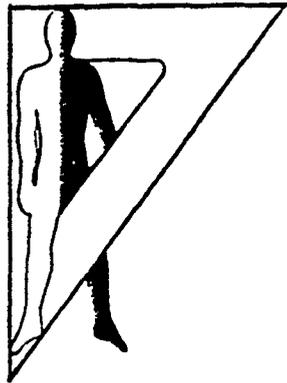


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Technical Memorandum 9-90

AD-A226 368

EVALUATION OF STRESS EXPERIENCED BY
YELLOWSTONE ARMY FIRE FIGHTERS

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Linda T. Fatkin
James M. King
Gerald A. Hudgens

August 1990
AMCMS Code 61110274A0011

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U.S. ARMY HUMAN ENGINEERING LABORATORY
Aberdeen Proving Ground, Maryland

90 09 10 288

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SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

Form Approved OMB No. 0704-0188

1a. REPORT SECURITY CLASSIFICATION Unclassified		1b. RESTRICTIVE MARKINGS	
2a. SECURITY CLASSIFICATION AUTHORITY		3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.	
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE			
4. PERFORMING ORGANIZATION REPORT NUMBER(S) Technical Memorandum 9-90		5. MONITORING ORGANIZATION REPORT NUMBER(S)	
6a. NAME OF PERFORMING ORGANIZATION Human Engineering Laboratory	6b. OFFICE SYMBOL (if applicable) SLCHE	7a. NAME OF MONITORING ORGANIZATION	
6c. ADDRESS (City, State, and ZIP Code) Aberdeen Proving Ground, MD 21005-5001		7b. ADDRESS (City, State, and ZIP Code)	
8a. NAME OF FUNDING/SPONSORING ORGANIZATION	8b. OFFICE SYMBOL (if applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER	
8c. ADDRESS (City, State, and ZIP Code)		10. SOURCE OF FUNDING NUMBERS	
		PROGRAM ELEMENT NO. 6.11	PROJECT NO. 1L161102B74A
		TASK NO.	WORK UNIT ACCESSION N
11. TITLE (Include Security Classification) Evaluation of Stress Experienced by Yellowstone Army Fire Fighters			
12. PERSONAL AUTHOR(S) Fatkin L. T., King, J. M., Hudgens, G. A.			
13a. TYPE OF REPORT Final	13b. TIME COVERED FROM _____ TO _____	14. DATE OF REPORT (Year, Month, Day) 1990, August	15. PAGE COUNT 41
16. SUPPLEMENTARY NOTATION			
17. COSATI CODES		18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)	
FIELD	GROUP	stress evaluation stress measurement	
05	08	fire fighting Yellowstone	
15	02	stress perception military rank (see reverse side)	
19. ABSTRACT (Continue on reverse if necessary and identify by block number)			
<p>An evaluation of the stress experienced by the soldiers who fought fires at Yellowstone National Park was conducted in September 1988. The psychological measures used to evaluate stress illustrated a discriminant sensitivity to variations in stress levels in this field situation and to naturally and experimentally induced stress. Compared to results obtained from other protocols involving surgical stress, examination stress, and competitive weapon firing, the soldiers fighting the Yellowstone fires experienced a stress level on the high end of the moderate range. A multivariate analysis of variance (MANOVA) was performed on the data to look at possible differences in stress perception according to rank and number of days spent actually fighting the fires. Significant differences were found in the stress experienced between soldiers of different ranks, indicating that the junior enlisted soldiers reported the highest stress ratings. No significant differences resulted from actual fire-fighting experience.</p>			
20. DISTRIBUTION/AVAILABILITY OF ABSTRACT <input type="checkbox"/> UNCLASSIFIED/UNLIMITED <input checked="" type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS		21. ABSTRACT SECURITY CLASSIFICATION Unclassified	
22a. NAME OF RESPONSIBLE INDIVIDUAL Technical Reports Office		22b. TELEPHONE (Include Area Code) (301) 278-4478	22c. OFFICE SYMBOL SLCHE-SS-TSR

18. (continued)

soldiers,

Multiple Affect Adjective Check List - Revised

Specific Rating of Events scale

coping

disease and nonbattle injury rates

field exercises

life threat

(SDU)

EVALUATION OF STRESS EXPERIENCED BY YELLOWSTONE ARMY FIRE FIGHTERS



Linda T. Fatkin
James M. King
Gerald A. Hudgens

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DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
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August 1990

APPROVED: 
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Aberdeen Proving Ground, Maryland

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EVALUATION OF STRESS EXPERIENCED BY YELLOWSTONE ARMY FIRE FIGHTERS

INTRODUCTION

Wildfires spread through Yellowstone National Park between the months of June and September 1988, destroying a million of the Park's 2.2 million acres. To help save this national resource, approximately 4,800 soldiers (including six battalions from Fort Lewis, Washington), along with 1,200 Marines and Army and Air National Guard forces, were deployed to battle the fires (Miles, 1988). The deployment marked only the second time in nearly 100 years that active duty soldiers were asked to help the U.S. Forest Service fight fires in a national forest. In 1987, a brigade of soldiers from the 7th Infantry Division (Light) at Fort Ord, California, spent 10 days fighting wildfires along the California-Oregon border. Most of the soldiers fighting the fires at Yellowstone were on location for approximately 30 days, however.

In an inter-agency effort to evaluate the level of stress experienced by the soldiers who fought fires at Yellowstone National Park, an evaluation team was formed including two personnel from U.S. Army Concepts Analysis Agency (CAA), two from the U.S. Army Human Engineering Laboratory (HEL), one from the Walter Reed Army Institute of Research (WRAIR), and one from the Army Research Institute (ARI). The unpredictable and life-threatening nature of the fires afforded a unique opportunity to study stress reactions and to collect human factors data in an operational setting that shared a variety of elements with combat, including those of personal danger, uncertainty, and intense physical demands. For the HEL portion of the effort, which is reported here, it was hoped that this data-collection effort would provide valuable input to the stress research program regarding the assessment of stress in situations that are closely tied to soldier performance.

The present HEL Stress Research Program (Hudgens, Torre, Chatterton, Wansack, Fatkin, & DeLeon-Jones, 1986), a combination of in-house and contract efforts, is presently studying the links between psychological and physiological stress responses and performance in a variety of settings. Fundamental goals of this program include the development of standard procedures for soldier and equipment performance testing, as well as a determination of which combination of psychological and physiological indices would constitute efficient and reliable measurements of the stress experienced (Fatkin, Hudgens, Torre, King, & Chatterton, in press; Hudgens, Fatkin, Torre, King, Slager, & Chatterton, in press). Based on the previous use and validation of these measures, the Multiple Affect Adjective Check List-Revised (MAACL-R) (Zuckerman & Lubin, 1985) and the Specific Rating of Events (SRE) scale (Fatkin et al., in press) were selected for use in the fire-fighting stress evaluation. Along with a general information questionnaire designed specifically for the fire-fighting situation, these indices were used to determine (a) whether the soldiers involved in fire fighting exhibited typical stress responses, (b) the level and intensity of their stress experience, and (c) the suitability of the instruments for use in future evaluations.

METHOD

Study Participants

The study participants (SPs) were soldiers of the 9th Infantry Division (Motorized) and supporting units who participated in the 1988 fire-fighting operation at Yellowstone National Park. The initial participant pool consisted of 1,100 soldiers, including enlisted soldiers (E1 through E8), warrant officers (WO1 through CW4), and officers (O1 through O5). Since the objectives of the study were directed toward assessing the reactions of soldiers involved in actual fire fighting or related duties, the higher ranking noncommissioned officers (E7 through E8), officers (O4 through O5), and warrant officers who did not perform these duties were removed from the initial pool, leaving a total of 855 soldiers. All soldiers participated in the study voluntarily.

General Information and Stress Evaluation

A survey packet (see Appendix) was administered to each study participant and included the Volunteer Agreement Affidavit, a general information questionnaire, the Multiple Affect Adjective Check List-Revised (MAACL-R) (Zuckerman & Lubin, 1985), and the Specific Rating of Events (SRE) scale (Fatkin et al., in press). The two stress perception measures used, the MAACL-R and the SRE, have been administered by HEL in previous investigations. Each of the measures used was designed to be self-administering, relatively brief, and easily given individually or to groups. The results reported by the Yellowstone fire fighters about these measures will be compared with the results for SPs (a) who have spouses undergoing serious abdominal surgery; (b) who are taking an important medical written exam; (c) in independent non-stressed control conditions; (d) in weapon-firing control conditions; and (e) in competitive weapon-firing conditions.

General Information Questionnaire

The general information questionnaire was used to obtain pertinent demographic information (age, primary military occupational specialty [MOS], sex, rank, length of service, education level, and unit), as well as specific information about the fire-fighting operation. The soldiers provided descriptions of their actual duties during the fire-fighting operation, identified specific problems encountered, listed similarities of fire-fighting operations to their knowledge or concept of a combat situation, and rated certain aspects of their fire-fighting experience on scales ranging from 0 to 100. These ratings reflected their evaluation of the life-threatening nature their duties, how successful they felt in getting the job done, and how well they coped with the fire-fighting experience.

Multiple Affect Adjective Check List-Revised (MAACL-R)

The MAACL-R consists of five primary subscales: Anxiety, Depression, Hostility, Positive Affect, and Sensation Seeking, which are derived from a one-page list of 132 adjectives. The soldiers were instructed to check all the words that described how they felt during the fire-fighting operation.

Because of the improved discriminant validity and the control of the checking response set, the MAACL-R has been particularly suitable for investigations that postulate changes in specific affects in response to stressful situations (Zuckerman & Lubin, 1985). (Note. The term "affects" as used in this report means emotions, feelings, and moods that the SP is experiencing.) In experimental studies of stress and stress reduction, the expected reactions include changes in affects such as anxiety, depression, or hostility. The MAACL-R is designed to give results addressed to such specific hypotheses.

Specific Rating of Events (SRE) Scale

The SRE (Fatkin et al., in press) was a measure designed for the HEL Stress Research Program, in which the SPs rated (on a scale of 0 to 100) how stressful the event was to them.

Procedures

The questionnaires were administered to soldiers in groups which normally consisted of either company or battalion groupings. Soldiers were surveyed at Yellowstone National Park and Bozeman, Montana, shortly after they had completed their fire-fighting duties. Soldiers were also surveyed at Fort Lewis, Washington, approximately 2 weeks after completing their mission. The soldiers were provided with the questionnaires and pencils and were briefed about the purpose and content of the survey. They were instructed to read the Volunteer Agreement Affidavit and, if they agreed to participate in the study, to complete the rest of the questionnaires. Great care was taken to emphasize the voluntary nature of their participation in the study. Members of the evaluation team solicited oral comments from individuals who wished to elaborate about their responses or to address issues not covered in the surveys. The soldiers and their leaders were extremely cooperative throughout the data collection process.

RESULTS

Questionnaire Location

A multivariate analysis of variance (MANOVA) was first performed on the questionnaire data to look at possible differences in stress responses that may have resulted from the timing and location of questionnaire administration. Of a total of 11 dependent measures included in the analysis (see Table 1), no significant differences were found in responses to the MAACL-R and SRE stress perception measures and the Life Threat rating. However, significant differences because of questionnaire location were found on three peripheral measures as described below (Wilks' lambda = .391; $F(12,742) = 96.28, p < .001$).

Subjective Performance Rating (SUBJ PERF) (see Figure 1)

The fire fighters were asked to rate (from 0 to 100) how successful they thought they were in getting the job done. Those who answered this question at Yellowstone shortly after completing their duties reported a

Table 1
MANOVA Summary Table of the Stress Evaluation Measures
by Questionnaire Location

Univariate F Tests					
Dependent Meas	SS	df	MS	F	p
Life Thr	306.980	1	306.980	0.413	0.521
Error	559354.936	753	742.835		
Subj Perf	18805.154	1	18805.154	19.621	0.000
Error	721686.321	753	958.415		
Coped	2092.167	1	2092.167	4.008	0.046
Error	393044.384	753	521.971		
Anxiety	51.492	1	51.492	0.169	0.681
Error	229094.502	753	304.242		
Depression	974.509	1	974.509	0.750	0.387
Error	978180.450	753	1299.044		
Hostility'	2876.037	1	2876.037	2.171	0.141
Error	997678.037	753	1324.938		
Pos Affect	157.438	1	157.438	3.044	0.081
Error	38943.503	753	51.718		
Sens Seeking	182.935	1	182.935	2.683	0.102
Error	51350.000	753	68.194		
SPE	301.618	1	301.618	0.418	0.518
Error	543709.262	753	722.057		
Days at YS	2.242	1	2.242	2.573	0.109
Error	656.081	753	0.871		
FF Exper	834.102	1	834.102	977.474	0.000
Error	642.553	753	0.853		

Multivariate Test Statistics

Wilks' lambda = 0.391
F-Statistic = 96.277 df = 12, 742 p < .001

Note. Life Thr = Rating of the life-threatening nature of their duties; Subj Perf = Subjective rating of performance; Coped = Coping assessment; Days at YS = Number of total days at Yellowstone National Park; FF Exper = Fire-fighting experience.

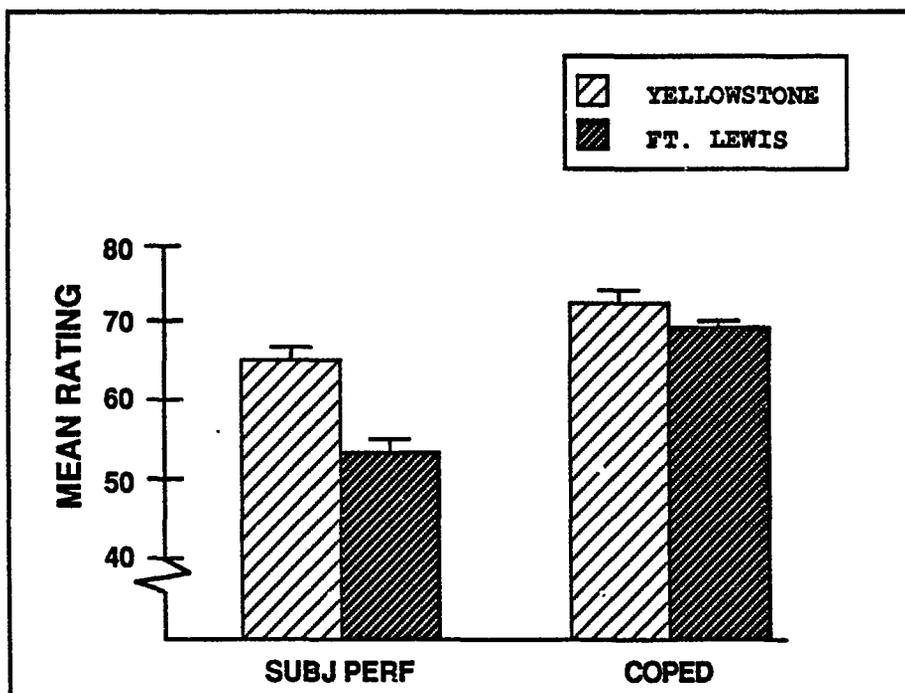


Figure 1. Mean (+standard error) ratings from the Subjective Performance (SUBJ PERF) and Coping Assessment (COPED) scales for the fire fighters surveyed at Yellowstone and Fort Lewis.

higher rating than those who completed the questionnaire at Fort Lewis, approximately 2 weeks after their return home ($F(1,753) = 19.62, p < .001$).

Coping Assessment (COPEd) (see Figure 1)

The soldiers were asked to rate (from 0 to 100) how well they coped with the situation. Those who completed the questionnaires at Yellowstone rated their ability to cope significantly higher than the soldiers who completed the questionnaire at Fort Lewis ($F(1,753) = 4.01, p = .046$).

Fire-fighting Experience

As shown in Table 2, the Fort Lewis group had significantly more fire-fighting experience than the Yellowstone group ($F(1,753) = 977.47, p < .001$).

Table 2

Percentage of Soldiers With Varied Fire-fighting Experience According to Group Location

Group location	Fire-fighting days				
	0	6	8	10	13
Yellowstone	73	17	0	10	0
Fort Lewis	0	7	43	24	26

Stress Perception Measures

Comparative Stress Data

The responses obtained from the fire fighters on the MAACL-R and SRE stress perception measures were compared with profiles obtained in the surgical and examination protocols conducted at Northwestern University (Hudgens, Chatterton, Torre, Slager, Fatkin, Keith, Rebar, DeLeon-Jones, & King, 1989) and with the results from the military Salvo Stress study (Torre, Wansack, Hudgens, King, Fatkin, Mazurczak, & Myers, in press) described in the METHODS section. All measures discussed here are stress perception measures taken immediately after the stress event (post-stress measures) for the respective protocols or after a comparable control interval for the Northwestern Non-stressed Control group ("Independent Control"), and the Salvo Stress Control group. A MANOVA indicated there were significant differences between the groups for all the measures as indicated in Table 3 (Wilks' lambda = .675; $F(35,4078) = 11.43, p < .001$). Post hoc tests conducted on the significant interactions used the Tukey-Kramer modification of the Tukey Honestly Significant Difference (HSD) test, which is appropriate for comparisons with unequal numbers of observations (Wilkinson, 1988, p. 709). The level of significance was set at .05 for the critical values (CV_{.05}) used

Table 3

MANOVA Summary Table of the Stress Perception Measures by Group

Univariate F Tests					
Dependent Meas	SS	df	MS	F	p
Anxiety	10267.644	5	2053.529	6.380	0.000
Error	313828.865	975	321.876		
Depression	39775.520	5	7955.104	6.339	0.000
Error	1223566.810	975	1254.940		
Hostility	77709.903	5	15541.981	12.615	0.000
Error	1201251.492	975	1232.053		
Pos Affect	6455.591	5	1291.118	25.439	0.000
Error	49484.313	975	50.753		
Sens Seeking	6885.304	5	1377.061	20.222	0.000
Error	66395.389	975	68.098		
SRE	44064.796	5	8812.959	12.524	0.000
Error	686109.870	975	703.702		
Multivariate Test Statistics					
	Wilks' lambda =	0.675			
	F-Statistic =	11.430	df =35, 4078	p = .001	

in determining significant differences between means. The actual difference between the means (Dm) will also be reported. Figures 2 through 7 present mean responses (+ standard error of the mean [SEM]) for these variables.

Specific Rating of Events (SRE)

Figure 2 illustrates how the stress ratings reported by the Yellowstone fire fighters compare with the ratings obtained on the same measure for the conditions studied at Northwestern University and the Salvo Stress Study. The fire fighters reported significantly higher stress ratings than the Independent Control group (Tukey HSD $CV_{.05} = 20.28$; $Dm = 38.0$). These data indicate that the fire fighters reported a level of stress comparable with the levels observed in the Salvo Stress weapon-firing competition.

MAACL-R Anxiety

As illustrated in Figure 3, the fire fighters had a significantly lower level of anxiety than the Surgical group (Tukey HSD $CV_{.05} = 13.72$; $Dm = 18.2$) and did not differ significantly from any other group.

MAACL-R Depression

Figure 4 illustrates that although the fire fighters reported the highest average levels of depression of all other groups, the differences observed were not statistically significant (Tukey HSD $CV_{.05} = 27.09$; $p > .05$).

MAACL-R Hostility

The fire fighters reported a level of hostility that compared with the level seen in the Salvo Stress Competition group (see Figure 5). These ratings were significantly higher than those reported by the Surgical group (Tukey HSD $CV_{.05} = 26.84$; $Dm = 39.1$) and the Independent Control group (Tukey HSD $CV_{.05} = 26.84$; $Dm = 35.3$).

MAACL-R Sensation Seeking

As illustrated in Figure 6, the fire fighters reported significantly lower levels of Sensation Seeking than did the Salvo Stress Control group (Tukey HSD $CV_{.05} = 6.31$; $Dm = 11.4$) and Competition group (Tukey HSD $CV_{.05} = 6.31$; $Dm = 6.8$).

MAACL-R Positive Affect

Figure 7 illustrates that the fire fighters reported Positive Affect levels that were significantly lower than those reported by the Surgical group (Tukey HSD $CV_{.05} = 5.45$; $Dm = 7.8$), the Exam group (Tukey HSD $CV_{.05} = 5.45$; $Dm = 6.4$), the Independent Control group (Tukey HSD $CV_{.05} = 5.45$; $Dm = 13.1$) and the Salvo Stress Control group (Tukey HSD $CV_{.05} = 5.45$; $Dm = 6.7$). The level of Positive Affect they experienced was comparable with the values observed for the Salvo Stress Competition group.

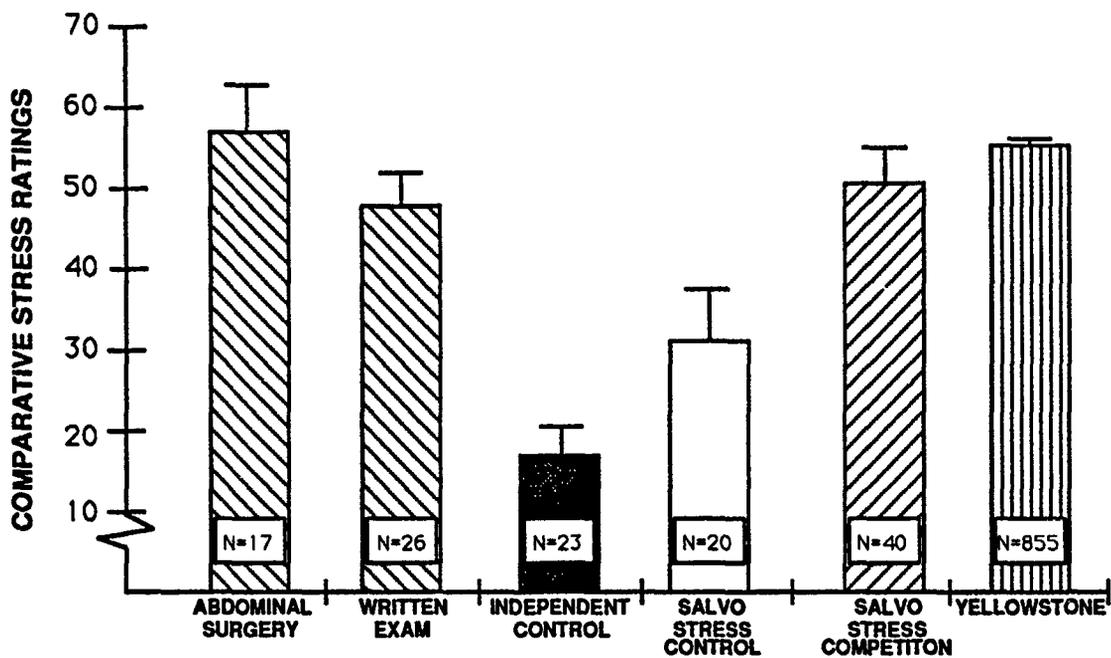


Figure 2. Comparison of mean stress ratings from the Specific Rating of Events (SRE) scale for the Yellowstone fire fighters with ratings for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control conditions; (4) in weapon-firing control conditions; and (5) in competitive weapon-firing conditions.

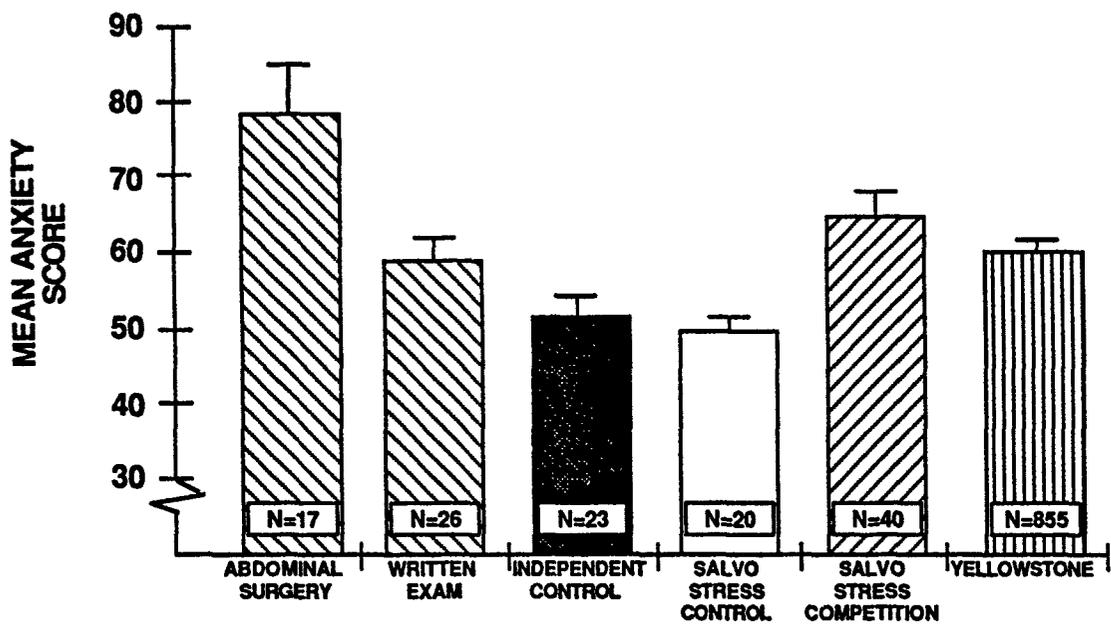


Figure 3. Comparison of mean post-stress MAACL-R Anxiety scores for the Yellowstone fire fighters with the scores for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control conditions; (4) in weapon-firing control conditions; and (5) in competitive weapon-firing conditions.

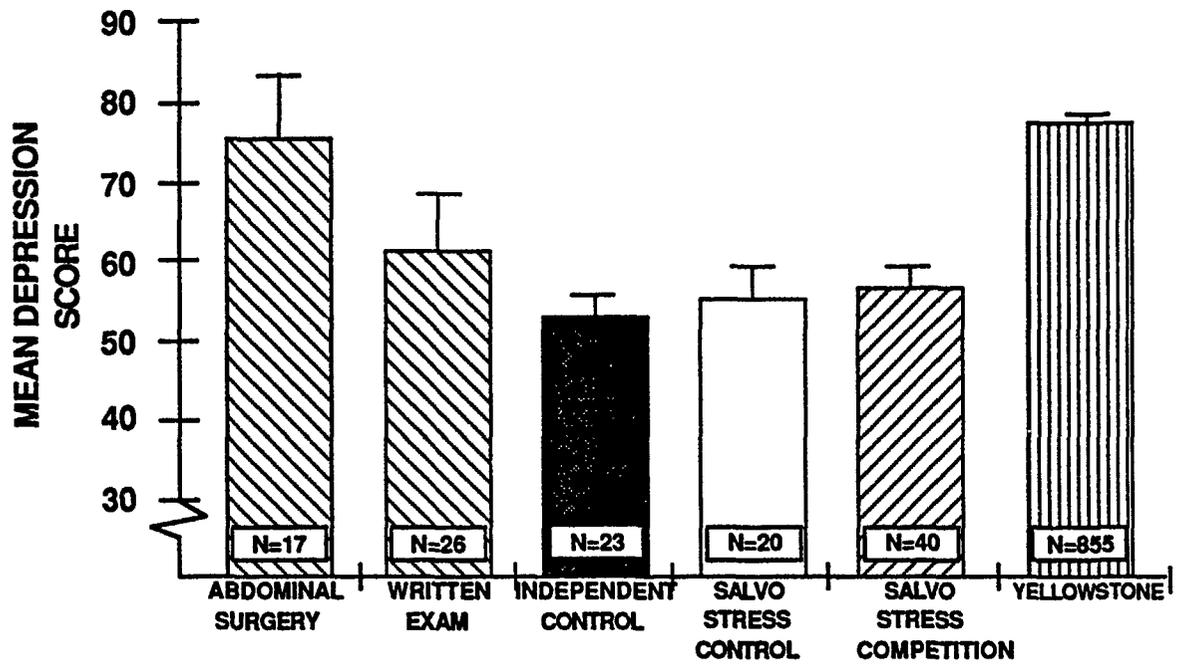


Figure 4. Comparison of mean post-stress MAACL-R Depression scores for the Yellowstone fire fighters with the scores for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control condition; (4) in weapon-firing control conditions; and (5) in competitive weapon-firing conditions.

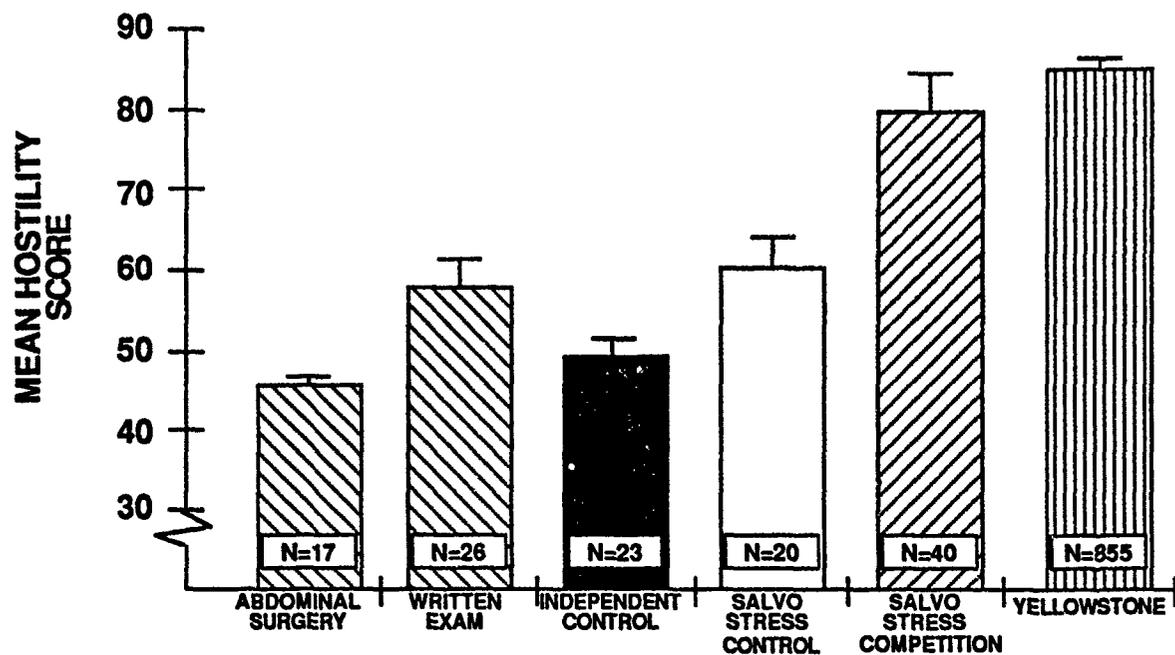


Figure 5. Comparison of mean post-stress MAACL-R Hostility scores for the Yellowstone fire fighters with the scores for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control conditions; (4) in weapon-firing control conditions; and 5) competitive weapon-firing conditions.

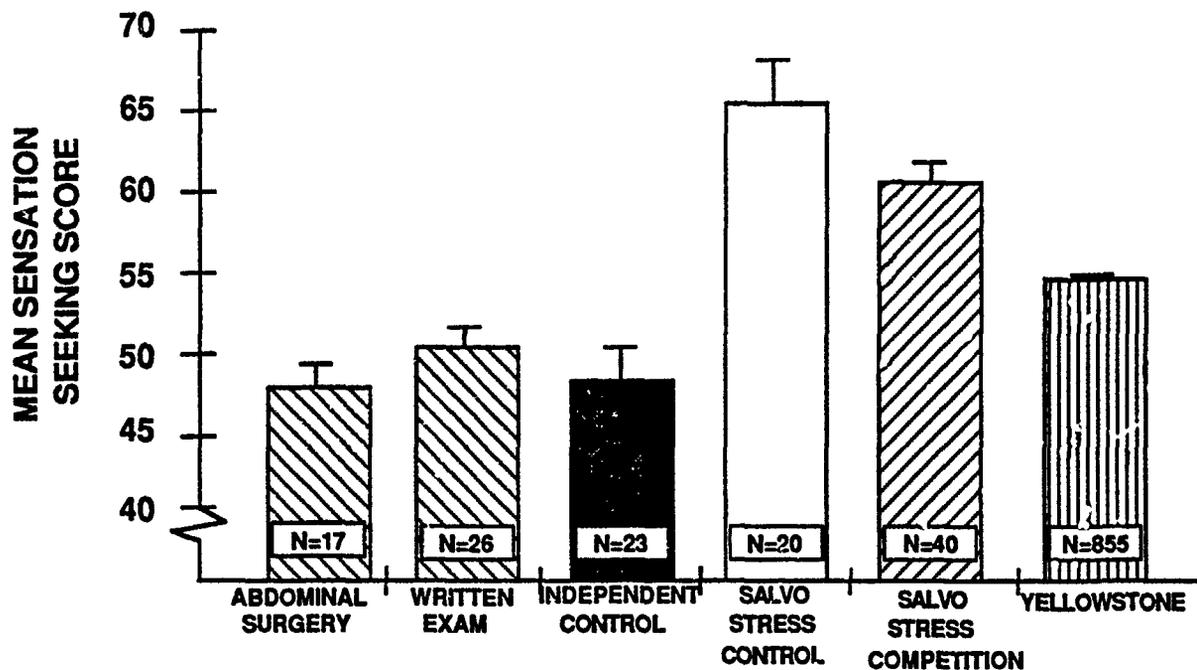


Figure 6. Comparison of mean post-stress MAACL-R Sensation Seeking scores for the Yellowstone fire fighters with the scores for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control conditions; (4) in weapon-firing control conditions; and (5) in competitive weapon-firing conditions.

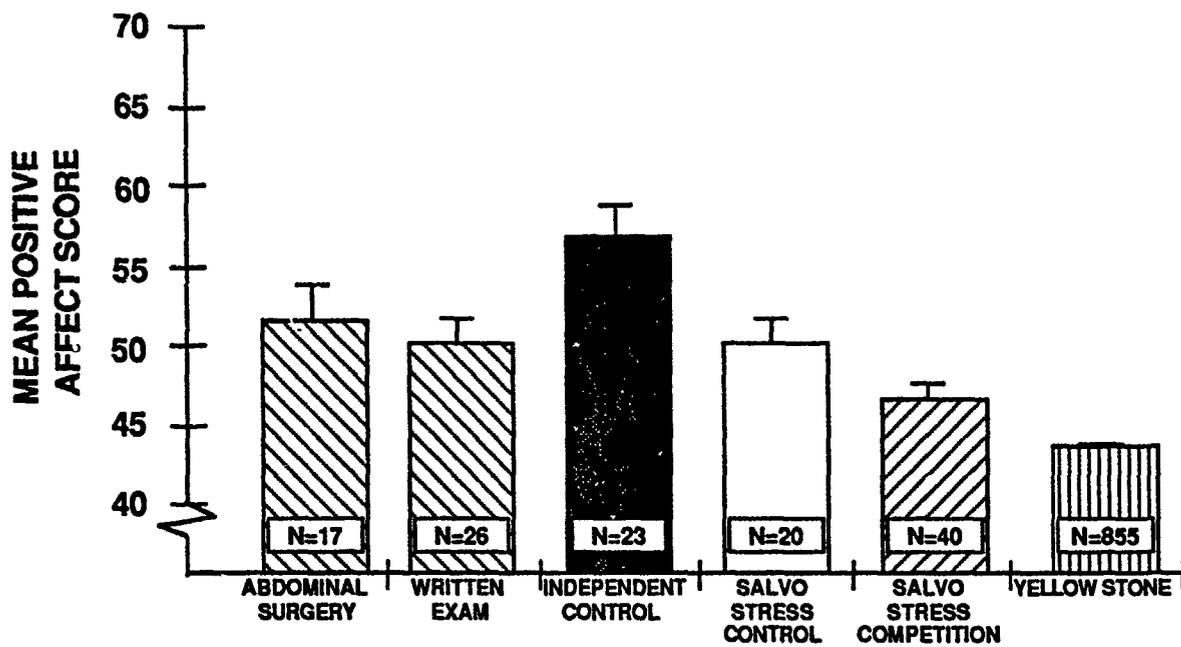


Figure 7. Comparison of mean post-stress MAACL-R Positive Affect scores for the Yellowstone fire fighters with the scores for SPs (1) who have spouses undergoing serious abdominal surgery; (2) who are taking an important medical written exam; (3) in independent non-stressed control conditions; (4) in weapon-firing control conditions; and (5) in competitive weapon-firing conditions.

Fire-fighting Experience and Rank

A MANOVA was performed on the data to evaluate differences in stress responses that may have resulted from the number of days actually spent fighting the fires (fire-fighting experience) or based on military rank categories. The soldiers were assigned to task forces that varied in their amount of exposure to actual fire fighting (0, 6, 8, 10, and 13 days). Rank categories consisted of two groups of enlisted soldiers (E1s through E3s and E4s through E6s) and two groups of commissioned officers (O1s through O2s and O3s). No significant differences because of fire-fighting experience were found for any of the stress perception measures (Wilks' lambda = .950; $F(32,2771) = 1.22$; $p = .186$). There was no significant Fire-fighting Experience by Rank interaction effect (Wilks' lambda = .910; $F(96,5069) = .743$; $p = .977$). Significant differences between soldiers in the different rank categories were found for the stress measures (see Table 4) as described below (Wilks' Lambda = .943; $F(24,2178) = 1.84$, $p = .008$). The Tukey-Kramer modification of the Tukey HSD test was used to conduct the post hoc tests of these measures to determine where the significant differences occurred.

Specific Rating of Events

The stress ratings illustrated in Figure 8 indicate that E1s through E3s rated the fire-fighting experience as more stressful than did all other soldiers. These junior soldiers reported significantly higher stress ratings than the O1s through O2s (Tukey HSD $CV_{.05} = 11.38$; $Dm = 23.2$) and the O3s (Tukey HSD $CV_{.05} = 11.38$; $Dm = 13.2$), while the E4s through E6s reported significantly higher stress ratings than the O1 through O2 group (Tukey HSD $CV_{.05} = 11.38$; $Dm = 14.9$).

MAACL-R Anxiety

Figure 9 illustrates a similar pattern to the stress ratings reported above. The E1s through E3s had the highest anxiety scores and reported anxiety levels that are significantly higher than the O1 through O2 group (Tukey HSD $CV_{.05} = 7.69$; $Dm = 9.9$) only.

MAACL-R Depression

As illustrated earlier in the comparative ratings, the depression scores fall in the moderate to high range as assessed by the investigators in previous reports. In Figure 10, a descending pattern of these scores is shown, with the E1s through E3s on the top end of the scale. Both enlisted groups reported significantly higher depression scores than the officers. The E1 through E3 group reported higher depression levels than both the O1s through O2s (Tukey HSD $CV_{.05} = 15.56$; $Dm = 21.4$) and the O3 group (Tukey HSD $CV_{.05} = 15.56$; $Dm = 26.1$), while the E4 through E6 group scored significantly higher than the O3s (Tukey HSD $CV_{.05} = 15.56$; $Dm = 18.8$).

MAACL-R Hostility

Hostility scores for both enlisted groups are relatively high as is illustrated in Figure 11. The overall pattern of responses is similar to

Table 4
MANOVA Summary Table of the Stress Perception Measures
by Rank Categories

Univariate F Tests					
Dependent Meas	SS	df	MS	F	p
Life Thr	8101.275	3	2700.425	3.909	0.009
Error	532604.078	758	690.771		
Anxiety	2414.811	3	804.937	2.722	0.043
Error	224177.460	758	295.749		
Depression	19062.124	3	6354.041	4.935	0.002
Error	976010.383	758	1287.613		
Hostility	22120.504	3	7373.501	5.758	0.001
Error	970603.409	758	1280.479		
Pos Affect	380.336	3	126.779	2.554	0.054
Error	37631.227	758	49.645		
Sens Seeking	287.923	3	95.974	1.445	0.228
Error	50345.841	758	66.419		
SRE	14200.636	3	4733.545	7.105	0.000
Error	505000.531	758	666.228		
Multivariate Test Statistics					
	Wilks' lambda =	0.943			
	F-Statistic =	1.844	df =24, 2178	$p = .008$	

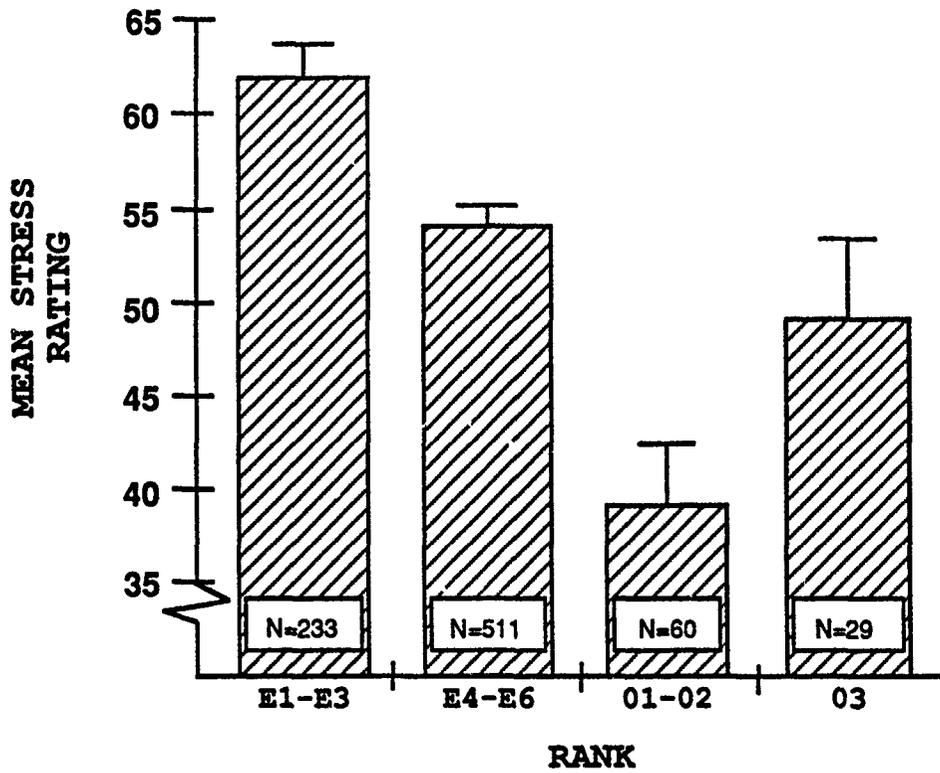


Figure 8. Mean post-stress ratings from the Specific Rating of Events (SRE) scale according to rank.

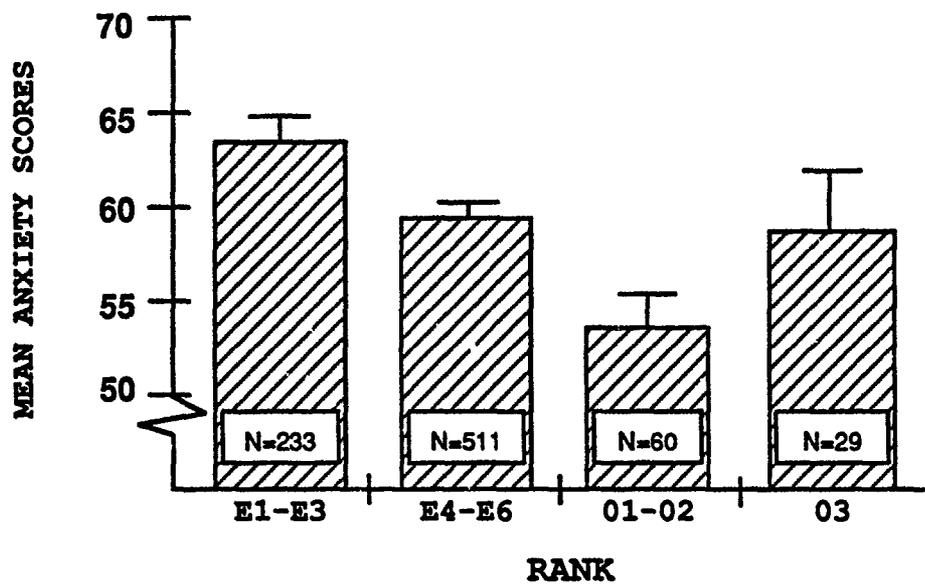


Figure 9. Mean MAACL-R Anxiety scores according to rank.

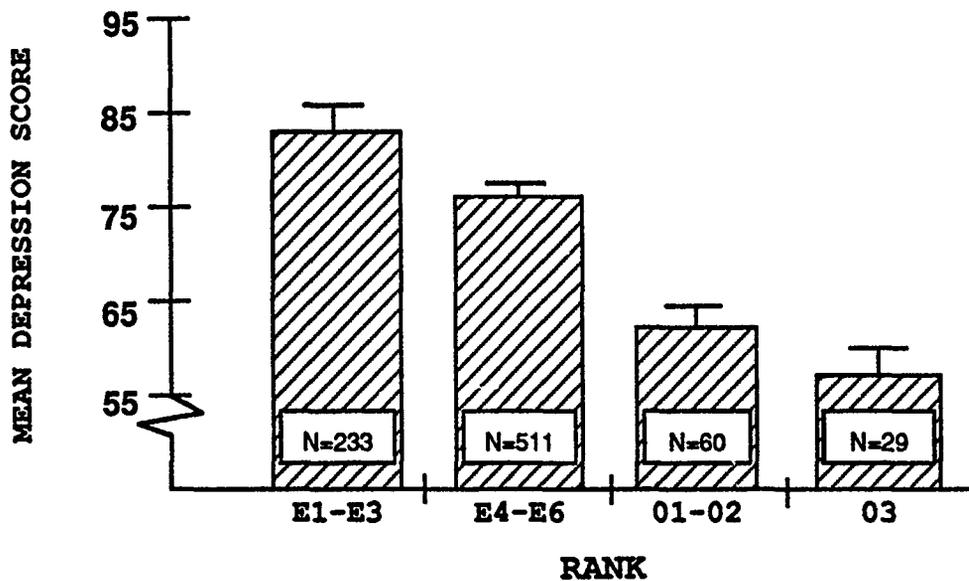


Figure 10. Mean MAACL-R Depression scores according to rank.

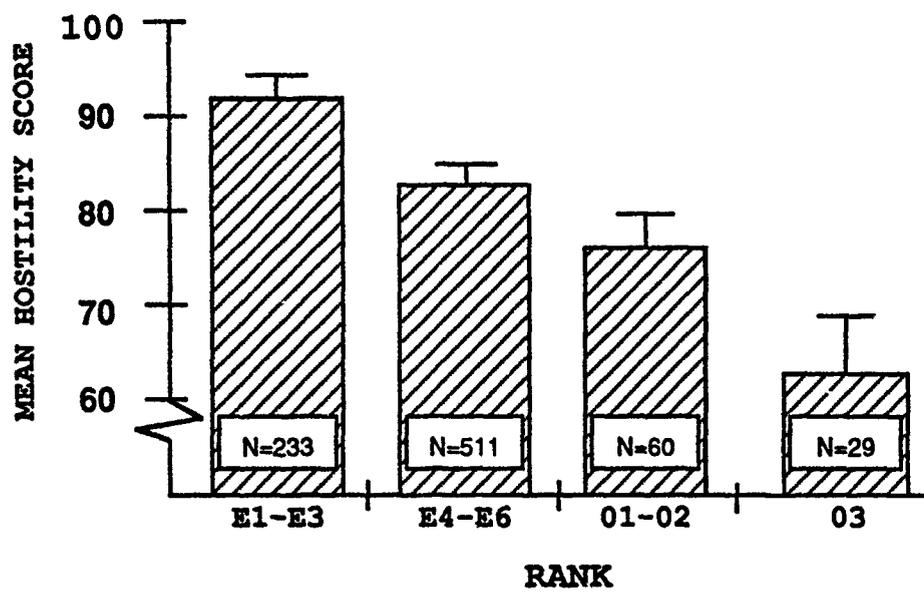


Figure 11. Mean MAACL-R Hostility scores according to rank.

that found for depression. The E1s through E3s reported hostility levels that were significantly higher than both the O1s through O2s (Tukey HSD $CV_{.05} = 15.68$; $Dm = 15.7$) and the O3s (Tukey HSD $CV_{.05} = 15.68$; $Dm = 28.7$), and the E4s through E6s scored significantly higher than the O3s (Tukey HSD $CV_{.05} = 15.68$; $Dm = 20.4$) for this measure.

MAACL-R Positive Affect

Figure 12 shows a reversal of the patterns demonstrated in the previous figures. The Positive Affect scores fall into an ascending pattern with the E1s through E3s at the lower end of the scale. The E1 through E3 group reported significantly lower Positive Affect than the O1 through O2 group (Tukey HSD $CV_{.05} = 3.06$; $Dm = 3.5$) and the O3 group (Tukey HSD $CV_{.05} = 3.06$; $Dm = 4.1$).

Life Threat Rating

The Life Threat ratings in Figure 13 represent the soldiers' evaluation of the life-threatening nature their duties. A clear distinction is made between the Life Threat ratings of the enlisted soldiers and those of the officers. Both enlisted groups rated the nature of their duties as more life threatening than either of the officer groups. The Life Threat ratings of the E1s through E3s were significantly higher than the ratings of the O1 through O2 group (Tukey HSD $CV_{.05} = 11.71$; $Dm = 15.9$) and the O3 group (Tukey HSD $CV_{.05} = 11.71$; $Dm = 18.4$). The E4s through E6s reported Life Threat ratings that were significantly higher than the O1s through O2s (Tukey HSD $CV_{.05} = 11.71$; $Dm = 12.8$) and the O3s (Tukey HSD $CV_{.05} = 11.71$; $Dm = 15.3$).

Combat Similarities

The comments made by the soldiers in the taped debriefing interviews and their responses about specific questions on the general information questionnaire pertain to the issue of using operations such as the Yellowstone National Park fire-fighting experience as a model of combat. About 60% of the soldiers felt that the Yellowstone operation shared several common factors with combat. These included the deployment process, the sustained nature of the work, with alternating periods of intense activity and boredom, unfamiliar terrain with limited ingress and egress routes and dangerous animals, the physical strain of fire fighting and the long (10- to 14-mile) marches to and from fire-fighting sites, complications arising from communications, and the unpredictable and sometimes insuppressible nature of the fire itself. Other common factors included family separation, the need for effective leadership, teamwork, and discipline at the unit level, and the requirement to manage individual differences in stress responses.

DISCUSSION

The psychological measures used to evaluate the stress experience illustrated a discriminant sensitivity to the type of stress in this field situation compared to the other surgical stress, examination stress, and competitive weapon-firing situations. For example, the different subscales of the MAACL-R seem to be sensitive to the particular situation being measured, with relatively high Anxiety scores for the Surgical group, relatively high

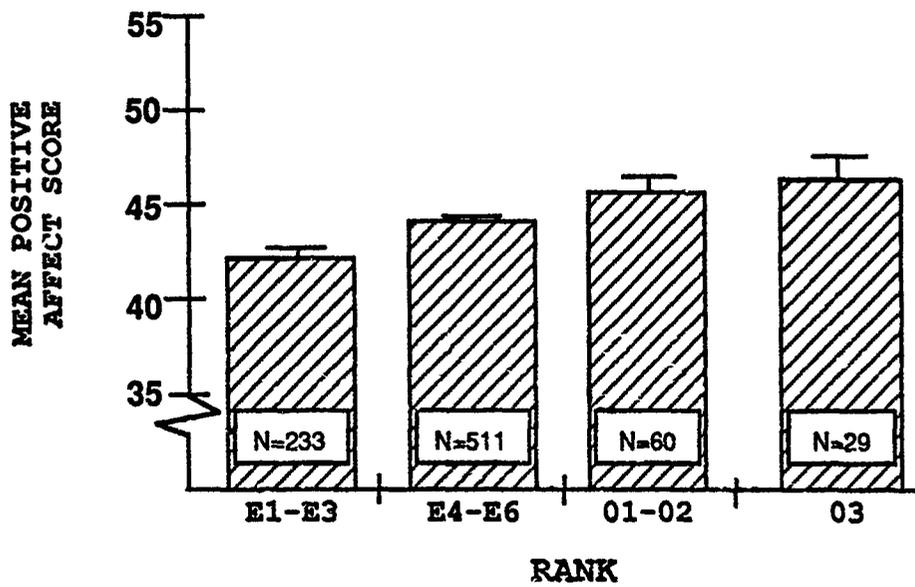


Figure 12. Mean MAACL-R Positive Affect scores according to rank.

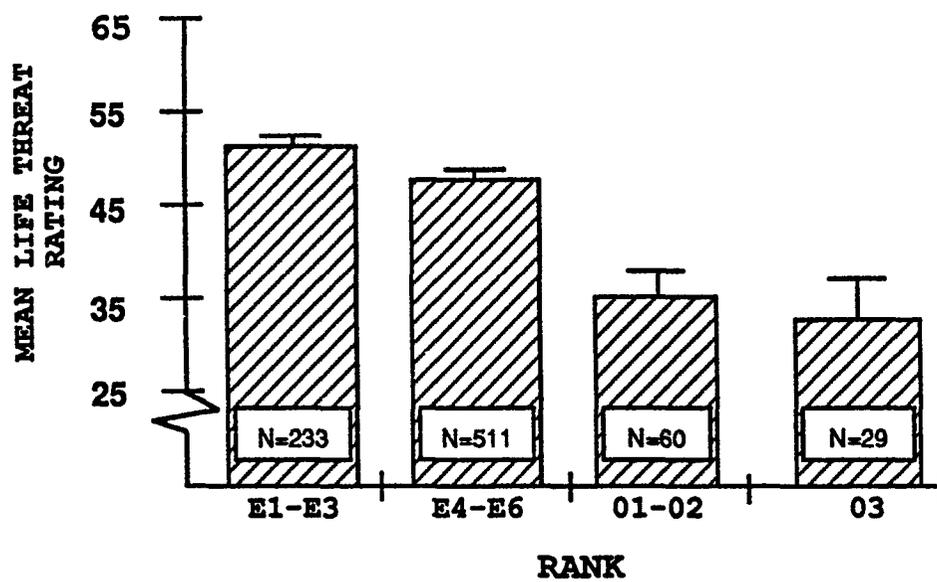


Figure 13. Mean Life Threat ratings according to rank.

Sensation Seeking scores for the military weapon firing in the Salvo Stress groups, and relatively high Hostility scores for soldiers in both the Salvo Stress Competition group and the Yellowstone fire fighters. The measures also distinguished between variations in the stress levels within the military rank structure. Overall, the fire fighters experienced moderate to high stress levels, as assessed in previous reports (Fatkin et al., in press), with particularly high scores on the MAACL-R Depression and Hostility subscales. The scores on the two state anxiety measures (SRE and MAACL-R Anxiety) seem to reflect the overall stress experience of the situation (i.e., the uncertainty and unpredictability), while the depression and hostility measures reflect a more personal sense of failure and frustration (Zuckerman, personal communication, April 3, 1989).

As discussed earlier, the fire-fighting operation had several common factors with combat. Tasks such as digging a 4,000-foot-long fire line to slow the fire's advance assumed a critical sense of urgency (Miles, 1988; Ross, 1989). Motivation to succeed and to save a national treasure was a primary driving force. The soldiers knew that if they could not complete their mission, homes would be lost and property destroyed (Interviews, 1988; Jeffery, 1989). The fire-fighting operation also provided an excellent opportunity for on-the-job leadership training. There was a vital need, particularly for junior leaders, to react quickly to unexpected changes in the situation and to treat the fire as an unpredictable enemy (Bogino, 1988; Ross, 1989).

An examination of the After Action Review and Report produced by the Joint Task Force, Yellowstone, allowed for a comparison of the Yellowstone disease and non-battle injury (DNBI) rate with historical and training exercise data (Mathur, 1989). The Yellowstone DNBI rates are considerably higher than training exercise DNBI rates. For example, Mathur (1989) reports that casualty data collected during two training exercises of the 40th Division of the California National Guard at Fort Irwin, California (Irwin I and Irwin II) reflected DNBI rates (1000 per day) of 15.04 for Irwin I and 17.10 for Irwin II, compared with 31.39 for Yellowstone during the fierce fire fighting days (4 September through 12 September) and 22.32 for the total operation (24 August through 23 September). The DNBI hospital admission rates (1000 per day) for Irwin I and Irwin II are 0.24 and 0.26, respectively, while the Yellowstone rates are 1.32 (4 September through 12 September) and 1.44 (24 August through 23 September). This suggests that the cost in terms of manpower or lost duty time may have been higher for the Yellowstone mission than for other standard field exercises. In addition to the noticeable health risks involving smoke inhalation and sinus-related problems, these statistics may reflect lost duty time related to the physical strain of fire fighting and the sustained nature of the work, discussed earlier as characteristics similar to combat situations.

The significant differences between the soldiers grouped according to their rank demonstrated that the junior enlisted soldiers rated the Yellowstone mission more stressful and life-threatening than did any other group. This finding could suggest that the nature of their duties was sufficiently different from the other ranks to warrant such reports. According to the debriefing interviews and written comments on the general information questionnaire, however, it is also highly probable that issues unrelated to the life-threatening nature of the mission (e.g., rapid deployment, leadership, and communication) influenced the soldiers' perception of the situation. Written comments about identical issues in the Army Research Institute (ARI) questionnaires addressed soldiers' concerns about the organization of activities by supervisors. Soldiers reported that the general

lack of reliable information provided to the troops, poor communications up and down the chain of command, and inconsistent activity plans were major contributors to their distress (Van Nostrand et al., 1989).

The soldiers received realistic deployment training, that is, deploying on short notice (less than 48 hours to complete their preparation routines) into unknown areas. Many found it difficult to manage conflicting information, particularly regarding their expected length of stay; they believed this was crucial information that could have helped them resolve at least one uncertainty. Many had to phone home and explain conflicting reports to their spouses. One commander involved in fighting the Canyon Creek fire stated that when he received information concerning his stay at Yellowstone, he informed his wife, "... so the *chain of concern* could respond to rumors .." (Ross, 1989, p.7).

Soldiers from different battalions reported that they repeatedly received conflicting reports about their departure date, sometimes two or three times within one day. They indicated that the inconsistent communication from the chain of command was a major stressor for them and was the primary cause of the frustration. Ensuring that unit members receive accurate and timely information is a critical factor in minimizing the effects of combat-like stressors and should not be taken lightly (Chermol, 1983; Department of the Army, 1983). Based on an analysis of the effects of battle threats and strains on World War II Army Air Force combat fliers, Grinker & Spiegel (1963) emphasized the role of leadership. They stated that the quality of leadership in the context of the maintenance of the spirit of self sacrifice in the fighting troops is the most important single factor in success in battle, "...more important, for example, than equipment, training, freshness or advantage of terrain" (p. 45). The Yellowstone fire fighters were provided with the necessary materials to get the job done (food, shelter, and proper equipment), yet they did not believe that they had leadership support or interest in their expressed concerns. Their dissatisfaction and frustration is reflected most specifically in the high Hostility levels of the junior enlisted soldiers. Much physical discomfort, for example, can be withstood if the soldiers believe that everything possible is being done for them. "But, if it becomes known or suspected that the poor living conditions are due to someone's stupidity, inefficiency, or lack of interest, the men develop intense resentment" (Grinker & Spiegel, 1963, p. 48).

This is an important reinforcement for leaders concerned with maintaining high morale within the unit and with enhancing the capabilities of the unit's members under stress. Field experiences, such as the fire fighting, and other formal training exercises provide opportunities for soldiers to develop a sense of self-confidence in their ability to perform effectively under stress. Leaders can make a significant contribution to effective troop performance by encouraging attitudes of self-efficacy and hope about a successful outcome with related expectations that make for perceived control (Dohrenwend, 1985). The vast differences in reports of depression and hostility among the different ranks suggest a need for more attention to be devoted to this issue.

CONCLUSIONS AND RECOMMENDATIONS

The stress perception measures used in the evaluation of the Yellowstone fire-fighting mission proved to be well-suited for the accomplishment of the study objectives. Based on the soldiers' responses on the SRE and the five

subscales of the MAACL-R, the soldiers reported their overall experience as being relatively stressful. A comparison of their responses in this field situation with profiles obtained from the Surgical, Examination, and Salvo Stress studies, as well as with their respective control groups, indicated that these soldiers may have been more stressed than participants in the other experimental groups in several respects. For example, the fire fighters reported the highest ratings on the Hostility subscale and the lowest ratings on the Positive Affect subscale obtained to date. Their scores on these subscales were significantly different from most of the other groups (including the controls) and were similar only to those obtained from the Salvo Stress soldiers.

Although no significant differences on the SRE and the MAACL-R resulted from actual fire-fighting experience, the measures revealed significant differences in the stress levels reported within the military rank structure. The junior enlisted soldiers rated the Yellowstone mission more stressful and life-threatening than did any other rank group participating in the operation. As discussed earlier, issues not directly related to the soldiers' fire-fighting duties may account for these differences. These include the rapid deployment, leadership concerns, and communication up and down the chain of command. Another possibility is that insufficient experience in managing the variety of concerns that surfaced during the Yellowstone mission may also have contributed to the high stress ratings of the junior enlisted soldiers.

The third objective was to assess the suitability of the instruments for use in future evaluations of situations similar to the Yellowstone mission. Based on this experience, methodological improvements are suggested to prepare for future opportunities to study soldiers in similar potentially stressful operations: (a) baseline measures would be obtained if possible; (b) measures would be administered as close to the stress event as possible; (c) repeated measures would be obtained when feasible; and (d) objective measures of performance would be obtained whenever possible.

Experiences to date suggest that much valuable combat-related information relevant to the behavior and performance of soldiers and their leaders can be collected in situations such as that offered by the 1988 Yellowstone fires. Unlike most training exercises, these situations involve real hazards, real dangers, and real consequences in a real world setting. The fire, unlike a human enemy, is neither alive nor is it motivated to defeat the soldiers; yet it is, nonetheless, a dangerous, unpredictable, and sometimes insuppressible foe. These findings further suggest that it is advisable to maintain a team prepared to collect data from soldiers in situations analogous to the Yellowstone operation. With the addition of performance data to the collection effort, such undertakings could provide a steady flow of valuable information about human performance in operational settings.

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APPENDIX

YELLOWSTONE STRESS EVALUATION PACKET

Volunteer Agreement Affidavit
General Information Questionnaire
Multiple Affect Adjective Check List-Revised
Specific Rating of Events

VOLUNTEER AGREEMENT AFFIDAVIT

For use of this form, see AR 70-25, the proponent agency is OTSG

PRIVACY ACT OF 1974

- Authority:** 16 USC 3013, 44 USC 3101, and 10 USC 1071-1087.
- Principle Purpose:** To document voluntary participation in the Clinical Investigation and Research Program. SSN and home address will be used for identification and locating purposes.
- Routine Uses:** The SSN and home address will be used for identification and locating purposes. Information derived from the study will be used to document the study, implementation of medical programs; adjudication of claims, and for the mandatory reporting of medical conditions as required by law. Information may be furnished to Federal, State and local agencies.
- Disclosure:** The furnishing of your SSN and home address is mandatory and necessary to provide identification and to contact you if future information indicates that your health may be adversely affected. Failure to provide the information may preclude your voluntary participation in this investigational study.

PART A(1).- VOLUNTEER AFFIDAVIT

Volunteer Subjects In Approved Department of the Army Research Studies

Volunteers under the provisions of AR 40-38 and AR 70-25 are authorized all necessary medical care for injury or disease which is the proximate result of their participation in such studies.

I, _____, SSN _____, having full capacity to consent and having attained my _____ birthday, do hereby volunteer/give consent as legal representative for _____ to participate in _____

HEL Stress Evaluation
(Research Study)

under the direction of Maj James M. King, AV 298-5982

conducted at Yellowstone National Park and Ft Lewis, WA
(Name of Institution)

The implications of my voluntary participation/consent as legal representative; duration and purpose of the research study; the methods and means by which it is to be conducted; and the inconveniences and hazards that may reasonably be expected have been explained to me by

Maj James M. King, HEL, SLCHE-BR, APG, MD 21005-5001

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights/the rights of the person I represent on study-related injury, I may contact

Name at hospital on site will be provided

at _____
(Name, Address and Phone Number of Hospital (include Area Code))

I understand that I may at any time during the course of this study revoke my consent and withdraw/have the person I represent withdrawn from the study without further penalty or loss of benefits; however, I/the person I represent may be required (military volunteer) or requested (civilian volunteer) to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my/the person I represent's health and well-being. My/the person I represent's refusal to participate will involve no penalty or loss of benefits to which I am/the person I represent is otherwise entitled.

PART A (2) - ABSENT VOLUNTEER AFFIDAVIT (MINOR CHILD)

I, _____, SSN _____, having full capacity to consent and having attained my _____ birthday, do hereby volunteer for _____ to participate in _____

(Research Study)

under the direction of _____

conducted at _____

(Name of Institution)

(Continue on Reverse)

PART A(2) - ASSENT VOLUNTEER AFFIDAVIT (MINOR CHILD) (Cont'd.)

The implications of my voluntary participation; the nature, duration and purpose of the research study; the methods and means by which it is to be conducted; and the inconveniences and hazards that may reasonably be expected have been explained to me by

I have been given an opportunity to ask questions concerning this investigational study. Any such questions were answered to my full and complete satisfaction. Should any further questions arise concerning my rights I may contact

at

(Name, Address, and Phone Number of Hospital (Include Area Code))

I understand that I may at any time during the course of this study revoke my assent and withdraw from the study without further penalty or loss of benefits; however, I may be requested to undergo certain examination if, in the opinion of the attending physician, such examinations are necessary for my health and well-being. My refusal to participate will involve no penalty or loss of benefits to which I am otherwise entitled.

PART B - TO BE COMPLETED BY INVESTIGATOR

INSTRUCTIONS FOR ELEMENTS OF INFORMED CONSENT: *(Provide a detailed explanation in accordance with Appendix E, AR 40-38 or AR 70-26)*

1. The purpose of this study is to evaluate stress level related to your mission at Yellowstone National Park.
2. You will be asked to complete a set of surveys. Should you decide not to complete them, you may do so at any time without penalty.
3. There is no risk associated with completing these surveys.
4. All responses and your identity will be kept confidential.

I do do not *(check one & initial)* consent to the inclusion of this form in my outpatient medical treatment record.

SIGNATURE OF VOLUNTEER	DATE	SIGNATURE OF LEGAL GUARDIAN <i>(if volunteer is a minor)</i>	
PERMANENT ADDRESS OF VOLUNTEER	TYPED NAME OF WITNESS		
	SIGNATURE OF WITNESS		DATE

REVERSE OF DA FORM 5303-R, MAY 88

GENERAL INFORMATION QUESTIONNAIRE

NAME _____ DATE OF BIRTH _____

PRIMARY MOS _____ SEX _____ RANK _____

LENGTH OF SERVICE _____ EDUCATION LEVEL _____
(years) (months)

UNIT _____
Company/Battalion

SITUATION DESCRIPTION

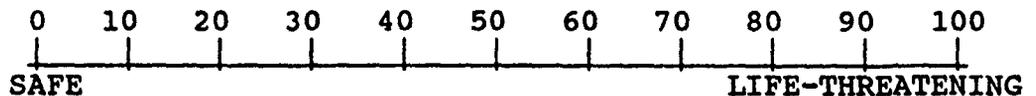
1. What were your actual duties during this fire fighting operation? Please be as specific as you can:

2. How much sleep did you get in the last 24 hours? _____

3. Is this fire fighting operation the current major stress in your life? ___ YES ___ NO

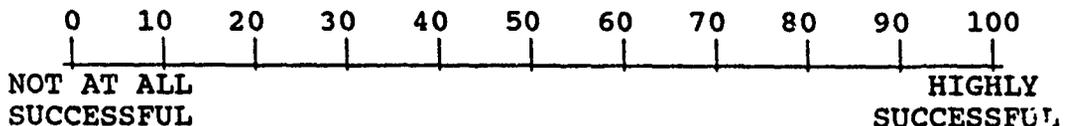
4. Did you feel you were in a life-threatening situation? ___ YES ___ NO

Using the scale below, place a check mark (✓) on the line to indicate how you would rate your actual duties:



5. How successful did you feel about getting the job done?

Using the scale below, place a check mark (✓) on the line to indicate how successful you felt:

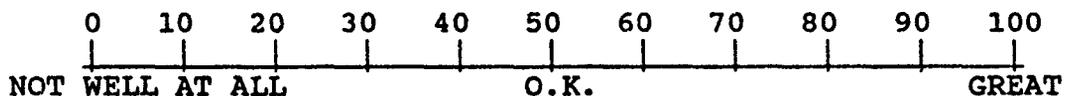


6. What types of problems did you encounter?

7. How does this compare to your idea of a combat situation?

8. How well do you think you coped with the fire fighting experience?

Using the scale below, place a check mark (✓) on the line to indicate how well you coped:



9. Some people find certain things helpful in dealing with stressful situations, like:

- talking to others who are in the same situation,
- thinking of other thoughts, like when this would be over,
- sleeping whenever possible,
- etc...

Please describe the things you did to help you get through this entire experience:

10. In addition to what you just listed in the previous question, what would you have found helpful in helping you get through this entire experience?

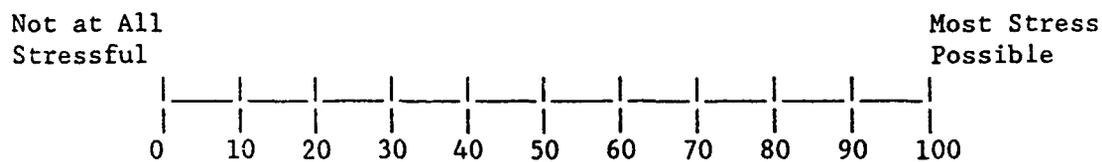
Multiple Affect Adjective Check List-Revised
(Zuckerman & Lubin, 1985)

Standardized forms are available to qualified persons from the publisher:
Educational and Industrial Testing Service (EdITS)
Box 7234
San Diego, California 92107

Specific Rating of Events

1. The scale below represents a range of how stressful an event might be. Put a check mark touching the line (✓) to indicate where you rate the fire fighting experience.

STRESS SCALE



2. At what number value does the check mark touch the line? _____