOMP													
INDCNTRL			<	<	<	<	<		<	<	<	<	<

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

STAI Anxiety

Figure 11 shows that subjects in this investigation displayed relatively low pre-session anxiety as measured by the STAI. Their anxiety scores were significantly below those for the ONCOSURG group for all 12 conditions and below those for the ABDMSURG and WREXAM groups for 8 and 9 of the 12 conditions which generally involved wearing MOPPIV. Their pre-session STAI Anxiety was not significantly higher than that for the SSCOMP or INDCNTRL groups for any condition in this study.

Figure 12 shows that the subjects' post-session STAI Anxiety scores increased so that they did not differ significantly from those for the ONCOSURG group except for 3 of the 12 conditions; those three conditions involved wearing MOPPI. Additionally, the subjects' post-session anxiety was significantly higher than that for the INDCNTRL group for 4 of 12 conditions and that for the SSCOMP group for one condition. Four of these five conditions involved wearing MOPPIV.

Specific Rating of Events

Figure 13 shows the subjects' pre-session stress ratings for each of the 12 study conditions relative to the referent protocols. The subjects rated the stress experienced in this study significantly lower than did subjects in referent protocols for 42 of 48 possible comparisons. None of the 12 conditions of this study were rated as significantly more stressful than those for the INDCNTRL group.

Figure 14 shows that the subjects' post-session stress ratings were significantly higher than those for the INDCNTRL for all 12 conditions in the present study. Their stress ratings were also significantly higher than those for the ONCOSURG, WREXAM, and SSCOMP groups for 18 of 36 comparisons with those referent groups. All 18 differences were for conditions involving wearing MOPPIV or for wearing MOPPI and performing during high work load.

Treatment Main Effects and Protocol Comparisons

In the tables associated with Figures 1 through 14, a total of 168 comparisons were made with referent protocols (12 treatment conditions, by 7 measures, by 2 times (pre and post), equals 168). Treatment main effects can be described by considering these comparisons relative to the INDCNTRL protocol. In all cases, the following differences involve significantly greater negative affect or less positive affect than the referent value for the INDCNTRL.

For comparisons involving pre-session measures, 1 of 84 indicated a measurement significantly different from the referent value for the INDCNTRL. For comparisons involving post-session measures, 46 of 84 did so. The difference between these proportions for pre-session and post-session measures was highly significant ($X^2 = 59.82$, $df = 1$, $p < .001$).

Since only 1 of 84 pre-session comparisons indicated a significant difference from INDCNTRL, the remaining main effects will be evaluated only for post-session data.
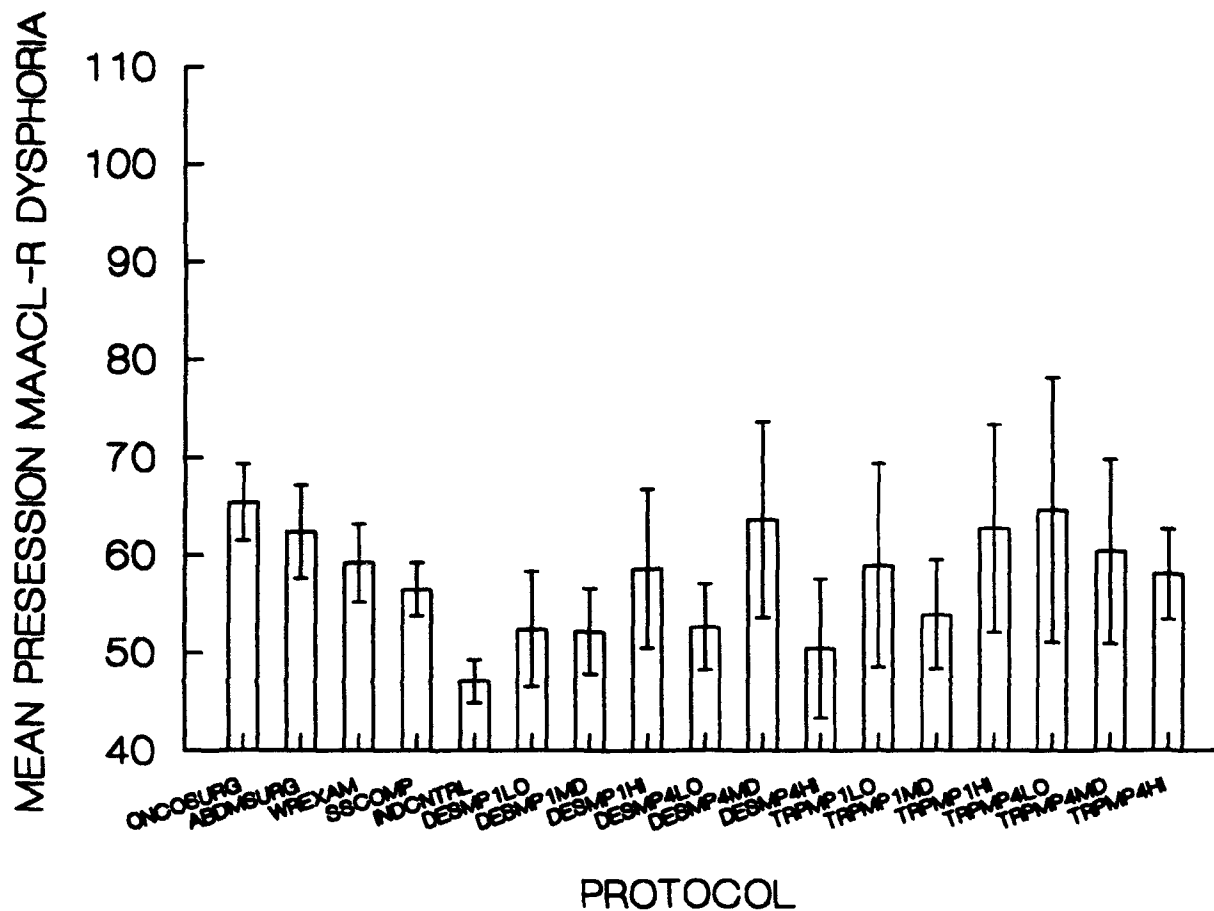
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Figure 11. Comparison of mean pre-session (± SEM) STAI Anxiety scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)
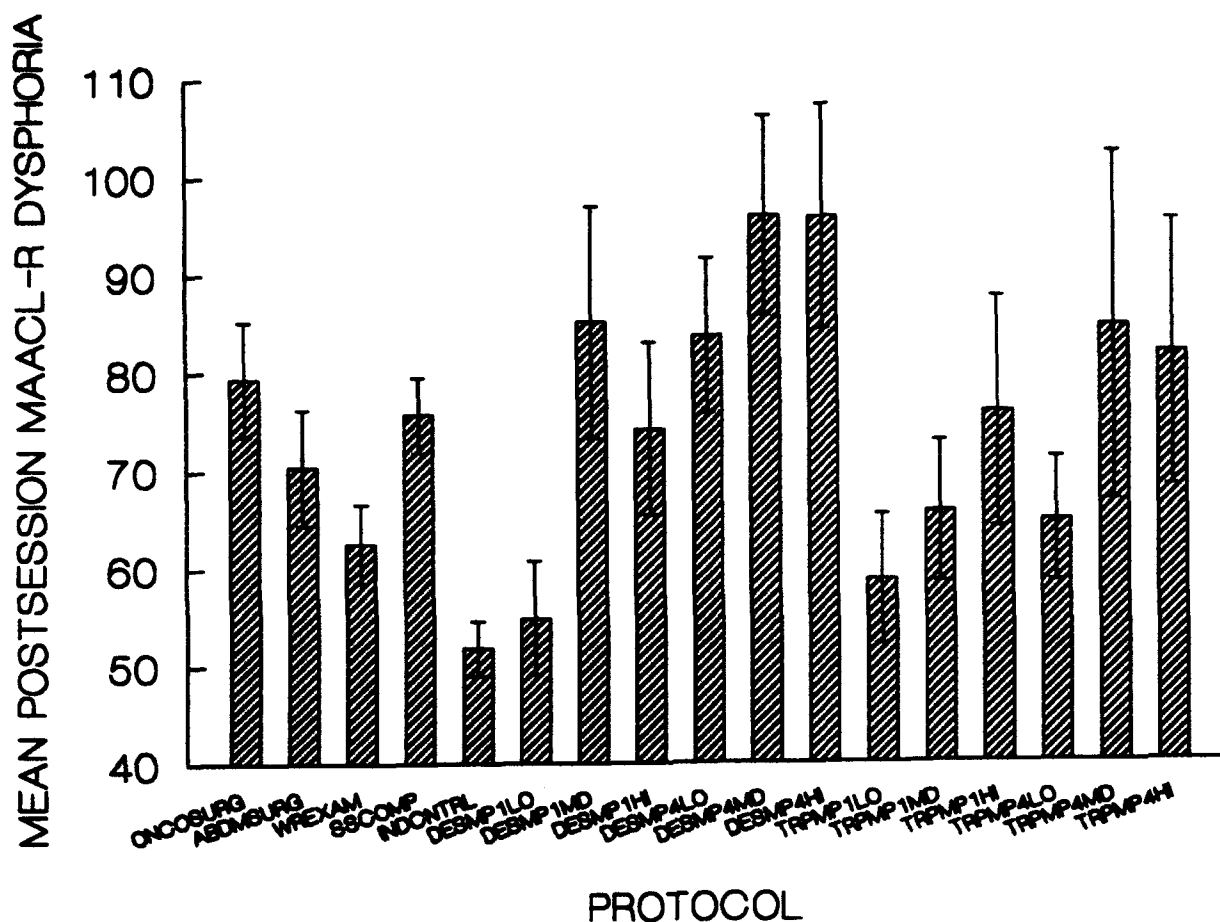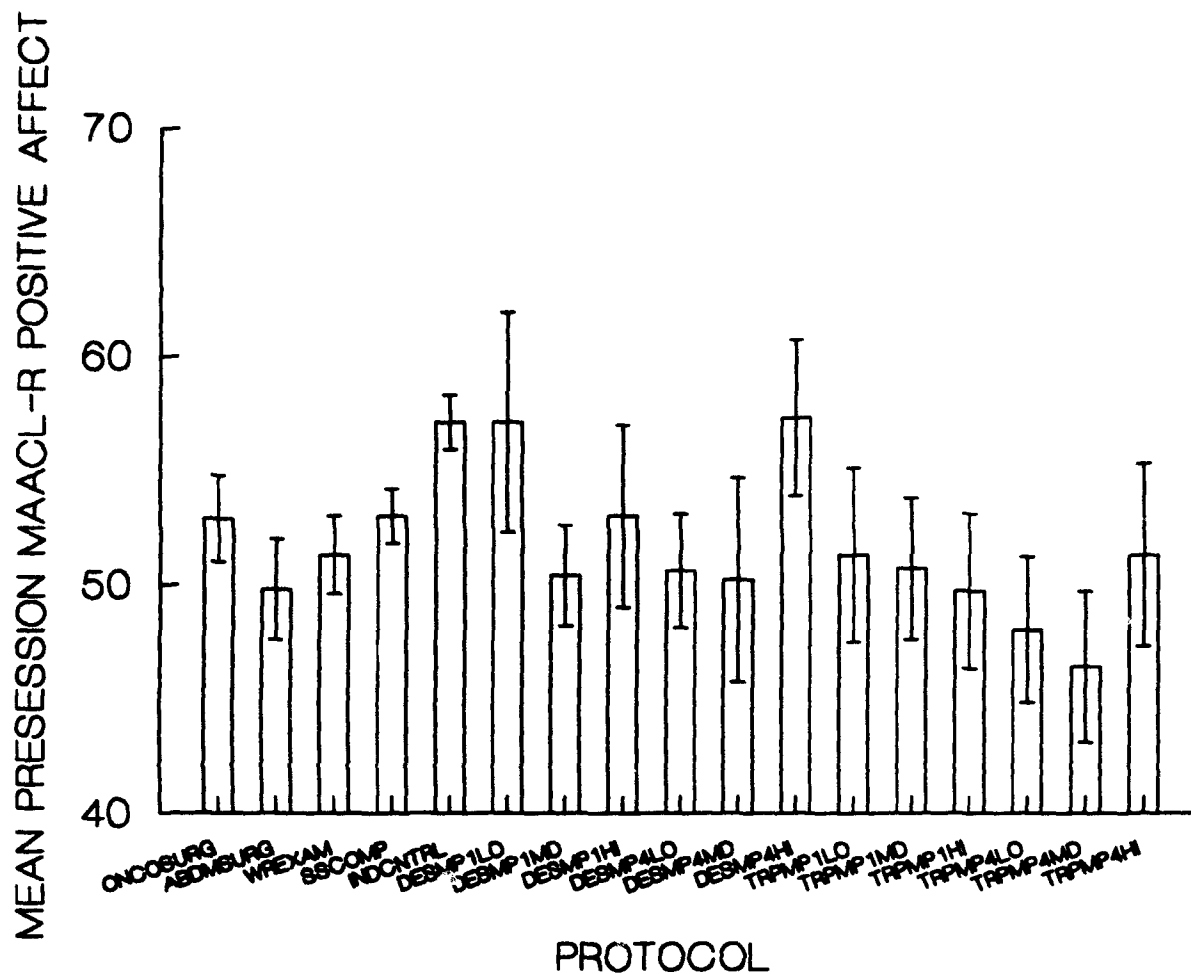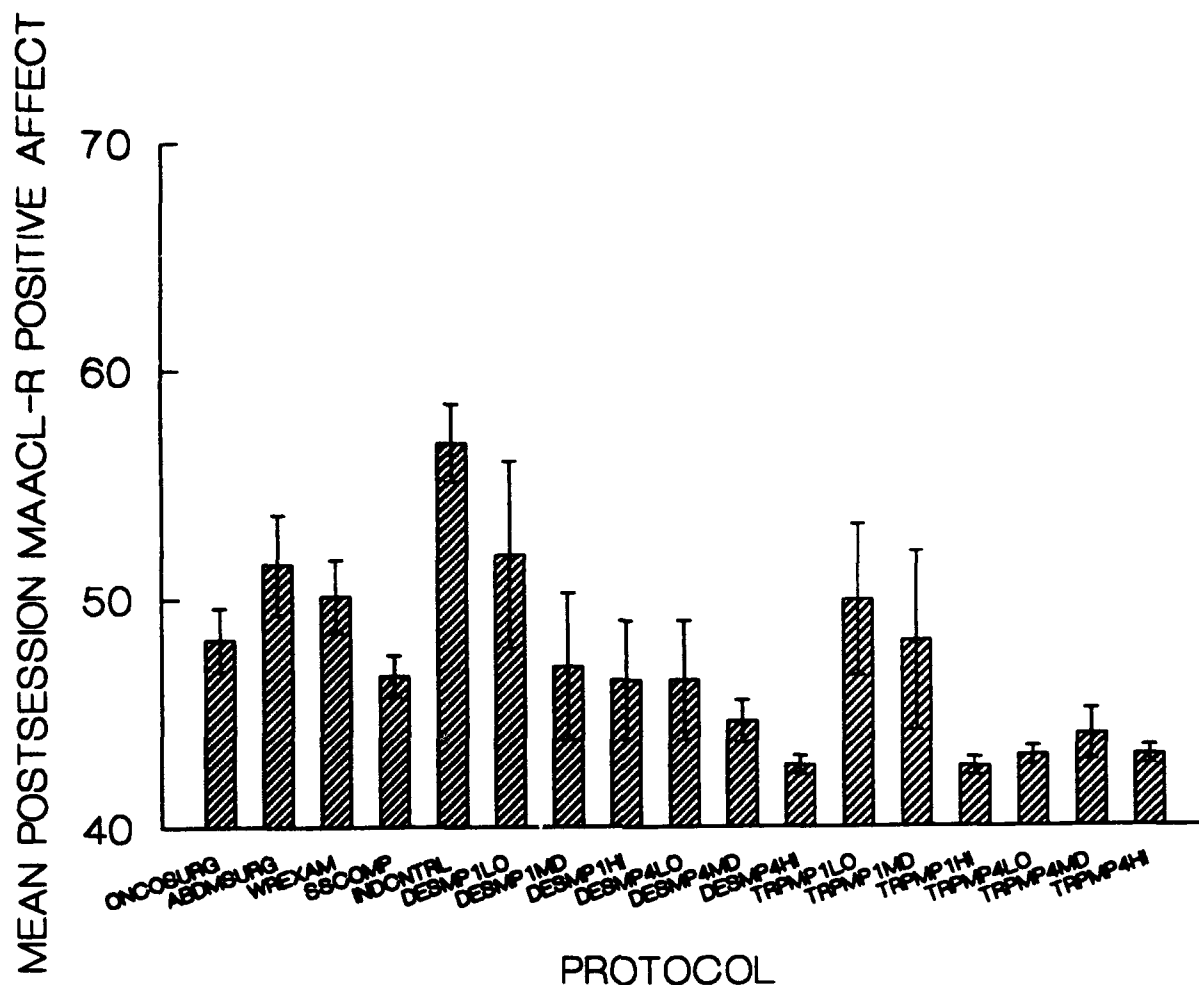
		Test condition												
		Desert environment						Tropic environment						
		MOPP I			MOPP IV			MOPP I			MOPP IV			
Referent protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<	<	<	<	<	<	<	<	<	<	<	<
ABDMSURG		<	<	<	<		<	<	<			<	<
WREXAM		<	<	<	<		<	<	<				<
SSCOMP													
INDCNTRL													

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

Figure 12. Comparison of mean post-session (± SEM) STAI Anxiety scores for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

		Test condition										
		Desert environment						Tropic environment					
Referent		MOPP I			MOPP IV			MOPP I			MOPP IV		
protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<						<	<				
ABDMSURG													
WREXAM													
SSCOMP						>							
INDCNTRL					>	>			>			>	

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

26

Figure 13. Comparison of mean pre-session (± SEM) SRE stress ratings for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at p < .01 are indicated below.)

		Test condition											
		Desert environment						Tropic environment					
Referent		MOPP I			MOPP IV			MOPP I			MOPP IV		
protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG		<	<	<	<	<	<	<	<	<		<	<
ABDMSURG		<	<	<	<	<	<	<	<	<		<	<
WREXAM		<		<	<	<	<	<	<			<	<
SSCOMP		<	<	<	<	<	<	<	<	<		<	<
INDCNTRL													

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

MEAN POSTSESSION SRE STRESS RATING

PROTOCOL

ONCOSURG ABDMSURG WREXAM SSCOMP INDCNTRL DESMP1LO DESMP1MD DESMP1HI DESMP4LO DESMP4MD DESMP4HI TRPMP1LO TRPMP1MD TRPMP1HI TRPMP4LO TRPMP4MD TRPMP4HI

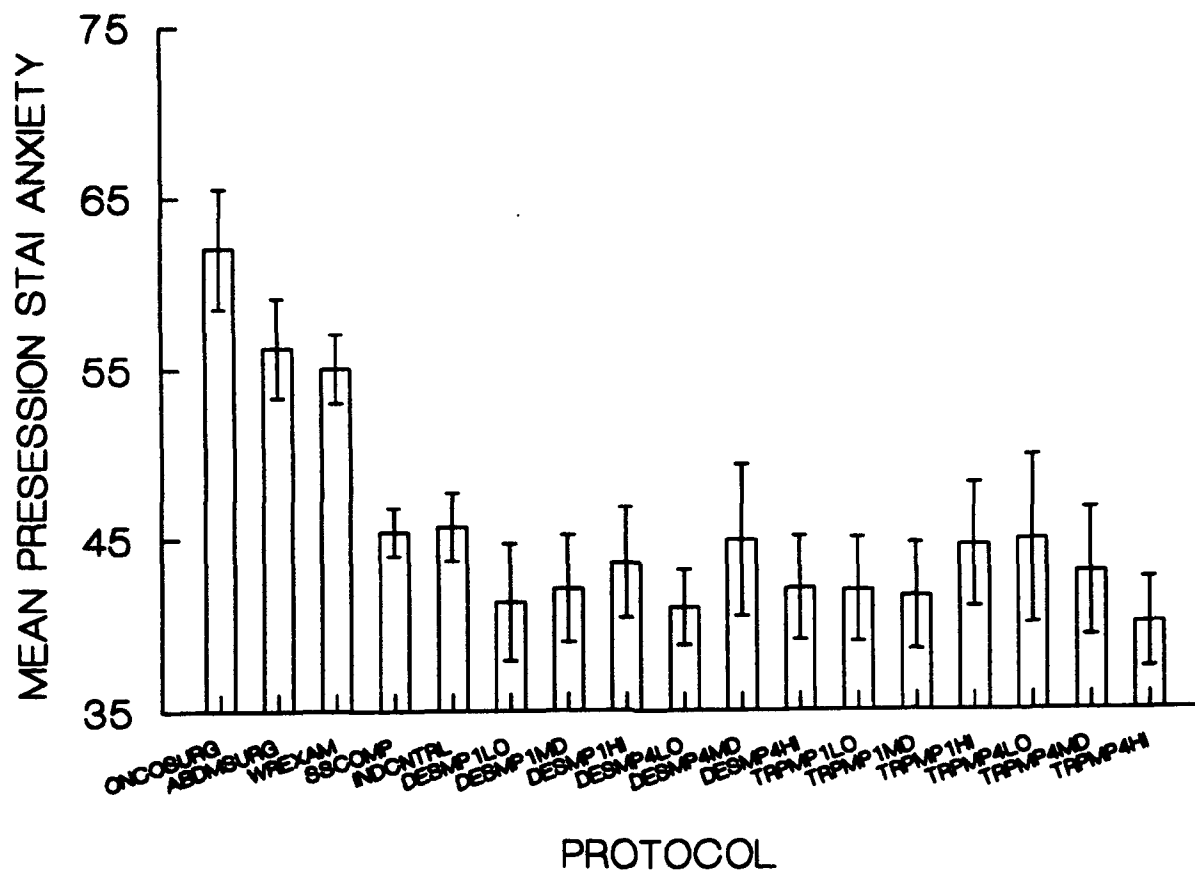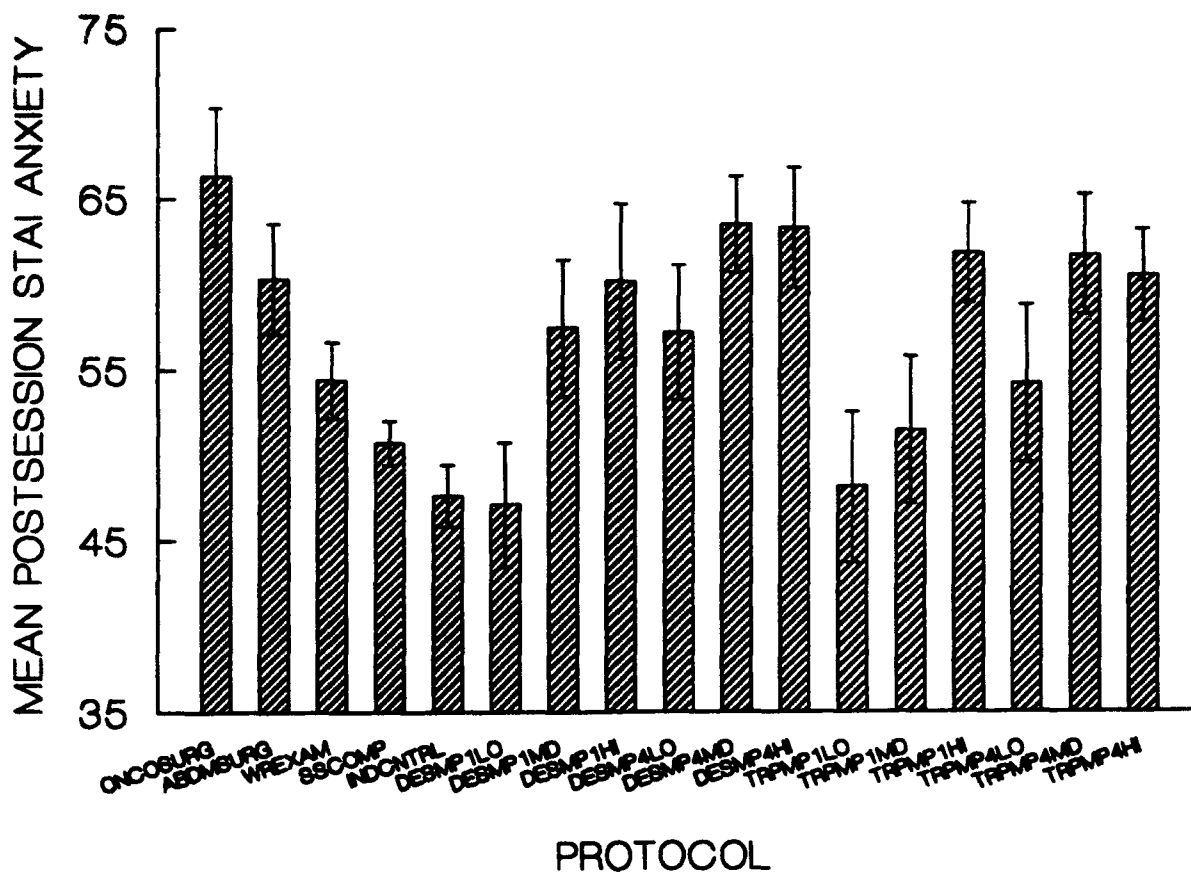Figure 14. Comparison of mean post-session (± SEM) SRE stress ratings for subjects in 12 test conditions of the present protocol with those for subjects in five referent protocols. (Differences between means that achieved statistical significance at $p < .01$ are indicated below.)

		Test condition											
		Desert environment						Tropic environment					
Referent		MOPP I			MOPP IV			MOPP I			MOPP IV		
protocol	Work load:	LO	MD	HI	LO	MD	HI	LO	MD	HI	LO	MD	HI
ONCOSURG				>	>					>			>
ABDMSURG													
WREXAM				>	>	>	>			>	>	>	>
SSCOMP				>	>	>				>		>	>
INDCNTRL		>	>	>	>	>	>	>	>	>	>	>	>

< = test mean significantly less than referent mean
> = test mean significantly greater than referent mean

28

For desert condition post-session measures, 27 of 42 comparisons indicated measurements significantly different from the referent value for the INDCNTRL. For those involving the tropic condition, 19 of 42 comparisons did so. The difference between these proportions for desert and tropic conditions was not significant (x^2 = 3.08, df = 1, p < .10).

For MOPPI condition post-session measures, 14 of 42 comparisons differed significantly from the INDCNTRL referent value. For MOPPIV, 32 of 42 comparisons differed significantly from the referent value. The difference between the proportions for MOPPI and MOPPIV conditions was highly significant (x^2 = 15.57, df = 1, p < .001).

For post-session measures involving low, moderate, and high work load conditions, 10 of 28, 20 of 28, and 16 of 28, respectively, indicated measurements significantly different from the referent value for the INDCNTRL (x^2 = 7.30, df =2, p < .05). Only the difference between proportions for the low and moderate work load conditions was significant (x^2 = 7.18, df = 1, p < .01).

Visual inspections of Figures 1 through 14 were conducted to determine for each combination of conditions whether subjects' responses were closest to the level of the INDCNTRL protocol (no to low stress), the SSCOMP or WREXAM protocols (moderate stress), or the ABDMSURG or ONCOSURG protocols (high stress). The tally results for the visual inspection are presented for all conditions in Table B-1 in Appendix B. The results are shown in summary form in Table 2. From the latter table, it can be determined that pre-session measures were predominantly closest to the moderate stress level (high = 21, moderate = 40, and low = 23). Post-session measures were in the moderate to high stress range (high = 35, moderate = 43, and low = 6). However, for the post-session apparel conditions, MOPPI measures were more in the moderate range and MOPPIV measures were more in the high range, and for the post-session work load conditions, the low work load measures were in the moderate stress range and the moderate and high work load measures were more in moderate to high stress range. Summaries of other comparisons indicated that MOPPI conditions generally resulted in moderate stress levels, while MOPPIV conditions resulted in moderate to high stress levels; low work load conditions generally resulted in moderate stress levels, while both moderate and high work load resulted in moderate to high stress levels; both the desert and tropic environmental conditions resulted in moderate to high stress levels.

Correlations of Psychological States With Session Durations

During each of the 12 sessions, subjects were tested for as long as 180 minutes. The duration of the sessions was shorter than 180 minutes when subjects felt they could not continue and when monitored physiological indicators led medical personnel to remove the subjects from the test situation. Session duration data were provided by USARIEM personnel for correlation with the psychological state data obtained in the present evaluation. The data are summarized in Table C-1 in Appendix C.

Table 2

Summaries for Environment, Apparel, and Work load Conditions of Indications of High, Moderate, and Low Stress Based on 84 Pre-session and 84 Post-session State Response Measurements

Stress category	Pre-session		Post-session	
	Environment			
	Desert	Tropic	Desert	Tropic
High[1]	10	11	20	15
Moderate[2]	17	23	18	25
Low[3]	15	8	4	2

Stress category	**Apparel**				
	MOPPI	MOPPIV		MOPPI	MOPPIV
High	11	10		12	23
Moderate	20	20		24	19
Low	11	12		6	0

Stress category	**Work load**					
	Low	Mod	High	Low	Mod	High
High	7	9	5	7	14	14
Moderate	14	13	13	15	14	14
Low	7	6	10	6	0	0

[1]High stress = measure means closest to ONCOSURG or ABDMSURG mean
[2]Moderate stress = measure means closest to WREXAM or SSCOMP mean
[3]Low stress = measure means closest to INDCNTRL mean

Correlations Across Test Conditions

Correlations with session durations were computed for mean state data across test conditions; that is, for the entire study, session durations were correlated with mean state data (averaged over subjects) for each pre-session and post-session state measure. Thus, 14 correlations (7 states x 2 pre/post measures) were computed. No significant correlations were obtained for pre-session measures. For post-session measures, however, for $\alpha = .05$, fewer than one significant correlation would be expected by chance, and six were obtained. Across sessions, session duration correlated significantly with the following post-session measures: MAACL-R Anxiety (Pearson $r = -.741$, $p < .01$), MAACL-R Hostility ($r = -.642$, $p < .05$), MAACL-R Dysphoria ($r = -.706$, $p < .01$), MAACL-R Positive Affect ($r = +.734$, $p < .01$), STAI Anxiety ($r = -.868$, $p < .01$), and SRE stress rating ($r = -.705$, $p < .01$) ($df = 10$ in all

cases). Thus, on average, the subjects reported higher positive affect and lower levels of stress and moods reflecting negative affect for sessions where they endured longer.

Correlations Within Test Conditions

Correlations between session durations and pre-session and post-session states were also computed for each of the 12 study conditions. For the 84 correlations involving pre-session state measures, with α = .05, about four significant correlations would be expected by chance, and only one was obtained. For the 84 post-session correlations, however, nine significant correlations were obtained, about twice the number expected by chance. The significant post-session correlations are shown in Table 3. While the within-test conditions correlations indicate the same relationships between affect and session duration as between test conditions correlations, they indicate, further, that the relationships between session duration and affect were limited to the higher work load conditions and that they were generally limited to the desert condition (the first half of the study).

DISCUSSION AND CONCLUSIONS

The psychological state data obtained from the several measures used in this investigation were first evaluated by comparing the data for within-study conditions and then by comparing those same data with data from referent protocols representing relatively low, moderate, and high levels of stress.

Psychological State Responses for Current Study Conditions

Several of the psychological state response measures indicated greater negative affect and less positive affect for subjects when tested in MOPPIV than when tested in MOPPI. The MAACL-R Dysphoria subscale yielded a significant main effect for MOPPIV versus MOPPI over all other test conditions. MAACL-R Anxiety was significantly higher for MOPPIV than for MOPPI but only during the desert test condition (the first half of the study). MAACL-R Depression was significantly higher for MOPPIV than for MOPPI but only post-session. MAACL-R Positive Affect was significantly lower for MOPPIV than for MOPPI but only during the low work load condition. STAI Anxiety was significantly higher for MOPPIV than for MOPPI for low and moderate work loads but not for the high work load condition.

Post-session measures of negative affect were significantly elevated over pre-session levels; however, in the case of MAACL-R Depression, this held only for MOPPIV and not for MOPPI. MAACL-R Positive Affect was significantly lower for post-session than for pre-session.

Three state measures distinguished among work load levels. SRE stress ratings were significantly higher for high and moderate work loads compared with low work load but only for the MOPPI condition. Similarly, MAACL-R Positive Affect was significantly lower for the high and moderate work loads compared with the low work load for the MOPPI condition. STAI Anxiety increased significantly from low to moderate to high work load but only for the MOPPI and post-session conditions; for MOPPIV, the increase was significant only from low to moderate work load.

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Table 3

Significant Within-Test Conditions Correlations Between Session
Durations and Pre-session or Post-session State Measures

Treatment combination	State measure	r	p
Pre-session			
DESERTxMOPPIVxLOWWkLd	MAACL-R		
	Anxiety	+.864	.006
Post-session			
DESERTxMOPPIxHIGHWkLd	MAACL-R		
	Pos Affect	+.830	.011
	STAI		
	Anxiety	-.895	.003
	SRE stress rating	-.846	.016
DESERTxMOPPIVxMODWkLd	MAACL-R		
	Depression	-.907	.005
	SRE stress rating	-.862	.013
DESERTxMOPPIVxHIGHWkLd	MAACL-R		
	Pos Affect	+.767	.044
	STAI		
	Anxiety	-.791	.034
	SRE stress rating	-.915	.004
TROPICSxMOPPIxHIGHWkLd	STAI		
	Anxiety	-.789	.035

Because the desert and tropic environmental conditions were not
counterbalanced in the test design, it was not possible to draw conclusions
about the environment variable.

Thus, it is concluded that the assessment measures used in this part of
the current study indicate significantly greater negative affect associated
with MOPPIV than with MOPPI and significantly greater negative affect
associated with high work load than with low work load. It is noteworthy that
two measures of negative affect, STAI Anxiety and SRE stress, demonstrated the
work load differences only for subjects in MOPPI; in MOPPIV, the subjects'
responses for those measures were high, regardless of work load. The measures
generally did not listinguish between the environmental conditions, which,
however, were confounded with order of presentation.

Stress Assessment Comparisons With Other Protocols

The stress and performance program of ARL has been collecting data to validate a procedure developed for estimating the degree of stress experienced in a given situation by comparing state responses obtained in that situation with those obtained previously in referent protocols representing high, moderate, and low stress situations. The procedure has proved quite useful in previous stress evaluations (Fatkin et al., 1991; Hudgens et al., 1991, 1992).

Comparison of data from the present study with those for the referent protocols indicated that the conditions of the present study exposed the subjects to situations of relatively moderate to high stress. Comparison of pre-session data with referent pre-session data indicated that the anticipatory stress was relatively moderate. For post-session data, the comparisons indicated that stresses of having experienced the study conditions were increased to the moderate to high range. Similarly, comparisons of MOPPI data with referent data reflected moderate stress levels, and comparisons of MOPPIV data with referent data reflected moderate to high stress levels. For the work load data, comparisons with referent data indicated moderate stress levels for low work load and moderate to high stress levels for both moderate and high work load.

Correlations of Psychological States With Session Durations

Correlations between session durations and psychological states, both within and across test conditions, indicated that no significant relationship exists between pre-session measures of psychological state and session duration. The correlations across test conditions indicated that for the post-session measures, longer session durations were related to lower levels of negative affect and higher levels of positive affect. The correlations within test conditions indicated that the significant post-session relationships were limited to the higher work load and desert conditions. Because causal relationship cannot be inferred from correlations between variables, it is not apparent whether the subjects endured longer because they felt better or they felt better because they endured longer.

General Conclusions

This investigation represents the first time the battery of measures and assessment procedures employed by the ARL stress and performance team has been applied to a relatively well-designed and controlled laboratory test sponsored by the P^2NBC^2 program. The findings demonstrate the advantage of using the battery of measures as opposed to using only a single measure as is the more common practice in studies purporting to assess stress effects. The various scales and subscales of the battery proved sensitive to different combinations of factors in the investigation; this is in accordance with the postulated interaction model described in the Introduction, which predicts unique profiles of responses for different combinations of kinds and levels of stress factors, of environmental factors, and of person-related factors. The findings also demonstrate the usefulness of the assessment procedures, wherein current study data are compared with a standard set of data obtained from previous studies involving relatively high, moderate, and low levels of stress. Those procedures allow a first order quantification of data into the three categories of stressfulness. Such standardized quantification, consequently, allows direct comparison of stress experienced in different

studies, as in a series of P^2NBC^2 studies. Thus, the levels of stress associated with the conditions of this test are made available to the P^2NBC^2 program data base.

From the perspective of achieving the goals of the ARL stress and performance program, the findings of this investigation provide data for novel combinations of potentially stress-inducing factors that are needed for the continuing validation of the stress assessment procedures. In the present investigation, results supporting such validation include higher levels of negative affect and lower levels of positive affect associated with MOPPIV conditions, which cause greater heat buildup and are more limiting of sensory input and of physical mobility than MOPPI conditions; high work load conditions, which tax subjects' resources more than lower work load conditions; and post-session measures, which better reflect responses to characteristics of the event than pre-session measures. The present investigation provides the first evidence that measures in the ARL stress battery are sensitive to varying levels of work load.

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APPENDIX A

MEAN STATE QUESTIONNAIRE DATA OBTAINED FOLLOWING A TRAINING SESSION
DURING THE TRAINING WEEK PRECEDING COLLECTION OF STUDY DATA

Table A-1

Mean State Questionnaire Data Obtained Following a Training Session During the Training Week Preceding Collection of Study Data

State measure	Mean(N=7)	SEM
MAACL-R		
Anxiety	61.0	6.9
Depression	71.1	13.0
Hostility	80.3	15.1
Dysphoria	78.4	15.6
Positive Affect	49.7	3.6
STAI		
Anxiety	50.7	3.9
SRE		
Stress rating	45.0	12.6

APPENDIX B

**TALLY RESULTS FOR SEVEN RESPONSE MEASURE MEANS INDICATING WHICH OF FIVE
REFERENT PROTOCOL MEAN VALUES THEY WERE CLOSEST TO
DURING EACH OF 12 TEST CONDITIONS**

Table B-1

Tally Results for Seven Response Measure Means Indicating Which of Five
Referent Protocol Mean Values They Were Closest to
During Each of 12 Test Conditions
(Maximum Tally = 7)

Referent protocol	Desert environment						Tropic environment					
	MOPPI			MOPPIV			MOPPI			MOPPIV		
	LWL	MWL	HWL	LWL	MWL	HWL	LWL	MWL	HWL	LWL	MWL	HWL
Pre-session												
ONCOSURG	1	1	1	1	1	0	0	0	1	2	1	1
ABDMSURG	1	2	0	0	2	0	1	1	2	1	1	0
WREXAM	0	0	1	1	0	0	2	1	0	0	1	1
SSCOMP	2	2	3	3	3	2	3	3	3	3	3	3
INDCNTRL	3	2	2	2	1	5	1	2	1	1	1	2
Post-session												
ONCOSURG	0	1	0	1	1	2	0	1	0	1	1	1
ABDMSURG	2	2	2	2	4	3	0	1	3	1	3	3
WREXAM	0	1	1	1	0	0	3	4	0	4	0	0
SSCOMP	1	3	4	3	2	2	2	1	4	1	3	3
INDCNTRL	4	0	0	0	0	0	2	0	0	0	0	0

APPENDIX C

MEAN SESSION DURATIONS (MINUTES) FOR 12 TEST CONDITIONS

Table C-1

Mean (± SEM) Session Durations (in minutes) for 12 Test Conditions

Environment	MOPP	Work load		
		Low	Moderate	High
Desert	I	180.0 (0.00)	167.7 (6.08)	98.7 (10.66)
	IV	122.3 (16.19)	68.7 (5.18)	46.0 (4.25)
Tropic	I	169.6 (10.43)	158.7 (13.90)	100.7 (12.95)
	IV	158.1 (14.79)	81.9 (7.49)	47.6 (4.08)