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Subjective Fatigue in A-6, F-14, and F/A-18 Aircrews During Operations Desert Shield and Storm

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Fatigue occurring during naval air combat can reduce performance, impair operational effectiveness, and compromise safety. This study examines the effect of combat missions on the subjective fatigue of naval aircrews deployed aboard USS AMERICA during Desert Shield and Desert Storm. Fatigue was determined using three questionnaires that were completed before and after each mission. Although fatigue significantly increased during combat missions, it usually returned to preflight levels by the next day without noticeably increasing as the operation progressed. We feel that judicious aircrew scheduling on the part of operational planners was one of the most important factors contributing to this result. To minimize fatigue during naval air combat operations, we recommend that, as resources permit, "no-fly" days be regularly scheduled, only one or two missions should be scheduled per day, and adequate crew rest should be planned between missions.

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SUMMARY PAGE

THE PROBLEM

Fatigue resulting from naval air combat can impair performance and operational effectiveness, and compromise mission safety. However, there have been no recent opportunities to study the problem under actual combat conditions. As a result, the current literature is confined to laboratory studies of simulated air combat scenarios and field investigations conducted during controlled fleet exercises. To study fatigue under combat conditions, we queried naval aircrews deployed aboard USS AMERICA during Operation Desert Shield and Operation Desert Storm.

FINDINGS

While fatigue did not change during missions flown in Desert Shield, it increased significantly during missions flown in Desert Storm. An examination of preflight fatigue scores demonstrated that fatigue did not appear to accumulate during the conflict. That is, although fatigue increased significantly during combat missions flown in Desert Storm, it usually returned to preflight levels by the next day and did not appreciably increase as the operation progressed.

We feel that judicious tasking on the part of operational planners was one of the most important factors contributing to this finding. Air combat operations aboard AMERICA appear to have been well managed during Desert Storm. As a result, aircrew fatigue remained minimal.

RECOMMENDATIONS

As resources permit, specific recommendations for future naval air combat operations are supported by this study.

1) Schedule "no-fly" days regularly. The cycle followed by the AMERICA was 4 days of operational tasking followed by 2 "stand-down" days.
2) Schedule only one mission per day. If a second mission must be scheduled, it should be a less stressful one. For example, an A-6 strike mission could be followed by a short-duration, local tanker mission.
3) Allow adequate crew rest between missions (i.e., follow NATOPS crew rest recommendations). This will normally be the case if aircrews are limited to one or two missions per day.

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INTRODUCTION

Fatigue has long been a factor in the aviation environment. Several studies have been undertaken to determine the extent of the problem. In one survey of U.S. pilots (1), 93% of respondents reported that fatigue was a problem, and 85% said they had felt "extremely tired or washed out" sometime during the previous 30 days. Analysis of NASA Aviation Safety Reporting System data from 1976-1980 (2) revealed that 21% of air transport crew errors were either directly or indirectly attributed to fatigue and that fatigue-associated decrements in performance resulted in substantially unsafe flying conditions. These broad surveys underscore the pervasiveness of fatigue in aviation.

Fatigue also has far reaching operational consequences for the aviation community. It can result in reduced reaction time, decreased vigilance, perceptual and cognitive distortions, and adverse mood changes (3). These alterations can lead to degraded performance, productivity, safety, and mission effectiveness (3-5). Several studies on the effects of fatigue in aviation have indicated that fatigue can interfere with aviation performance. Fatigued pilots have been shown to make larger control errors, they are less accurate in executing coordinated maneuvers, and they are more likely to ignore flight instruments (6). In a study to measure flight performance in helicopters (7), pilots who flew one 4-h low-level mission a day for 4 days allowed rotor speed to vary within wider limits, and control movements to increase in amplitude with flight time. Information processing threshold and the ability to perform flight maneuvers decreased while subjective fatigue increased with flight time in a study of fatigue during simulated long-duration flights (5). In an investigation of aviator performance during extended flight operations in a helicopter simulator (8) pilots made serious cognitive and judgmental errors such that monitoring flight surgeons felt that they were unsafe to fly by the third night.

Fatigue has also been implicated as a factor in many aircraft accidents costing millions of dollars and hundreds of lives each year. Borowsky and Wall (9) reported that U.S. Navy fighter and helicopter pilots who had worked at least 10 h in the previous 24 were significantly more likely to have a mishap. Krueger and Jones (10) surveyed U.S. Army aviation accident data from 1971 to 1977. They found pilot fatigue to be a contributing factor in 4.1% of U.S. Army aviation accidents, over 8% of aviation-related fatalities, and over 6% of aviation-related injuries, representing 4.8% ($10.23 million) of all material losses during the period.

Military flying is often much more stressful than commercial flying (11). The naval aviation environment is uniquely stressful and unforgiving of error. Naval aircrews are constantly exposed to high levels of noise, heat, and vibration. Flying off a carrier, often during inclement weather at night, requires complex psychomotor coordination, high rates of information processing, and precise, high-speed decision making. Long periods of vigilance are necessary in a relatively monotonous environment. With the additional stressors of armed conflict, such as fear and sleep loss, a temporary response known as combat fatigue may result (11). The overall incidence of combat fatigue has been reported to range from 10 to 54% of all combat casualties (12). Combat fatigue is important because it could undermine naval operations. Aircrews could become fatigued earlier in a conflict than would normally be anticipated, and unable to fly the number of missions expected of them.

Subjective methods have been used extensively by researchers to study fatigue in aviation (5,13-18) and in military operations in general (19,20). Some authors describe fatigue subjectively because of the difficulty in defining it in other terms. Holding (21) regarded fatigue as a hypothetical construct similar to hunger. Nicholson and Stone (4) defined fatigue as a subjective appreciation of tiredness that they felt was more important than a decrement in performance. Hart and Hauser (16) reported that pilots' opinions could be the most sensitive and accepted estimates of mental workload and fatigue.

Subjective fatigue has been shown to accurately reflect aircrew workload. In a study conducted by the NASA Kuiper Airborne Observatory (16), subjective fatigue increased significantly from take-off to landing on all flights. In addition, subjective fatigue has been found to correlate well with other aspects of the aviation experience. Chidester (14) found that airline pilots experienced a decline in positive mood, an increase in negative mood, and an increase in reported fatigue over the course of normal multi-day trips. After studying the effects of the cockpit environment on long-term pilot performance, Stave (22) reported that the occurrences of mental lapses, resulting in abnormally poor pilot performance, correlated with self-ratings of fatigue. In a study to quantify sleepiness, Hoddes et al. (23) described how Stanford Sleepiness Scale ratings were highly correlated with performance. Pirelli (5) found that subjective fatigue and sleepiness reports of U.S. Air Force pilots flying simulated long-duration missions were significantly correlated with performance of aviation related tasks. More recently, we have found subjective fatigue to vary similarly with cognitive performance while studying the effects of stimulants on subjective fatigue during simulated sustained flight operations (24).

There is an urgent need for continued study of fatigue in aviation, especially in the air combat environment, because of the prevalence of the problem and its potential for severe consequences. Aviation researchers have been concerned about the impact of demanding flight schedules on aircrews for some time. The U.S. Navy has shown a special interest in combat fatigue during sustained operations. In 1988, the U.S. Naval Medical Research and Development Command approved Medical Requirement Number 20 to research and assess the effects of repeated episodes of continuous work/rest/sleep schedules on performance. In response to Medical Requirement Number 20, the Naval Aerospace Medical Research Laboratory has been investigating the effects of sustained naval flight operations on fatigue and performance. As part of this investigation, we collected data on U.S. naval aircrews aboard USS AMERICA involved in Operations Desert Shield and Desert Storm. This paper reports their subjective fatigue responses during these operations.

The purpose of this study was twofold: to investigate the effect of combat missions on fatigue, and to validate the three subjective questionnaires under combat conditions. We elected to use subjective methods because of their acceptance by the research community, their ability to accurately reflect aircrew workload and fatigue, and their established correlation to aircrew performance.

METHODS

SUBJECTS

Thirty-nine male naval aircrew members, age 24-37, volunteered to participate in a study to investigate the effect of combat missions on subjective fatigue, while deployed aboard USS AMERICA during Operations Desert Shield and Desert Storm. Subjects were U.S. naval officers ranging in rank from ensign to commander. Of these, 27 were pilots and 12 were Naval Flight Officers (NFOs) from three different squadrons: VA-85 (A-6 aircraft), VF-102 (F-14 aircraft), and VFA-82 (F/A-18 aircraft). Naval Flight Officers assigned to A-6 aircraft were bombardier/navigators (B/Ns), while those assigned to F-14s functioned as radar intercept officers (RIOs). Table 1 summarizes the distribution of subjects by aircrew position.

TABLE 1. *Distribution of Subjects by Aircrew Assignment.*

Squadron	VA-85		VF-102		VFA-82
Aircraft	A-6		F-14		F/A-18
Crew Position	Pilots	B/Ns	Pilots	RIOs	Pilots
Number	6	5	4	7	17

The crew and mission of each aircraft varied (25). The A-6 Intruder has a crew of 2: pilot and B/N. A-6 missions during the conflict included mostly night bombing raids, and tanker flights. F-14 Tomcat aircrews include a pilot and RIO. Tomcats flew fighter escort and combat air patrol (CAP) missions. F/A-18 Hornets are single piloted aircraft with close-air-support, air-to-air, and light-attack missions.

RESEARCH DESIGN

The USS AMERICA departed Norfolk, Virginia, for the Red Sea on 28 December 1990. During the transit, each squadron was briefed on the design and purpose of the study, and volunteers were recruited. Following their recruitment, volunteers were given additional details about the study and precise instructions for completing the questionnaires. Data collection began on 12 January and Operation Desert Storm commenced five days later on 17 January. Data collection continued until 3 February, covering approximately 36% of Operation Desert Storm.

Subjects were given a supply of printed forms each of which contained three subjective fatigue questionnaires: the Addiction Research Center Inventory (ARCI), the Mood Questionnaire (MQ), and the Stanford Sleepiness Scale (SSS). There were two identical versions of the form, one labeled "Preflight" and the other labeled "Postflight." Subjects were instructed to fill out the "Preflight" version as close to actual take-off time as possible and the "Postflight" version as close to recovery time as feasible. Subjects were requested to answer questions as they applied when the form was completed.

QUESTIONNAIRES

Fatigue Scale from the Addiction Research Center Inventory (ARCI)

The ARCI Fatigue Scale used in this study was an adaptation of the one originally developed by Heartzen (26) and later expanded by Martin et al. (27). The complete ARCI has 10 scales. We used the PCAG (phentolamine, chlorpromazine, and alcohol "G") scale which reflects subjective feelings of fatigue. Our version of the PCAG scale contained an additional statement.

Fifteen statements from the ARCI Fatigue Scale were listed on the questionnaire. Subjects were instructed to circle the statement if it applied to them at that time. Scores could range from 0 (no fatigue) to 15 (maximum fatigue). Appendix A includes a list of the ARCI Fatigue Scale statements. The final statement (number 15) was added for this study.

Stanford Sleepiness Scale (SSS)

The SSS is a self-rating scale used to quantify degrees of sleepiness (28). To correlate subjective sleepiness ratings with performance, Hoddes et al. (23) evaluated the relationship between subjective sleepiness ratings and decrements in performance on mental tasks after sleep loss. They found that sleepiness, as measured by the SSS, increased following sleep deprivation. In addition, the SSS ratings were highly correlated with performance on tasks that were sensitive to moderate amounts of sleep loss.

The seven statements of the SSS were listed on the questionnaire. Subjects were instructed to circle the statement that best described their present state of sleepiness. Scale values could range from 1 (wide awake and alert) to 7 (ready to fall asleep). See Appendix B for a list of the SSS statements and their scale values.

Fatigue Scale from the Mood Questionnaire (MQ)

The MQ (29) as revised by Ryman et al. (30) is an abbreviated test to measure the subjective states of individuals in a form suitable to field research. The questionnaire, which consists of six scales including

happiness, activity, depression, fear, anger, and fatigue, has been validated using several objective performance criteria. For example, Biersner et al. (31) found a significant correlation between scores on the Happiness and Activity scales and success in a 6-week strenuous physical training course. In another study, Radloff and Helmrich (32) found these scales to be the best predictors of aquanaut performance on SeaLab II. In addition, McHugh et al. (33) have shown that the Fear Scale was negatively associated with pilots' landing performance following a mission.

Each questionnaire listed the five adjectives from the MQ Fatigue Scale. Subjects were instructed to indicate how each word applied to them by using a three-choice response format (1 = not at all, 2 = somewhat or slightly, 3 = mostly or generally). Scores could range from 5 (no fatigue) to 15 (generally fatigued). A list of the MQ Fatigue Scale adjectives is contained in Appendix C.

DATA ANALYSIS

All scales were ordinal in nature. For example, ARCI Fatigue Scale measurements could range from 0-15. An ARCI score has no verbal description associated with it. Unlike interval and ratio scales, the difference between an ARCI score of 5 and an ARCI score of 6 is undefined, and a score of 10 does not necessarily represent twice as much fatigue as a score of 5. In addition, the scores were not normally distributed for any of the scales. This made it necessary to analyze the data using nonparametric statistical methods (34). The Wilcoxon Signed Ranks Test (35) is an appropriate method. The Wilcoxon Signed Ranks Test is a nonparametric, distribution-free test for matched samples. If a group of subjects is measured under two sets of conditions (i.e. preflight and postflight) the Wilcoxon test can be used to test the null hypothesis that the population distributions are identical.

Field studies often lack the tight controls that are generally present in most laboratory investigations. This was also true in our study. It would have been ideal if each subject had contributed approximately the same number of questionnaires. Unfortunately, this was not the case. Although each squadron was given identical recruitment presentations and instructions, not all subjects cooperated equally. Some subjects completed only one or two questionnaires, while others completed one nearly every time they flew. If all questionnaires were weighted equally, the results would have been strongly biased by those subjects who completed the greatest number of questionnaires. To compensate for this problem, we used the median score for each subject in the data analyses. The median is the appropriate measure of central tendency because the data are discontinuous, ordinal in nature, and are not normally distributed.

RESULTS

Accumulation of Fatigue During the Operation

To examine changes in fatigue during the conflict, each subject's median preflight scores for the ARCI, MQ, and SSS are plotted as a function of study days in Fig. 1. Only preflight scores are plotted to reduce the effect of missions. Median fatigue/sleepiness scores are plotted along the vertical axis, while the days of the study are plotted along the horizontal axis. The study began on 12 January (day 1) and continued through 3 February (day 23). A vertical line at 17 January (day 6) represents the commencement of hostilities and separates Operation Desert Shield from Operation Desert Storm.

Preflight fatigue scores did not appear to change appreciably during the conflict for any of the scales. With one exception, there were no reports of extreme fatigue, and most of the data were closely grouped. For the ARCI, more than 2/3 of the median preflight fatigue scores were between 2 and 6, while greater than 2/3 of the MQ data occurred between 5 and 7, and approximately 2/3 of the SSS measurements were between "not at full alertness" and "alert, wide awake." The exception, denoted by asterisks in Fig. 1, was an A-6 pilot who flew from 2100 on 24 January until 0400 on 25 January (7 1/2 h). Following this flight, he

debriefed for 30 min. He then completed the preflight questionnaire, reporting an ARCI score of 12, an MQ score of 15, and an SSS score of 6. After this mission, he flew another 6-h mission. His postflight scores (not shown in Fig. 1) following the 6-h mission were 13, 15, and 7 for the ARCI, MQ, and SSS, respectively.

The least square regression lines appear to be low. This is because some points represent more than one subjects' median fatigue score. As an example, many subjects reported minimum fatigue scores (5 out of a possible 15) for the MQ Fatigue Scale (Fig. 1b) which caused the regression line to appear lower than the data points would indicate if each one represented only one subjects' median score.

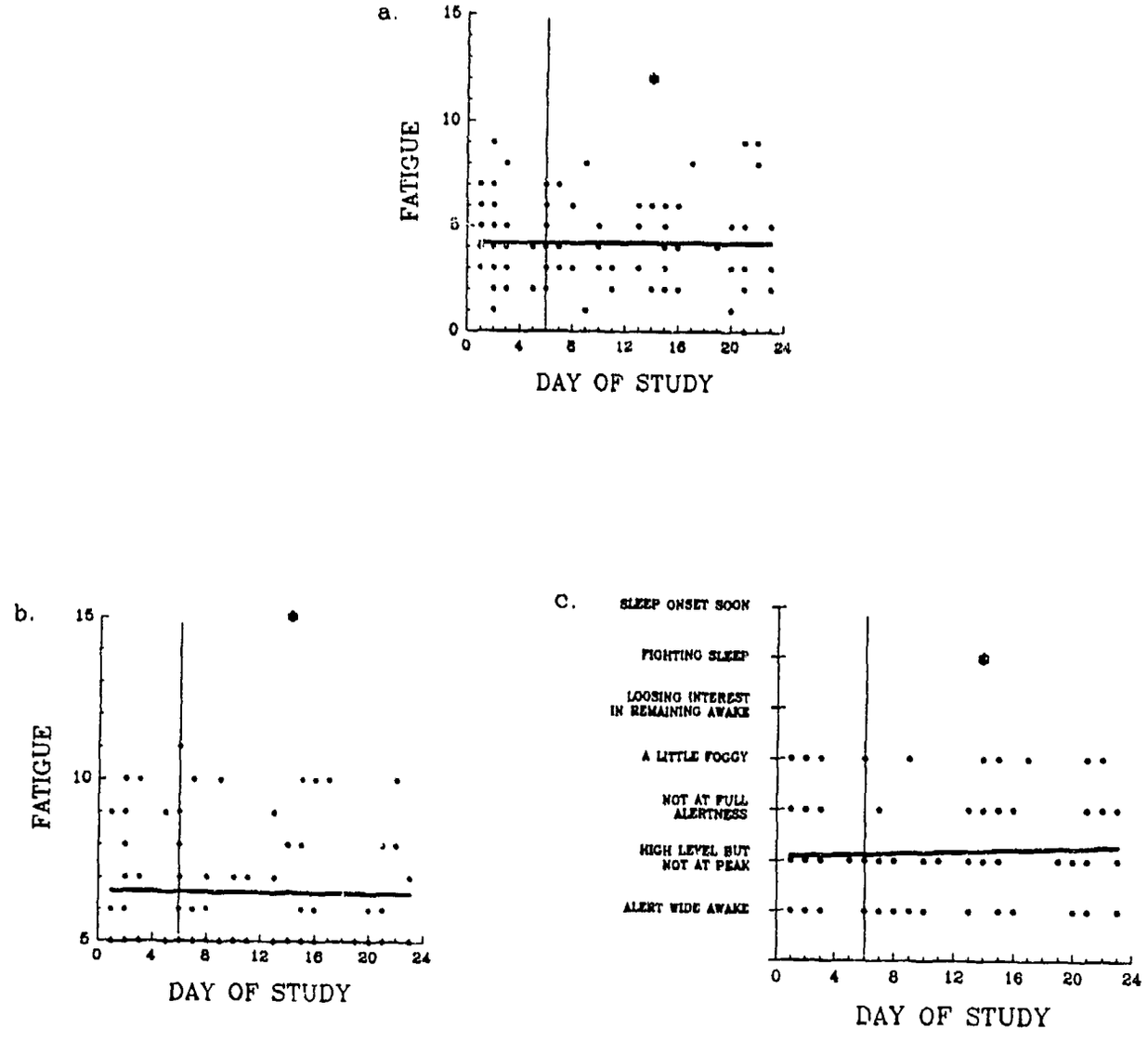

Figure 1. *Median preflight scores. ARCI (a), MQ (b), and SSS (c). Some points represent multiple subjects. The asterisks represents an A-6 pilot that reported exceptional fatigue.*

Fatigue During Missions

To determine if fatigue changed as a result of missions, a Wilcoxon Signed Rank Test (35) was performed on the ARCI, MQ, and SSS median scores. Separate Wilcoxon tests were performed on data from Operation Desert Shield and Operation Desert Storm to ascertain differences in reported fatigue between missions flown prior to and during combat.

The results of the Wilcoxon tests are summarized in Table 2. Reported fatigue scores increased significantly between pre- and postflight for Operations Desert Shield and Desert Storm combined. This was true for each scale. There were no reported pre-post differences during Operation Desert Shield. However, all scales showed significant increases in reported fatigue between pre- and postflight during Operation Desert Storm.

TABLE 2. *Summary of Wilcoxon Signed Ranked Test Results.*

Group	Test	Number of Times Post > Pre	Number of Times Post < Pre	Number of Times Post = Pre	*p*
Desert Storm & Shield	ARCI	12	5	9	<.01
	MOOD	15	4	7	<.01
	SSS	13	5	8	<.05
Desert Shield	ARCI	5	2	6	NS
	MOOD	5	3	5	NS
	SSS	5	4	4	NS
Desert Storm	ARCI	7	3	3	<.05
	MOOD	10	1	2	<.01
	SSS	8	1	4	<.01

DISCUSSION

Plotting the median fatigue/sleepiness pre-flight scores across days allowed us to determine changes in fatigue during the operation while minimizing the effect of the missions flown. Examination of the plots (Fig. 1) reveals that fatigue/sleepiness did not appear to accumulate during Desert Shield or Desert Storm. These results imply something of the conduct of air operations aboard USS AMERICA during the conflict. Air combat operations appear to have been well managed, preventing an appreciable accumulation of fatigue as the operation progressed.

Of the many factors that could have influenced the accumulation of fatigue, we feel strongly that one of the most important is level of tasking. Fortunately, there was a strong naval presence during the Gulf War. Six aircraft carriers were involved in the conflict at the time of this study. Three were stationed in the Red Sea and three in the Persian Gulf. This would have been a formidable show of force in any conflict, however, these naval forces were complimented by the army and air forces from several nations. During the Red Sea portion of the deployment, the AMERICA would typically be stationed in the "Southern Box" for 2 days and the "Northern Box" for 2 days. During this 4-day period, aircrews were routinely tasked with operational missions. Following this period, the AMERICA would retire to "Gasoline Alley" for two days

where it would refuel and replenish supplies, and the aircrews would not normally be tasked to fly operational missions. This 6-day cycle does not appear to have resulted in an accumulation of fatigue.

Our data suggest that flight operations during Operation Desert Storm were more fatiguing than flight operations during Operation Desert Shield. This difference could be due to combat stress. There are, however, differences in the Desert Shield and Desert Storm data, other than the presence or absence of combat stress alone, that could have affected the results. Differences existed in the time of day the missions were flown, the length of the missions, and the types of aircraft involved. Unfortunately, the data insufficient are to divide into subpopulations, such as type of aircraft, and still make meaningful comparisons.

Figure 2 shows the distribution of flights by time-of-day for the ARCI. Similar distributions were found for the MQ and SSS but are not be discussed here. Time of day is plotted along the horizontal axis by quartiles, while the percentage of flights is plotted along the vertical axis. The mean flight time for missions flown during a particular quartile appears above its respective bar. Desert Shield results are represented by filled bars, while Desert Storm results are shown with open bars. During Operation Desert Shield, all squadrons were in a training posture. Most missions were flown during normal working hours and were of relatively short duration. For example, 50% of the missions flown during Operation Desert Shield occurred between 1201 and 1800 with a mean flight time of 2.6 h. During Operation Desert Storm, squadrons were in a combat mode. Most missions occurred at times other than the normal work day and were longer. Approximately 35% of the missions occurred between 0001 and 0600 (mean flight time 5 h). This represents a noticeable shift in mission scheduling and duration from Desert Shield to Desert Storm.

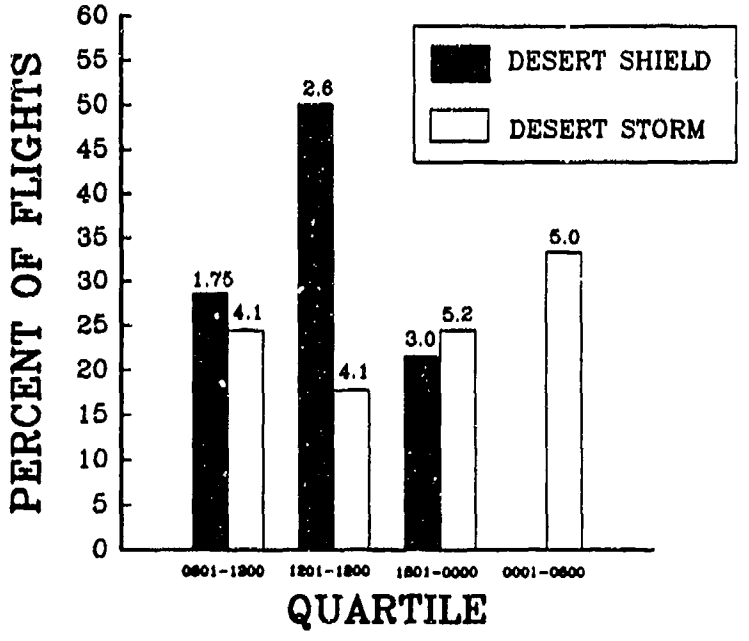

Figure 2. *Distribution of flights by time of day for the ARCI.*

Time-of-day effects could have affected mission fatigue. Circadian rhythms have been established for several physiological, biochemical, and psychological functions. Performance on many tasks has been shown to rise to a peak between 1200 and 2100 and fall to a minimum between 0200 and 0600 (4). As shown in Fig. 2, fifty percent of the missions during Desert Shield were scheduled during the 1200 to 2100 circadian peak, while only 18% of the missions during Desert Storm were scheduled during this time. Conversely, 35% of the missions during Desert Storm were flown during the 0200 to 0600 circadian trough, while no missions are shown for Desert Shield for the same period. These circadian differences could have contributed to differences in mission fatigue between Desert Shield and Desert Storm.

Mission duration is another factor that could have caused differences in reported fatigue. Fatigue has been shown to relate to flight duration and associated sleep deprivation (4,11,25,36). The mean flight duration during Desert Storm was greater than Desert Shield for each quartile in Fig. 1. It is possible that the longer operational missions during Desert Storm contributed to significant increases in reported fatigue, while the shorter training missions during Desert Shield did not.

The type of aircraft flown on a mission may have also affected reported fatigue. Aircraft type determined crew composition and size, and mission assignment. The proportion of the data contributed by different communities changed from Desert Shield to Desert Storm. During Desert Shield, most of the questionnaires were completed by F/A-18 pilots, while A-6 aircrews contributed the majority of the questionnaires during Desert Storm. This may have had little impact during Desert Shield, when missions consisted of short training flights without an enemy threat for all communities. The diversity of missions and threat experienced during Desert Storm, however, could have played a greater role. For instance, an A-6 crew on a night bombing mission might have been exposed to heavy anti-aircraft fire and surface-to-air missiles while flying low enough to improve bombing accuracy. In contrast, because we had complete control of the air, escorting F-14 crews may have flown well above the "flack" unopposed by enemy fighters. Thus, variations in missions resulting from differences in the type of aircraft could have played an important role in subjective fatigue.

Because of the limited data, these factors could not be accounted for separately in the analysis. Each questionnaire was treated alike. For example, we did not distinguish between questionnaires submitted by A-6 B/Ns flying night tanker missions and questionnaires from F-14 pilots flying day air-to-air missions.

CONCLUSIONS

This study supports the conclusion that air combat operations aboard USS AMERICA appear to have been well managed during Operation Desert Storm. Although fatigue was shown to significantly increase during missions, it normally returned to preflight levels by the following day. As a result, fatigue did not noticeably accumulate during the operation.

We feel that tasking level was one of the most important factors that contributed to these findings. Our results show that even during times of air combat, fatigue remained low among the AMERICA's aircrews as the operation progressed, possibly because tasking was carefully managed. In an exceptional case when a pilot was scheduled to fly two consecutive extended combat missions with minimal crew rest in between, he reported extremely high levels of fatigue. If similar demanding schedules had been routinely imposed on other aircrews, fatigue might have accumulated during the operation. This could have resulted in reduced performance, impaired operational efficiency, and compromised safety-of-flight. Fortunately, reasonable tasking was the rule, and no aircraft from USS AMERICA were lost to combat or accidents during the portion of Operation Desert Storm covered in this report. These results underscore the need for careful management of aircrew tasking during naval air combat operations.

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APPENDIX A

This appendix contains a list of the statements presented during the administration of the Addiction Research Center Inventory. The subject responded by circling each item that applied to him at the time. For statements 1-11, a point was added to the total for each item that was circled. For statements 12-15, one point was added to the total for each item that was not circled. Scores could range from 0 (no fatigue) to 15 (maximum fatigue).

1 - My speech is slurred [1]

2 - I am not as active as usual [1]

3 - I have a feeling of just dragging along rather than coasting [1]

4 - I feel sluggish [1]

5 - My head feels heavy [1]

6 - I feel like avoiding people although I usually do not feel this way [1]

7 - I feel dizzy [1]

8 - It seems harder than usual to move around [1]

9 - I am moody [1]

10 - People might say that I am a little dull right now [1]

11 - I feel drowsy [1]

12 - I am full of energy [2]

13 - I can completely appreciate what others are saying when I am in this mood [2]

14 - I feel more clear headed than dreamy [2]

15 - A thrill has gone through me one or more times since I started answering these questions [2]

[1] Statement required a true response to contribute to fatigue score.

[2] Statement required a false response to contribute to fatigue score.

APPENDIX B

This appendix contains a list of the statements presented during the administration of the Stanford Sleepiness Scale. Subjects were instructed to circle the one statement that applied to them at the time. This statement was their score. Scores could range from 1 (least sleepiness) to 7 (most sleepiness).

Scale Values	Statements
1	Feeling active and vital; alert; wide awake.
2	Functioning at a high level, but not at peak; able to concentrate.
3	Relaxed; awake; not at full alertness; responsive.
4	A little foggy; not at peak; let down.
5	Fogginess; beginning to lose interest in remaining awake; slowed down.
6	Sleepiness; prefer to be lying down; fighting sleep; woozy.
7	Almost in reverie; sleep onset soon; lost struggle to remain awake.

APPENDIX C

This appendix contains a list of adjectives presented during the administration of the Mood Questionnaire. Subjects were instructed to circle the number corresponding to how strongly each adjective described thei. level of fatigue at that time. The total score was calculated by adding the numbers circled. Scores could range from 5 (least fatigued) to 15 (most fatigued).

	Not at all	Somewhat or slightly	Mostly or generally
weary	1	2	3
lazy	1	2	3
drowsy	1	2	3
sluggish	1	2	3
inactive	1	2	3

RELATED NAMRL PUBLICATIONS

Neri, D.F. and Shappell, S.A., *The Effect of Combat on the Work/rest Schedules and Fatigue of A-6 and F-14 Aviators During Operation Desert Shield/Storm*, NAMRL-1375, Naval Aerospace Medical Research Laboratory, Pensacola, FL, August 1992.

Shappell, S.A. and Neri, D.F., *The Effect of Combat on Aircrew Subjective Readiness and LSO Grades During Operation Desert Shield/Storm*, NAMRL-1369, Naval Aerospace Medical Research Laboratory, Pensacola, FL, May 1992.