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THE FATIGUE EQUIVALENT OF JOB EXPERIENCE AND PERFORMANCE IN SUSTAINED OPERATIONS

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14. ABSTRACT
Individual cognitive performance data taken under a 36-hour fatigue protocol, are assessed for predictability using self-reports of previous fatigue experience. The performance data are from three-person teams of Air Battle Management students, from Tyndall AFB, FL, participating in a larger study. Variables related to age at first remembered sustained wakefulness and frequency of sustained wakefulness were significantly related to individual cognitive performance. Applications for the current research and suggestions for future research are given.

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Abstract

This study is part of a series of investigations examining communication, behavior, cognition, and decision-making during team and individual-play simulations of the Airborne Warning and Control System (AWACS) job domain during sustained operations (Elliott, Coovert, Barnes, & Miller, 2003; Harville, Barnes, & Elliott, 2004). In this particular study, individual cognitive performance data, taken under a 36-hour fatigue protocol plus a recovery measurement period, are assessed for predictability using self-reports of previous fatigue experience. The performance data are from three-person teams of Air Battle Management students, from Tyndall AFB, FL, participating in the larger study. Variables related to age at first remembered sustained wakefulness and frequency of sustained wakefulness were significantly related to individual cognitive performance. Applications for the current research and suggestions for future research are given.

INTRODUCTION

Command and Control (C2) warriors in the United States Air Force (USAF) face complex environments, multiple channels of vigilance, rapid situation assessment, and coordinated adaptive response (Orasanu & Connolly, 1993), while performing dynamic battle management and time-critical targeting. Information updates and coordination of resources depend on the cooperation of many agents in a distributed network system of systems. Adaptive planning is both frequent and challenging.

Much effort in meeting these challenges has been focused on the development of advanced technology, to provide time-critical information during mission execution. These capabilities are needed to facilitate situation awareness and coordinated response in conditions of information complexity and time pressure. However, technology can only support, not replace, the role of war fighters. In fact, it can be argued that technology increases the demands of the human decision maker. Despite any particular advanced technology, individual performance will still vary, depending on the competence of each individual and how much they are stressed (Harville, Barnes, & Elliott, 2004). An ongoing, long-term goal, is to enhance the processes by which war fighters recognize, interpret and respond effectively under stress (Elliott, Coovert, Barnes, & Miller, 2003). For a short-term goal, it would be useful to predict war fighter resilience to stress (i.e., their stress "competence").

Sustained Operations and Fatigue

One kind of stress is sustained operations. Combat missions require vigilance over time and adaptive performance over prolonged periods. During the early stages of actual campaigns, members of the command center are often up for several days with little if any time for recuperative sleep. Over time, chronic fatigue will affect everyone, and the likelihood of error will increase (Hursh, 1998). This is particularly relevant to C2 situations, which require constant monitoring for sudden-onset time-critical events.

There is extensive documentation on the negative impact of acute and/or chronic sleep loss on individuals. In a review of findings, Bonnett (2000) report an array of negative effects. These effects include mood changes, disorientation, irritability, perceptual distortions, hallucinations, difficulty in concentration, and/or paranoid thinking, depending on the extent of sleep loss. Negative effects have also been demonstrated on a range of cognitive tests, such as monitoring tasks, speed/accuracy tests, short-term memory, logical reasoning, and mental subtraction/addition. Physiological effects to fatigue include nystagmus, hand tremor, slurring of speech, sluggish corneal reflexes, hyperactive gag reflex, and increased sensitivity to pain.

Prior Research in Fatigue and Team Performance

While extensive data are available on effects of sleep loss on physiological, attitudinal, and cognitive function (Kryger, Roth, & Dement, 2000), very few studies reported data regarding sleep loss effects on particular aspects of information processing in complex team performance or decision making tasks. A few preliminary studies, provide some introductory results (Mahan, 1992, 1994; Mahan, Elliott, Dunwoody, & Marino, 1998; Coovert, et al., 2001; Hollenbeck, Ilgen, Tuttle, & Sego, 1995).

The Chronobiology and Sleep Laboratory at Brooks City-Base, TX has initiated a program of research that extends fatigue-effects research by (a) utilization of a complex command and control simulation based on demanding and time-critical USAF operational tasks, (b) utilization of operational USAF military personnel as research participants, and c) comparison of cognitive performance measures from individual command and control tasks. The current study is a part of that overall context.

The general design for our studies has teams of Intelligence, Surveillance, and Reconnaissance (ISR), Strike, and Sweep battle roles conduct multiple missions throughout a fatigue protocol, along with performance assessment batteries (during alternate hours of testing). This fatigue protocol allowed an exploration of team fatigue assessment for both mission outcome and team process, complementing past analyses (Elliott et al., 2003; Harville et al., 2003).

The Automated Neuropsychological Assessment Metric (ANAM; Reeves, Winter, Kane, Elsmore, & Bleiburg, 2001) was used in this research context, to assess individual fatigue for cognitive tasks. ANAM performance (actually a subset of tests available from the ANAM) is important to include in fatigue studies, since ANAM performance has been demonstrated to be sensitive to fatigue. Given this sensitivity, a study can use ANAM data to show that fatigue was indeed present. For our purposes, ANAM is also the most appropriate type of measure to assess previous fatigue-experience (i.e., the fatigue equivalent of job experience), as a predictive measure for fatigued performance. ANAM has been psychometrically well-studied, and all tests on it have reasonable reliability.

Current Study on Fatigue and Team Performance

Job experience is routinely cited as the second best predictor of job performance (Quinones, Ford, & Teachout, 2001). An example of job experience research is Harville (1996). His research used expensive, high quality, work sample data from 261 first-term Aerospace Ground Equipment (AGE) Air Force Specialty incumbents. Each incumbent, performing 16 tasks, was rated by AGE experts with a week of training on rating AGE personnel. Incumbents with all the steps correct for a given task tended to have more recent task experience, more overall task experience, and more average task experience per month (Harville, 1996).

The focus of the current report concerns the fatigue equivalent of job experience, and a literature search was conducted for literature on this variable. No existing literature was located. The current paper reports the results for reported previous fatigue experience variables and the ANAM test results.

METHOD

Participants

A pool of USAF officers awaiting Air Battle Management Training at Tyndall AFB FL was the source of the research participants. They were selected for the study on the basis of being volunteers. The participants included 22 males and 8 females. One team had three females, another team had two females, and three teams had one female. Prior to their arrival at Brooks City-Base, all participants had completed the Aerospace Basics Course. This course gave them background knowledge of doctrine, but no actual field or simulation experience in Air Battle Management. After running a pilot study with one team to finalize and test procedures of the study, a total of 10 three-person teams participated in the study. The mean age of the 30 experimental participants was 26.1 with a standard deviation of 2.6 years.

Training and Software Descriptions

Each participant experienced 32 hours (4 days) prior to the fatigue session, including administrative processing (2 hours), training (30 hours), and baselining (2 hours). Training on the Command, Control, Communications, Simulation, Training and Research System (C3STARS) software scenarios was accomplished by a subject matter expert (a former Senior Weapons Director), using formal course material and hands-on training with the C3STARS system. Training on the ANAM tasks was self-paced and handled by trained proctors. Baseline measures were taken for individual cognitive performance (ANAM), individual C3STARS task performance, and team C3STARS task performance at the end of the 32 hour period. The training specific for our study was two hours of prior-to-baseline *practice* on the Math and Two-back (working memory) ANAM tests. For this study, only fatigue questionnaires and ANAM procedures/measures will be further described.

Fatigue Experience Questionnaire

The subjects filled out several questionnaires when they arrived Monday morning, one of which was the "Fatigue Experience" questionnaire. This questionnaire asked about the subjects' previous fatigue experience, in terms of being awake all night or half the night, without being sick or using caffeine. Questions include when they first stayed up all night, or half the night. In addition, how many times they had stayed up all night/half the night, and when (how recently) they last stayed up all night/half the night were asked. The subjects also reported their age, gender, plus their typical amounts of sleep, separately for weekdays and for weekends. The fatigue experience questionnaire is given in Appendix A. The previous fatigue experience questions start at item 6.

ANAM Subset Battery

Our ANAM subset battery consisted of the simple math knowledge/processing (for brevity "Math") and the "Two-back" working memory tests from the ANAM (Reeves et al., 2001). In the Math task, the participant needs to decide whether or not the answer to a simple math problem is more or less than five. The math problem is on the screen for a maximum of 5 seconds. An example would be 4+2-3. The participant would then need to click the appropriate mouse button to indicate that this sum is less than 5. Prior to beginning training on Two-back, participants ran a "one-back" (an easier variation of the test idea) test three times. This allowed them to build up to the more difficult Two-back task. One-back is a succession of single digit numbers that are on the screen for half of a second with up to an additional 1.5 seconds before the next number appears. For one-back, the participant must decide whether or not the current number is the same or different than the number that was shown just previously, or one spot back. Similarly, in Two-back the participant must decide whether or not the current single digit number, is the same or different than the number that was shown two spots previously. One of the 30 participants never scored above 50% (i.e., chance) on Two-back accuracy during training, and therefore was not given this test during the testing protocol. Both tests have a self-paced component (problems come more quickly if you respond more quickly) and a fixed-time limit of three minutes.

ANAM's provided "throughput" measure is the number of correct responses per minute (Reeves et al., 2001). We found the provided measure to be "gameable" for one subject and on one occasion, where the test period had near random accuracy, but very rapid responding. On that occasion the resulting ANAM throughput score looked equivalent to a more accurate (but much slower) subject. An alternative to this was used for the current report. While looking for a transform to fix this problem, we found that accuracy multiplied by the number of problems given, provided a more realistic appraisal of performance for that one subject X condition cell. Therefore, Math was scaled using this simpler metric, which can also be considered a "throughput" measure (i.e., a measure combining speed and accuracy for a fixed time-limit, self-paced test). Two-back throughput performance was computed like the Math task, so that identical scaling could be used for both ANAM tasks. In the case of Two-back, performance functions are highly similar regardless of metric.

Study Design

Table 1 has the timelines for major events, starting with the baseline sessions. As noted in the footnote, data from the team task and the individual task (both of these were C3STARS tasks) are not the subject of the current paper.

The rationale behind the timing of the ANAM tasks is illustrated by Figure 1. This figure is the output of the Fatigue Avoidance Scheduling Tool (FAST) software, which generates predicted effectiveness levels (a.k.a. predicted fatigue) expected given the time since last sleep. The predictions are based on assuming a reasonable schedule for participants during the training (seen in the typical cyclical, or circadian pattern, prior to the sustained wake), a shortened amount of sleep Thursday night, no sleep during the study, and finally a 16 hour recovery sleep after being driven to housing, at the end of the fatigue protocol. Note that during Friday's part of the fatigue session (i.e., starting with when they arrive at the lab by 0300), their performance displays a similar pattern, but with lower mean effectiveness than during training. On day 2 of the fatigue protocol, there is an even greater drop in mean effectiveness. Finally, an almost complete recovery is predicted after 16 hours of sleep.

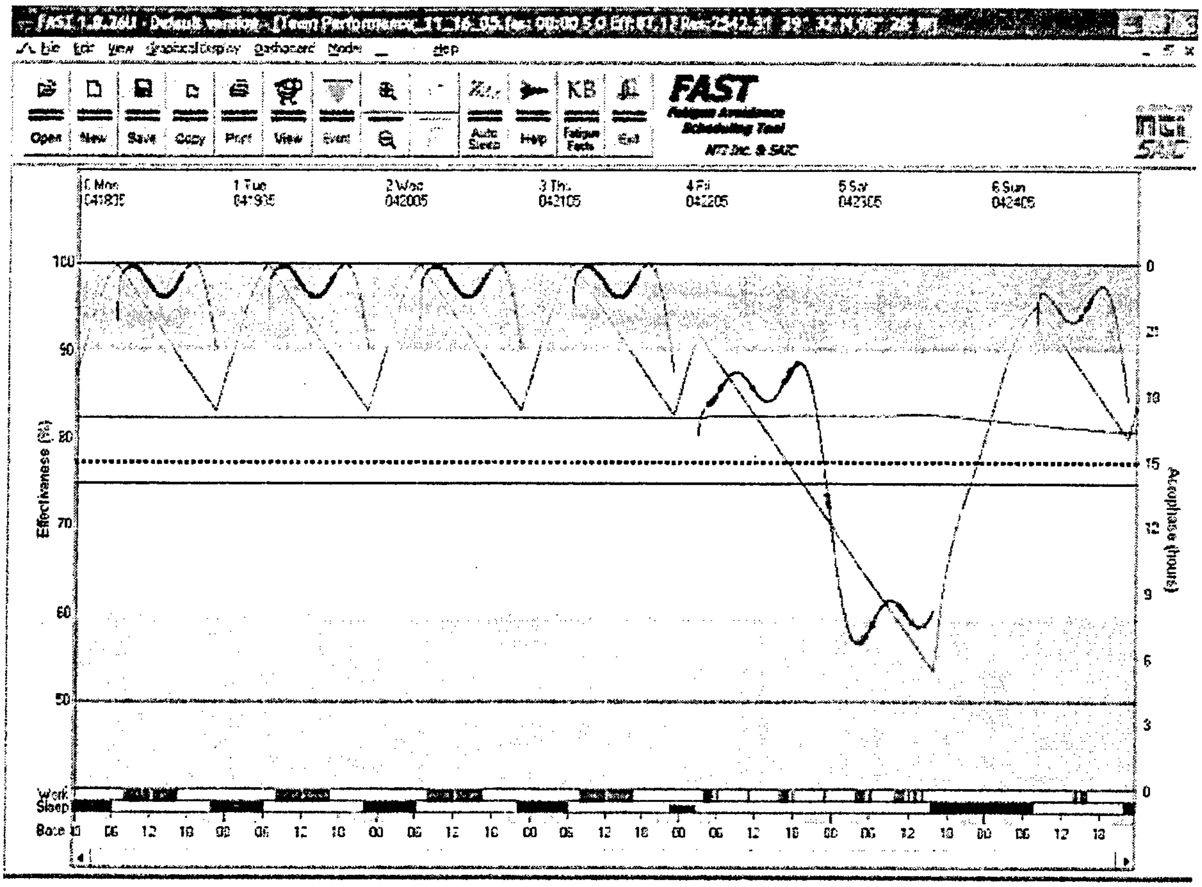
Table 1.

Baseline, Fatigue, and Recovery Timeline

Time, Day	Activities
1430, **Thursday** 1700, **Thursday**	Team Task, ANAM Individual Task, **Baseline** session complete and participants released
-------	----------------
0300, **Friday**	Participants Arrive for **Fatigue session**
0400	Team Task[1]
0500	ANAM
0600	Individual Task[1]
0700	
0800	Meal
0900	
1000	
1100	ANAM
1200	Meal
1300	
1400	
1500	
1600	Team Task
1700	ANAM
1800	Individual Task
1900	Meal
2000	
2100	
2200	
2300	ANAM
0000	
0100, **Saturday**	Meal
0200	
0300	
0400	Team Task
0500	ANAM
0600	Individual Task
0700	
0800	Meal
0900	
1000	Team Task
1100	ANAM
1200	Meal
1300	Individual Task, ANAM
1400	Individual Task
1500, **Saturday**	**Fatigue session complete**, participants taken to lodging
-------	----------------
1400, **Sunday** 1500 1630, **Sunday**	Participants arrive for **Recovery session**, Team Task ANAM, Individual Task, Fill out Study Feedback Form. Turn in acti-watches and self-report sleep logs **Recovery session complete**

[1] Data from the team task and the individual task are not the subject of the current paper.

Figure 1. Predicted Effectiveness Using FAST



RESULTS

Descriptive statistics for age, reported half-nighters, and reported all-nighters are presented in Table 2. An all-nighter refers to going to bed no earlier than when you usually wake up. A half-nighter refers to going to sleep at the point where you should be halfway through your sleep (e.g., given a sleep duration of 2200 to 0600, implies going to sleep at 0200). These questions also asked subjects to exclude times when they were "sick or used stimulants (e.g., caffeine)." It is hard to know what the effects of having this qualification were. This qualification was a requirement of our Institutional Review Board. However, one possibility is that it made the subject focus more on unplanned sustained wakes.

With an average age of 26.1, all 30 participants reported previous half-nighters. Their average age for the first half-nighter was 14.25, and the average age for their last half-nighter was 25.87. These two ages were significantly different. The average reported age for the first all-nighter was 15.05, with the average age of their last all-nighter being 24.79. These two ages were also significantly different. The average lifetime number of half-nighters reported was 105.10, with a large standard deviation of 245.65. The average lifetime number of all-nighters was 10.95, with a standard deviation of 10.47. The number of half-nighters reported is significantly different than the number of all-nighters. Note that only 21 participants reported having a previous all-nighter.

Table 2.

Descriptive Statistics for Age and t-tests for Reported Previous Fatigue Experience

Variable	M	N	SD	t	df	p
Age	26.10	30	2.58			
Age at first half-nighter	14.25	28[1]	4.72	-11.774	27	
Age at last half-nighter	25.87	30	2.54			.000**
Age at first all-nighter	15.05	21	4.20	-9.129	18	
Age at last all-nighter	24.79	19[2]	3.39			.000**
Lifetime half-nighters	105.10	30	245.65	-2.099	20	
Lifetime all-nighters	10.95	21	10.47			.049*

*p<.05. **p<.01.

[1]Two participants reporting multiple half-nighters each, reported that their last half-nighter occurred in the past year, but did not report their age for their first half-nighter.

[2]This N does not include two participants who reported only one all-nighter.

Figure 2 shows the average results and error bars for the Math task, while Figure 3 has these results for Two-back. As expected, both figures, particularly the one for Two-back, show lowest performance at various times on Saturday, with a noticeable recovery on Sunday.

Figure 2. Average Results and Error Bars for Math

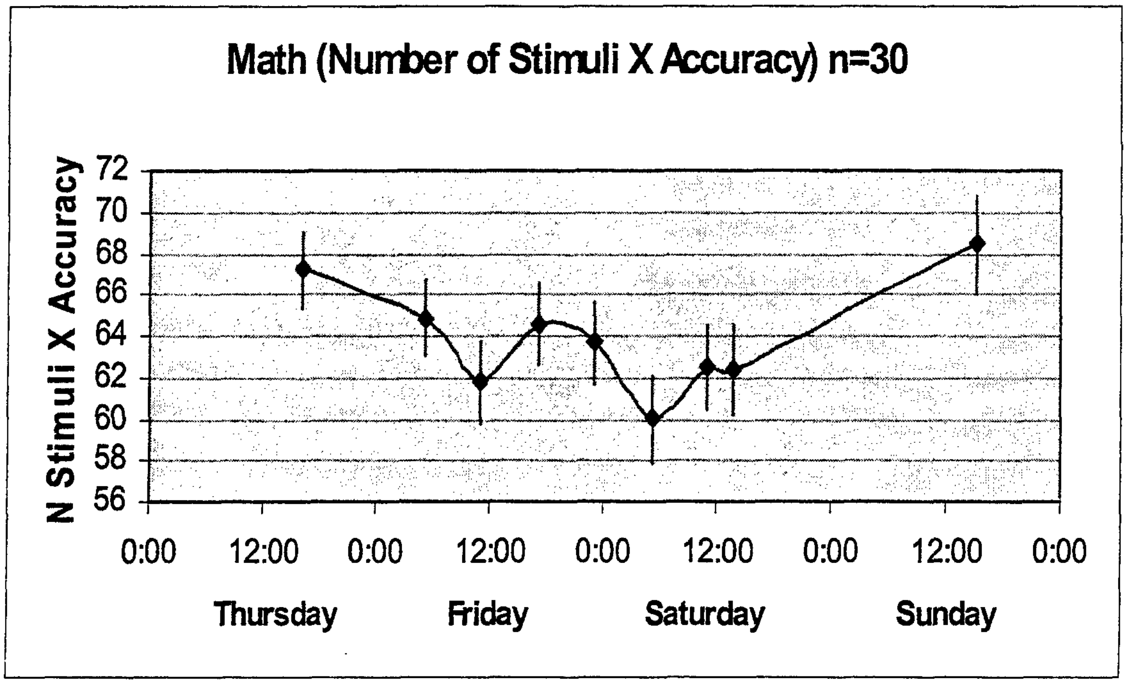


Figure 3. Average Results and Error Bars for Two-Back

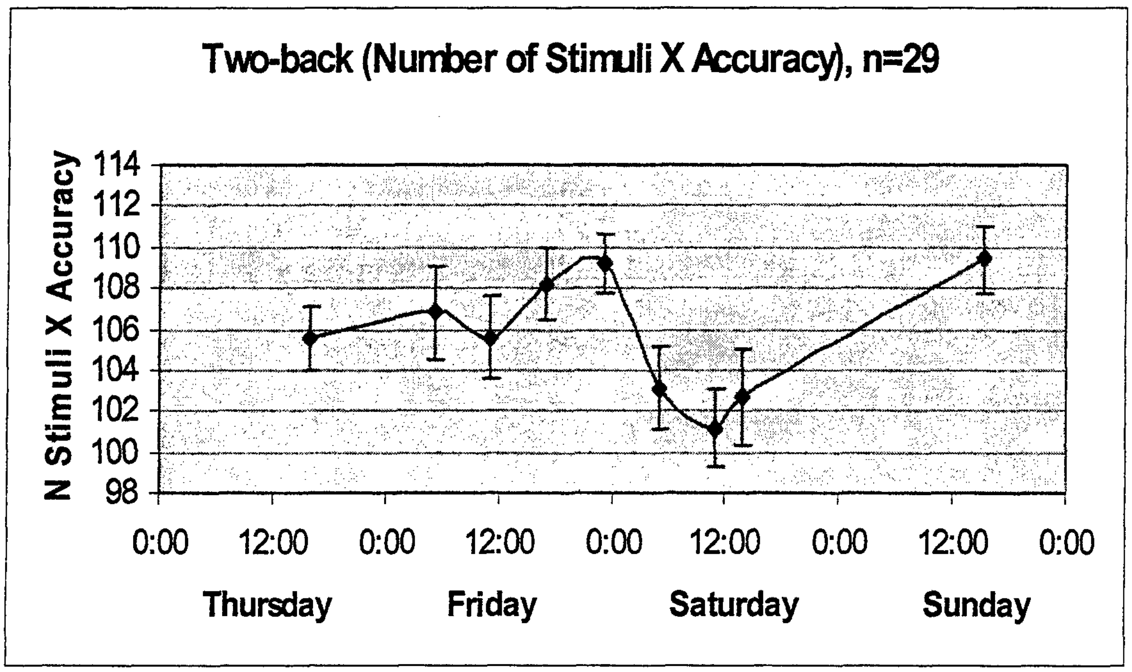


Table 3 has descriptive statistics for Math and Two-back. A possible "going home" effect (in reality being driven to base housing), may have caused participants to perform non-significantly better at 1300 Saturday on Two-back, than they did at 1100. Therefore, it was decided that the data at the previous point, collected at 1100 on Saturday, would serve as the fatigue data point when used for both Math and Two-back correlations. That is, this point was close to the end of the fatigue protocol, but buffered some from "going home" effects. For Math, with slightly less than a 10% increase in the standard deviation, the participants scored an average of 4.67 points lower at the fatigue point than they did at baseline. However, for Two-back the participants' standard deviation increased by slightly more than 50%, with their average decreasing by 4.43 points. Both Math and Two-back were significantly worse (relative to the baseline) at the chosen fatigue point.

Table 3.

Descriptive Statistics and t-tests for Math and Two-back

Variable	M	N	SD	t	df	p
Math at baseline	67.20	30	10.24	3.196	29	
Math at fatigue	62.53	30	11.14			.003**
Two-back at baseline	105.59	29[1]	8.36	2.727	28	
Two-back at fatigue	101.16	29	12.67			.011*

*p<.05. **p<.01.

[1]One participant did not reach proficiency on Two-back during training and was not tested during the study.

Partial correlations, controlling for baseline performance, for fatigued Math and Two-back with age and reported previous fatigue experience, are in Table 4. Age was nonsignificant for both ANAM tests. Age at first reported half-nighter had a significant partial correlation ($r=.5936$, $n=25$) with fatigued Math. In other words, a higher age at the first half-nighter was associated with less fatigue (higher Math scores). The remaining five partial correlations involving half-nighters were all nonsignificant. Age at first reported all-nighter had a significant partial correlation ($r=.5723$, $n=18$) with fatigued Math. A higher age at the first all-nighter was associated with less fatigue (higher Math scores). Four of the remaining partial correlations involving all-nighters were nonsignificant. Only the previous lifetime number of all-nighters and Math had a significant partial correlation ($r=-.4723$).

Table 4

Partial Correlations of Fatigued Math and Two-back, with Age and Reported Previous Fatigue Experience

Variable	Math r (n)	Two-back r (n)
Age	-.0448 (27)	-.1816 (26)
Age at first half-nighter	.5936** (25)	.3538 (24)
Age at last half-nighter	-.0958 (27)	-.1983 (26)
Lifetime number of half-nighters	-.1108 (27)	-.1131 (26)
Age at first all-nighter	.5723** (18)	.2009 (17)
Age at last all-nighter	-.0786 (16)	-.1705 (15)
Lifetime number of all-nighters	-.4723* (18)	-.2349 (17)

* p<.05. **p<.01.

Ten additional previous fatigue experience variables were calculated. As reported in Table 5, four variables concerned the number of years since the first (or last) half-nigher (or all-nighter). Six variables were per year averages for the time between the first and last half-nighter (or all-nighter), or per year averages between the first half-nighter (or all-nighter) and the date of testing, and per year lifetime half-nighters (or all-nighters). The first half-nighter averaged almost 12 years ago, while the first all-nighter averaged 11.24 years ago. The last half-nighter

Table 5

Descriptive Statistics for Calculated Fatigue Experience Variables

Variable	M	N	SD
Years since first half-nighter	11.82	28	5.03
Years since last half-nighter	.23	30	.43
Average half-nighters per year between first and last half-nighter	9.11	28	15.10
Average half-nighters per year between first half-nighter and date of testing	8.64	28	14.59
Average lifetime half-nighters per year	3.69	30	8.02
Years since first all-nighter	11.24	21	4.47
Years since last all-nighter	1.37	19	1.83
Average all-nighters per year between first and last all-nighter	1.49	19	1.33
Average all-nighters per year between first all-nighter and date of testing	1.11	21	1.04
Average lifetime all-nighters per year	.43	21	.44

averaged a quarter of a year ago, and the last all-nighter averaged 1.37 years ago. Given the stereotypical number of all-nighters and half-nighters p...led by undergraduates and the average age of the participants, these results were not surprising. The average number of half-nighters per year between the first and the last half-nighter was slightly over 9 per year, but the similar variable for all-nighters averaged 1.49 per year. For the average half-nighters per year between the first one and the date of testing, the value was 8.64, while for all-nighters the average was only 1.11. Average lifetime half-nighters per year had a mean of 3.69, and for all-nighters the mean per year was .43.

Table 6 presents the partial correlations for fatigued Math and Two-back, controlling for baseline performance, with the 10 calculated previous fatigue experience variables. Years since the first half-nighter had significant partial correlations with both Math ($r=-.6183$) and Two-back (-.4426). In other words separately for both Math and Two-back, a shorter amount of time since the first half-nighter (i.e., a more recent half-nighter) was associated with less fatigue (higher Math and Two-back scores). Years since the first all-nighter had a significant partial correlation with Math ($r=-.5700$), but a non-significant partial correlation with Two-back. The only other significant partial correlation was average lifetime all-nighters per year and Math ($r=-.4439$).

Table 6.

Partial Correlations of Fatigued Math and Two-back, with Calculated Fatigue Experience Variables

Variable	Math r (n)	Two-back r (n)
Years since first half-nighter	-.6183** (25)	-.4426* (24)
Years since last half-nighter	.2915 (27)	.2195 (24)
Average half-nighters per year between first and last half-nighter	.0174 (25)	-.1163 (24)
Average half-nighters per year between first half-nighter and date of testing	-.0001 (25)	-.1288 (24)
Average lifetime half-nighters per year	-.1018 (27)	-.1467 (24)
Years since first all-nighter	-.5700** (18)	-.2230 (17)
Years since last all-nighter	.0915 (16)	.1726 (15)
Average all-nighters per year between first and last all-nighter	.0340 (16)	.0630 (15)
Average all-nighters per year between first all-nighter and date of testing	-.0371 (18)	-.0274 (17)
Average lifetime all-nighters per year	-.4439* (18)	-.2077 (17)

* $p<.05$. ** $p<.01$.

DISCUSSION

The basic rationale behind the current report investigating previous fatigue experience, involves the reported relationships between job experience and job performance. Also, the lack of previous research investigating the influence of previous fatigue experience on performance in sustained operations, contributed to the need for the current report. Given their age, the self-reported quantities for previous all-nighters and half-nighters from the sample of officers in casual status were reasonable, with reasonable differences between the frequency of half-nighters and all-nighters. Also fatigue for both Math and Two-back fatigue was evident, relative to the baseline performance, at the sample point investigated (which occurred at roughly 32 hours of wakefulness). Figures 2 and 3 may also show Two-back to be more sensitive to fatigue than math-knowledge processing, although both tests qualitatively show good fatigue effects and recovery after sleep.

The partial correlations, controlling for baseline performance, in Tables 4 and 6 offer some support for a relationship of previous fatigue experience to future performance while fatigued. Age in this restricted sample was a nonsignificant predictor for both Math and Two-back performance. The significance level did not change for any of the eight half-nighter partial correlations, when two outliers each with 1000 lifetime half-nighters were excluded. The significant partial correlation ($r=-.4723$) between previous lifetime number of all-nighters and Math was opposite the expected direction, but only had a sample size of 18. Also, this partial correlation becomes a nonsignificant partial correlation of -.1676, if the subject with the most reported lifetime all-nighters (50) is not used in the analysis. A value of 20 for two participants, was the second highest value for the reported number of lifetime all-nighters.

Due to a lack of previous research, there were no specific expectations for the relative sizes of the results for the 10 calculated variables in Table 5. Three of the 10 partial correlations reported in Table 6 for Math were significant (years since first half-nighter, years since first all-nighter, and average lifetime all-nighters per year). Average lifetime all-nighters per year had a negative partial correlation of -.4439 ($n=18$). However, this partial correlation had a nonsignificant value of -.1173 if the participant with the most lifetime all-nighters, a value of 50, is excluded from the analyses. The only significant partial correlation in Table 6 for Two-back was years since first half-nighter. Similar to Table 4, the significance level did not change for any of the half-nighter partial correlations, when two outliers each with 1000 lifetime half-nighters were excluded.

Based on this report what are some future research needs? When the results from Tables 4 and 6 are combined, the half-nighter variables are significant three times and the all-nighter variables are significant four times. Therefore, for this exploratory research with a sample size of 30, replication plus additional previous fatigue experience questions is recommended. In order to receive approval, the Fatigue Questionnaire instructed the participants to exclude times when they used caffeine. Future research should leave this exclusion out of one form of the questionnaire, and keep the exclusion in another form (which would otherwise be identical). Both sets of questions should continue to ask the participants to exclude times when they were sick. These additional questions will allow the researchers to investigate if previous fatigue experience using caffeine, has similar effects to previous fatigue experience without using caffeine.

The long range goal, if previous fatigue experience is significant in future research, will be to develop a fatigue-experience inventory. The inventory could be useful in changing entry standards for *selected* officer and enlisted career fields, and in justifying the need for career training to include more fatigue experience.

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APPENDIX A

Courses, Organized Athletic Endurance Events, and Fatigue Experience Questionnaire

1. What was the total number of semesters of **high school** courses, you completed in the biological sciences? ____
   Other, similar course (course name and number of semesters) ____________________

2. For each of the following types of courses, what was the number of semesters of **undergraduate college** courses you completed?
   Biology ____
   Physiology ____
   Microbiology ____
   Biochemistry ____
   Zoology ____
   Physiological Psychology ____
   Other, similar course (course name and number of semesters) ____________________

3. Have you ever done any organized athletic endurance events? (Workouts done by yourself or without a winner do not count.) ("Yes" or "No") ____ (If your answer is "No," skip question 4.)

4.a. For each organized, athletic endurance event, except for recurring events (e.g., weekly runs), fill in the table below with: 1) the type of event [run, swim, bike, walk, hike, etc.], 2) the distance [for triathlons and biathlons the distance for each part of the event], and 3) how many years ago the event happened [If the event was in the last 365 days, write down "0"] (Workouts done by yourself or without a winner do not count.)

Type of Event	Distance(s)	How many years ago

4.b. Have you ever had any organized, regularly recurring (weekly or monthly) athletic endurance events? ("Yes" or "No") ____ (Workouts done by yourself or without a winner do not count.) If "Yes" fill in the table below with: 1) the type of event [run, swim, bike, walk, hike, etc.], 2) the distance, 3) how often the event happened (weekly or monthly), 4) how many total times you did the event, 5) how many years ago you first did the event, 6) and how many years ago you last did the event [[For the last two questions below, if the event occurred in the last 365 days, write down "0"]]

Type of Event	**Distance**	**Weekly or Monthly event?**	**How many total times you did the event**	**How many years ago you first did the event**	**How many years ago you last did the event**

5. How old in years are you now? ____

6. For all the following questions, exclude times when you were sick or used stimulants (e.g., caffeine). Have you ever stayed up **all night**, without getting any sleep? ("Yes" or "No") ____ (If your answer is "No" go to Question 10.)

7.a. How old were you the first time you stayed up all night, without getting any sleep? ____

7.b. What was your main activity the first time you stayed awake all night (studying, playing cards, camping, watching TV, other activities with friends, etc.)?

____

7.c. How difficult was it to stay awake all night, the first time?
____ Very Difficult
____ Difficult
____ Easy
____ Very Easy

8.a. How old were you the last time you stayed awake all night? ____ (If you have stayed awake all night once in your life, skip to Question 9 and answer it with a "1")

8.b. What was your main activity the last time you stayed awake all night (studying, playing cards, camping, watching TV, other activities with friends, etc.)?

____

8.c. How difficult was it to stay awake all night, the last time?
____ Very Difficult

____ Difficult
____ Easy
____ Very Easy

9. Excluding times when you were sick or used stimulants (e.g., caffeine), how many times in your life, have you stayed awake all night, without getting any sleep? ____ times

10. For all the following questions, exclude times when you were sick or used stimulants (e.g., caffeine). Have you ever gotten **half or less** of your usual amount of sleep at night? ("Yes" or "No") ____

11.a. How old were you the first time you got half or less of your usual amount of sleep? ____

11.b. What was your main activity the first time you got half or less of your usual amount of sleep (studying, playing cards, camping, watching TV, other activities with friends, etc.)?

____

11.c. How difficult was it to stay awake, the first time you got half or less your usual amount of sleep?
____ Very Difficult
____ Difficult
____ Easy
____ Very Easy

12.a. How old were you the last time you got half or less of your usual amount of sleep? ____ (If you have gotten **half or less** of your usual amount of sleep once in your life, skip to Question 13 and answer it with a "1.")

12.b. What was your main activity the last time you got half or less of your usual amount of sleep (studying, playing cards, camping, watching TV, other activities with friends, etc.)?

____

12.c. How difficult was it to stay awake, the last time you got half or less the usual amount of sleep?
____ Very Difficult
____ Difficult
____ Easy
____ Very Easy

13. Excluding times when you were sick or used stimulants (e.g., caffeine), how many times in your life, have you gotten half or less of your usual amount of sleep? ____ times