1995

Some effects of shift work on fatigue

Sandhya Murthy
San Jose State University

SOME EFFECTS OF SHIFT WORK ON FATIGUE

A Thesis
Presented to
the Faculty of the Department of Psychology
San Jose State University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
Sandhya Murthy
August, 1995

APPROVED FOR THE DEPARTMENT OF PSYCHOLOGY

James Hawkins, Ph D

Nathan Phillips, Ph D

Howard Tokunaga, Ph D

APPROVED FOR THE UNIVERSITY

M. Lon Lewandowski

ABSTRACT

SOME EFFECTS OF SHIFT WORK ON FATIGUE

by Sandhya Murthy

This study is an exploration of the relation between shift work and some of its effects on fatigue on a sample of health care workers. All participants were administered the VAS-F questionnaire followed by the VLS to evaluate fatigue severity. It was hypothesized that differences would be found within the shift variable, that is, respondents who worked the night shift would report a higher level of fatigue than those respondents who work the day shift. A 2 (shift) x 2 (gender) x 2 (arising) x 7 (days) mixed model ANOVA was used to evaluate the data. A significant main effect of shift on the fatigue scale was obtained, $F(1,59) = 5.87$ $p < .01$. The arising variable did result in some significant effects. However, no significant differences were observed on the gender variable. The days variable did result in some of the expected outcomes. Overall, the outcomes show that the VAS-F is effective with shift workers as well as with the original clinical population, and that the VLS is quite similar to the VAS-F in revealing subgroup differences.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

Some Effects of Shift Work on Fatigue

Sandhya Murthy

San Jose State University

Running Head: Shift and Fatigue

Footnotes

Requests for reprints should be sent to Sandhya Murthy, Department of Psychology, San Jose State University, San Jose, California 95192.

Abstract

This study is an exploration of the relation between shift work and some of its effects on fatigue on a sample of health care workers. All participants were administered the VAS-F questionnaire followed by the VLS to evaluate fatigue severity. It was hypothesized that differences would be found within the shift variable, that is, respondents who worked the night shift would report a higher level of fatigue than those respondents who work the day shift. A 2 (shift) x 2 (gender) x 2 (arising) x 7 (days) mixed model ANOVA was used to evaluate the data. A significant main effect of shift on the fatigue scale was obtained, $F(1, 59) = 5.87$ $p < .01$. The arising variable did result in some significant effects. However, no significant differences were observed on the gender variable. The days variable did result in some of the expected outcomes. Overall, the outcomes show that the VAS-F is effective with shift workers as well as with the original clinical population, and that the VLS is quite similar to the VAS-F in revealing subgroup differences.

Some Effects of Shift work on Fatigue

The prevalence of shift work in the form that we see today is the outcome of industrialization. Factory owners soon realized that if they could keep their machinery operating on a twenty-four hour schedule, they could spread the cost of their investment over more units of production and thus, reduce their unit costs. Hence, as equipment has become more expensive, there is an increasing pressure to operate it around the clock (Mott, Mann, McLoughlin & Warwick, 1965). Many organizations operate beyond the standard business day, and some maintain as many as three shifts. Certain services, such as hospitals and emergency medical care, require a 24-hour operation. Also, some manufacturing is done around the clock (Berry & Houston, 1993).

The prevalence of different types of work hours varies according to the country and the kind of occupation. It has been estimated, however, that approximately one-fourth of the working population in industrialized countries is employed on some kind of shift work system (Akerstedt, 1988). A large proportion of today's labor force works during some span of time each day other than the typical hours from morning to evening (Mott et al., 1965). Shift work usually indicates an arrangement of work hours which utilizes two or more teams or shifts to cover the time needed for production.

Working at night produces a non work life out of synchrony with the rest of the world. The night worker is sleeping when others are working and working when others are socializing. Household duties and family life can be disrupted (Muchinsky, 1993). Shift work can also be detrimental to an individual's health and well being. One of the most important consequences of shift work is disrupted or changing sleep times (Chan, Phoon, Gan & Ngui, 1989). A major problem often encountered by people who work the night shift is to stay awake during the night shift and then be able to sleep the following day (Matsumoto & Morita, 1987).

It is the worker who has to make the required adjustments to a shift schedule, and he/she is a complex being. The individual is a physiological organism with basic body rhythms of eating, sleeping, and elimination, rhythms which do not change easily as a person moves from one time sequence of living to another. The individual is a social being: a husband, a father, a friend, etc. When the person is asked to change his/her schedule of working hours, the manner in which he/she can perform in all these roles is affected. Last but not least, the worker is a psychological entity. The individual has aspirations and he/she calculates regularly how well he/she is achieving them. Shift work may affect a worker's estimate of himself or herself, and also, the optimism with which the person views the world around him/her, and the ways in which he/she relates to other people (Mott et al., 1965).

A large body of research has suggested that shift work, particularly night work, may have adverse consequences for health and well-being and also results in an increase in work stress (Rosa, Colligan & Lewis, 1989). Working at night may involve irregular behaviors that are difficult to adapt to (Monk & Tepas, 1985). One important consequence of shift work, especially working at night, is reduced sleep length. A number of studies have reported variations in sleep quantity related to the type of shift worked. These studies have reported that workers on the afternoon/evening shifts sleep longest, workers on the day shift sleep slightly less, and night shift workers sleep least. The changes in sleep length have an effect on the subjective state of the individuals, especially fatigue (Paley & Tepas, 1994). In a study conducted by Lavie (1981), even individuals working regular day shifts appeared to report sleep disturbances, and more women than men were found to report sleep problems. Hence, it can be seen that despite working regular day shifts, workers still had problems associated with sleep.

There is a great amount of consensus in the literature on shift work about its effects on what is called "time-oriented body functions." The principal time-oriented functions

which have been studied are sleep, appetite, and elimination. The difficulties that occur in these areas seem to be traceable in each case to a conflict between the timing of work schedules and the body's accustomed rhythms (Mott et al., 1965).

Shift workers experience a lot of problems in physiological and social adjustment. Many of the physiological problems are associated with disturbances of the circadian rhythm, where bodies are programmed for a certain time cycle. Because shift work interrupts the cycle of eating, sleeping and working, workers often experience physiological problems. They often complain of lack of sleep, fatigue, constipation, irritability, and loss of appetite (Muchinsky, 1993).

The major disadvantage of the night shift is its possible effects on the time-oriented body functions. The person who cannot adjust his sleeping habits to the demands of this shift must live in a physically unpleasant situation. The workers on the night shift in one study reported the lowest average number of hours sleep per night of all of the shift workers in the study, although the average was not as low as that reported in other studies (Mott et al., 1965). Workers who experience difficulty adjusting their time-oriented body functions to their work schedule feel fatigue most of the time. Because of this fatigue, he/she is less inclined or able to fulfill his/her various role obligations. This decline in role performance could in turn affect self esteem and levels of anxiety and conflict pressure (Mott et al., 1965).

One of the biggest problems created by shift work is the change or reversal of regular sleep schedules. In a study done in 1957 by Ulich in Germany (in Mott et al., 1965), it was found that more than one half of the men in his sample mentioned sleep disturbances as problems related with shift work. Their specific complaints included both insufficient hours of rest and the inferior quality of their sleep during the day.

Some researchers report that shift workers found sleep during the day to be less refreshing than at night. Furthermore, when the members of the subject sample were

questioned as to when they felt the most tired, 83 percent reported that it was on the night shift, as compared with nine percent who mentioned the day shift (Mott et al., 1965).

Sleepiness is a relatively new concept in scientific enquiry. It refers to some urge for, or tendency towards, sleep. Subjectively, this may involve difficulties with keeping one's eyes open and difficulties in concentration. Behaviorally, it may involve half-closed or closed eyelids, nodding off, performance lapses, and so on; physiologically, it may involve intrusions of sleep-like patterns into waking electroencephalographic (EEG) and electro-oculographic (EOG) activity (Akerstedt, 1988).

As major changes take place over the day in the physiological make-up of an individual, it is not unexpected that psychological variables also show a diurnal variation, even in those individuals who are not lacking in sleep and living a "normal" routine. Hence, there are changes over the day in mood, subjective and objective sleepiness and also, the ability to perform various functions (Monk, 1987).

Early laboratory research has repeatedly demonstrated time of day differences in behavior that is driven by the circadian biological system. These results weaken the assumption that all hours of the day are equal and interchangeable. Field research performed on industrial shift workers, however, has repeatedly demonstrated time of day (shift) differences for variables including sleep, sleepiness, and mood (Tepas & Monk, 1987).

EEG recorded studies which have been done on shift workers have compared their day and night sleep, and the findings largely support the reports of day sleep difficulties. Basically, day sleep has revealed shorter total sleep time, an earlier onset of REM sleep, and an increase in REM sleep early in the sleep period during daytime sleep. These studies of shift work have been performed on workers who did not doze or nap during the night shift (Matsumoto & Morita, 1987).

Another aspect of sleep problems is the effect of fatigue and reduced sleep on the worker's performance of his roles as husband, father, friend, etc. since shift work often results in disrupted or changing sleep times (Dekker, Paley, Popkin & Tepas, 1993). A number of functions which are important for survival and also the prosperity of society are becoming alarmingly dependent on the performance capabilities of the individual. This performance capability could be under the influence of various factors. One of the more important may be the sleepiness induced by various forms of shift work (Akerstedt, 1988).

Much of the information on shift work sleepiness comes from questionnaire studies. One primary observation from such studies is that the majority of shift workers report more fatigue than do regular day workers (Akerstedt, 1988). Normally, the fatigue is particularly widespread on the night shift as compared to that of the afternoon or morning shifts.

The extent of the occurrence of sleepiness in shift work depends to some degree on how sleepiness is defined. In one of the earlier studies, Bjerner et al. (in Akerstedt 1988) found that 81% of three-shift workers "felt tired during the night shift week" in contrast to the 4% during the week of the afternoon shift. Another study found that 88% of a group of policemen felt sleepy at one time or another during the night shift. In a number of studies on policemen, steelworkers, and meteorologists, about 80 to 90% stated that they often experienced fatigue during night work (Akerstedt, 1988).

Fatigue is often viewed as a simple variable that is very highly and also, positively correlated with time on task in the workplace, and is a result primarily of physical activity (Paley & Tepas, 1994). Fatigue is a major cause for concern to the providers of health care, because of its ramifications for safety in the work setting (Yositake, 1978). In general, the prevalence of fatigue in the US population as a whole is estimated to be between 14% and 20% (Chen, 1986). From a physiologist's perspective, fatigue can be viewed as the product of excess energy consumption, depleted hormones, or the

diminished ability of muscle cells to contract. From a psychiatric point of view, fatigue can be seen as a subjective state of weariness that is related to reduced motivation, prolonged mental activity, or even boredom that occurs in situations such as chronic stress, anxiety, or depression (Lee, Hicks & Nino-Garcia, 1991).

In a number of research studies, fatigue is measured either qualitatively by self-report or observation, or quantitatively by measurement of muscle cell activity or strength. The Visual Analogue Scale (VAS) has been demonstrated to be a valid and reliable instrument for the quantitative assessment of fatigue and energy levels in both healthy subjects and patients who complain of poor sleep. It allows health care providers to evaluate fatigue in a rapid, quantitative manner (Lee et al., 1991).

The 18-item visual analogue scale to evaluate fatigue severity (VAS-F) was developed by Lee et al., (1991) for use in various healthcare settings. Of the two subscales, one is related to fatigue and the other to energy. However, though the VAS-F is easy for subjects to take, it is time consuming and tedious for researchers to score. Since the scale has reported high internal consistency and compares favorably with scales such as the Stanford Sleepiness Scale and the Profile of Mood States, Hawkins & Murthy (1993) developed a modified version of the VAS-F called the Vigor Lassitude Scale (VLS), which is a 10 item scale, that uses a labeled and numbered line. The VLS is has been designed to monitor the participant's fatigue and energy levels twice in a day over a 7 day period. For the purpose of convenience, these responses have been labeled as the 'arising' variable in the present study.

Shift work usually refers to an arrangement of working hours that uses two or more teams to cover the time needed for production. Shift work is often related to several health problems, most of them being related to the circadian rhythmicity of humans. Most shift workers have occasional disturbances of sleep, and about one-third of them complain of fatigue (Harma, 1993). Working at night may involve behaviors that are, for the most

part, difficult to adapt to and irregular. A number of shift workers complain of sleep disturbances because of the reversal of sleep schedules.

Fatigue can be seen as an important variable because of its implications for safety in the work setting. Fatigue can be measured either qualitatively or quantitatively. This study uses quantitative measures of fatigue as can be seen in the VAS-F and the VLS. The purpose of this study was to use a reliable and valid quantitative measure to evaluate fatigue and energy levels of shift workers in the health care setting. The VAS-F and the VLS were used in this study to evaluate the level of fatigue and energy of the shift workers. The VAS-F was administered to the subjects followed by the VLS, in order to test for differences between scores.

The independent variables that were used in this study were shift (day/night) and gender (male/female) to test for differences in fatigue scores (if any) between the sexes as more women than men have been reported to complain of sleep problems. Other independent variables that were included in the study were arising - to evaluate the fatigue and energy levels of participants (level 1 indicated subjects' awakening from their main sleep and level 2 indicated the period before subjects' went to bed at the end of the day) and days of the week to test for differences between groups. It was expected that differences would be found within the shift variable, where subjects who worked the day shift, might have reported lower fatigue scores than subjects who worked the night shift. Regarding the arising variable, it was expected that the participants' level of fatigue would increase over the course of the day as compared to when they first awake. The gender variable was considered to test for differences between the sexes, as more women are reported to have sleep problems than men. It was hypothesized that based on the days variable, participants would experience more fatigue during the workweek, that is, from Monday through Friday and less fatigue over the weekend (since they did not have to work over the weekend).

Method

Subjects

The subject sample included individuals who work the day shift as well as those who work the night shift from departments such as critical care and the emergency room at the San Jose Medical Center and the Good Samaritan Hospital in San Jose. Participation in the study was voluntary, and each subject was required to sign an informed consent form approved by the College of Social Sciences, Department of Psychology, San Jose State University. The collected data was not identified with any one individual. Subjects were contacted through their department managers. Participant age ranged between 22 years and 62 years with a mean age of 33.5 for women (Standard Deviation = 8.8) and 32.9 for men (Standard Deviation = 7.7). There were 24 males and 39 females in the study. 31 subjects worked the day shift while 32 subjects worked the night shift. Both male and female participants were randomly distributed on both shifts.

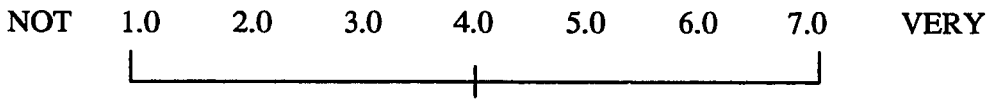
Materials

The 18-item VAS-F to evaluate fatigue severity was developed for use in a wide variety of health care settings (Lee et al., 1991). There are two subscales. One is related to fatigue, and the other to energy. The test is completed quickly and with little effort, yet it provides interval scale values for statistical analyses. Unlike some tests that have been used, this scale was developed using standard item analysis techniques and then validated against instruments that have had wide use. The VAS-F compares favorably with both the Stanford Sleepiness Scale and the Profile of Mood States. The internal consistency reliabilities for the items are high.

Subjects are required to make their responses on the VAS-F simply by marking an "X" along 100mm lines. The VAS-F is easy for subjects to take but tedious for researchers to score. In developing the test, the authors intentionally did not use a

numbered line. However, they point out that "A major limitation of the use of the VAS-F is the time-consuming measurement process for the research team." The VAS-F is very attractive in its simplicity and in the rigor of its development. (See Appendix I)

Based on the concept of developing a self administered self-scoring short form of the VAS-F, a 10-item scale was developed using a labeled and numbered line (Hawkins & Murthy, 1993). This test was called the Vigor-Lassitude Scale (VLS). The VAS-F was modified as follows: The first 10 of the VAS-F lines anchor at one end with "Not at all" and at the other end with "Extremely." The remaining VAS-F items (i.e., 11 through 18) have anchors of varying form. The Lassitude sub scale included: Tired, Sleepy, Drowsy, Fatigued, and Worn out. The Vigor sub scale included: Energetic, Active, Vigorous, Efficient, and Lively. For the VLS, subjects are told to "use the line to rate each word between 1.0 (NOT at all) and 7.0 (VERY much) according to how you feel RIGHT NOW." The VLS is shown below:



AVERAGE

(See Appendix II)

Procedure

All subjects were given standardized instructions on how to complete the two questionnaires. In order to minimize bias in their responses, subjects were told that they had been selected for a "general attitude and well being survey" and the questions were to be completed. They were not informed that shift work was the subject of study. The

subjects were instructed to complete the (VAS-F) before the beginning of their relevant shift. The subjects were then asked to take the other questionnaire (the VLS) home and complete the questionnaire over a 7 day period. The subjects were instructed to record their responses twice a day at home, that is, when they first awoke from their main sleep, and also, at the end of the day before they went to bed. The VLS was used to collect information for repeated measures. The subjects were asked to provide demographic data such as age and sex before filling out the questionnaires. Information regarding the shift they work (day or night) was also collected.

The subjects used in this study were hired by Good Samaritan Health System to work a forty hour work week from Monday through Friday. The subjects worked non rotating 8 hour shifts, and their shift schedule (day/night) was determined at their time of hire.

Design

A 2 (shift) x 2 (gender) x 2 (arising) x 7 (days) mixed model ANOVA was used with shift (day/night) as one independent variable, gender (male/female) another independent variable, arising which had two levels, whereby, level one indicated when subjects awoke from their main sleep, and, level two indicated subject responses before they went to bed or after completing their daily activities and were ready to sleep, and days of the week (7 days) as the fourth independent variable. All respondents were asked to complete both questionnaires in order to yield a repeated measures design. Simple effects were also evaluated using t-tests for related measures. An alpha level of .05 was used. All of the analyses were completed using the CRISP microcomputer program. The readout includes specific details for all ANOVA tests and provides the set of t comparisons (based on the error mean square for *F*) for each variable with more than two levels.

Results

VLS Fatigue Scale

The results indicated the following: the overall effect of shift on the fatigue scale was statistically significant, F (1, 59) = 5.87 $p < .01$. The day shift workers reported lower fatigue scores than the night shift workers. However, no significant differences were observed on the gender variable F (1, 59) = .02 $p > .05$ (See Table 1). On the other hand, with respect to the within subjects factor, a statistically significant difference was obtained on the arising variable, F (1, 56) = 28.43 $p < .01$. The participant's scores revealed that their fatigue scores increased over the course of the day as compared to when they first awoke.

The shift x arising interaction produced a significant effect with an F (1, 56) = 4.88, $p < .03$ (See Table 1). When both shifts (day/night) were assessed on the arising variable, the results revealed that the participants' level of fatigue increased as the day progressed, that is, their level of fatigue when they first awoke (level 1) was significantly lower than their level of fatigue at the end of their work day (level 2) (See Figure 1).

The shift x days interaction produced a statistically significant difference, F (1, 336) = 2.35 $p < .03$ (See Table 1). When looking at the relationship between the type of shift and days of the week, each shift revealed a different pattern across the days of the week. For those individuals who worked the day shift, their fatigue level increased from Monday through Friday, and decreased on Saturday and Sunday.

For those participants who worked the night shift, a different pattern was observed. Sunday revealed a higher level of fatigue than Monday through Friday, and fatigue level declined on Saturday (See Figure 2).

Table 1

Mixed Effects ANOVA with Repeated Measures of the VLS (Fatigue Scale)

Source	df	SS (H)	MSS	F	P
Between Subjects	59	443.21			
G (GENDER)	1	0.14	0.14	0.02	0.89
S (SHIFT)	1	41.98	41.98	5.87	0.01
GS	1	0.32	0.32	0.05	0.83
Subj w Groups	56	400.76	7.16		
Within Subjects	780	2649.35			
A (ARISING)	1	681.91	681.91	28.43	0.00
GA	1	0.07	0.07	0.00	0.96
SA	1	116.95	116.95	4.88	0.03
GSA	1	0.02	0.02	0.00	0.98
A X SwGps	56	1343.18	23.99		
D (DAYS)	6	18.52	3.09	3.60	0.00
GD	6	4.29	0.71	0.83	0.55
SD	6	12.08	2.01	2.35	0.03
GSD	6	2.54	0.42	0.49	0.81
D X SwGps	336	288.25	0.86		
AD	6	4.50	0.75	1.47	0.19
GAD	6	2.71	0.45	0.89	0.51
SAD	6	2.11	0.35	0.69	0.66
GSAD	6	1.24	0.21	0.41	0.88
AD X SwGps	336	170.96	0.51		

Figure 1

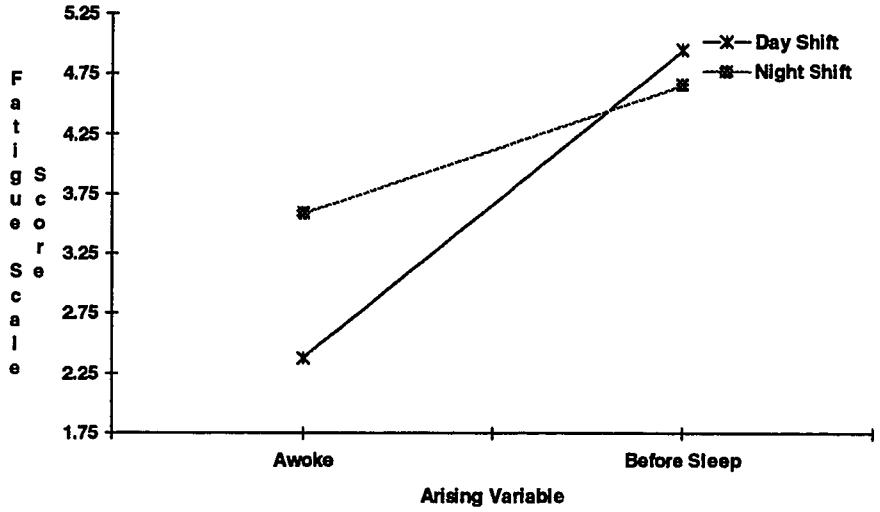


Figure 1. Fatigue level measured by the arising variable for the day and night shift

Figure 2

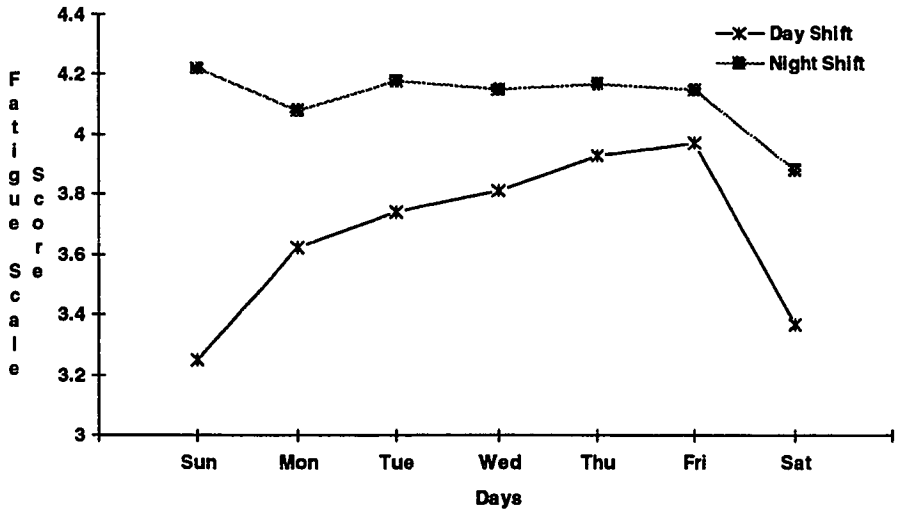


Figure 2. Relationship between the type of shift and the Fatigue scale score over the days of the week

t-tests were performed on the day variable to test for simple effects. *t*-tests revealed that weekend days were significantly different from each of the weekdays, but not from each other. Weekdays were not significantly different from each other. The *t*-tests revealed that subjects experienced less fatigue on Saturday and Sunday, and the respondents level of fatigue appeared to increase as the week progressed (See Figure 3).

VLS Energy Scale

Considering the energy scale, no statistically significant differences were obtained between subjects with the shift or the gender variable. However, the arising factor did result in a main effect, $F(1, 56) = 13.99, p < .01$. Results on the arising variable reveal that participants do have a higher energy level when they first wake up, and their energy level decreases before they go to bed at the end of the day. The energy scale values were derived from the means of 5 scores: energetic, active, vigorous, efficient and lively.

The day variable also produced a statistically significant difference whereby, $F(1, 336) = 2.96\ p < .01$. Looking at simple effects on the day factor indicates that participants do have more energy on Saturday and Sunday when compared to the rest of the week (See Table 2).

VAS-F Fatigue Scale

Results on the VAS-F fatigue scale indicate an almost significant difference on the shift variable whereby $F(1, 59) = 3.78\ p < .056$ (See Table 3).

VAS-F Energy Scale

Results on the VAS-F energy scale reveal that shift has produced a statistically significant difference on the energy scale, $F(1, 59) = 6.47\ p < .01$. Day shift workers appear to have more energy than the night shift workers (See Table 4).

Figure 3

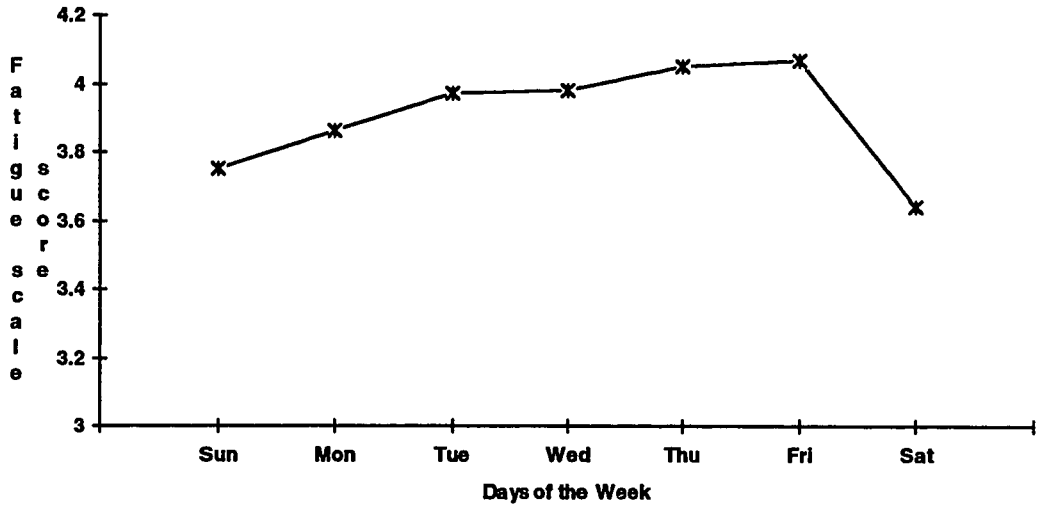


Figure 3. The mean Fatigue scale score across the days of the week

Table 2

Mixed Effects ANOVA with Repeated Measures of the VLS (Energy Scale)

Source	df	SS (H)	MSS	F	P
Between Subjects	59	327.39			
G (GENDER)	1	0.99	0.99	0.17	0.68
S (SHIFT)	1	1.10	1.10	0.19	0.66
GS	1	2.35	2.35	0.41	0.53
Subj w Groups	56	322.95	5.77		
Within Subjects	780	2188.60			
A (ARISING)	1	344.81	344.81	13.99	0.00
GA	1	21.22	21.22	0.86	0.36
SA	1	40.17	40.17	1.63	0.21
GSA	1	3.57	3.57	0.15	0.71
A X SwGps	56	1380.00	24.64		
D (DAYS)	6	10.99	1.83	2.96	0.01
GD	6	1.85	0.31	0.50	0.81
SD	6	4.42	0.74	1.19	0.31
GSD	6	1.26	0.21	0.34	0.92
D X SwGps	336	207.54	0.62		
AD	6	1.65	0.27	0.55	0.77
GAD	6	0.65	0.11	0.22	0.97
SAD	6	2.28	0.38	0.77	0.60
GSAD	6	1.99	0.33	0.67	0.68
AD X SwGps	336	166.21	0.49		

Table 3

Between groups ANOVA of VAS-F (Fatigue Scale)

Source	df	SS (H)	MSS	F	P
Between Subjects	62	535.23			
G (GENDER)	1	16.33	16.33	2.02	0.16
S (SHIFT)	1	30.53	30.53	3.78	0.06
GS	1	11.34	11.34	1.40	0.24
Subj w Groups	59	477.03	8.09		

Table 4

Between groups ANOVA of VAS-FE (Energy Scale)

Source	df	SS (H)	MSS	F	P
Between Subjects	62	416.03			
G (GENDER)	1	15.15	15.15	2.50	0.12
S (SHIFT)	1	39.07	39.07	6.47	0.01
GS	1	4.96	4.96	0.82	0.37
Subj w Groups	59	356.84	6.05		

Discussion

The overall effect of shift on the VLS fatigue scale produced significant results, which are consistent with the findings that individuals who work the night shift do experience a higher level of fatigue than individuals who work the day shift (Akerstedt, 1988). Typically, fatigue appears to be more widespread on the night shift than on the day shift. An important consequence of working the night shift is reduced sleep length. This reduced sleep length can have a major effect on the subjective state of the individual, especially fatigue. Figure 2 reveals that the night shift workers in this study demonstrate an overall higher level of fatigue during the work week as compared to the day shift workers who demonstrate a greater increase in fatigue over the work week (but at a lower level in contrast to the night shift workers).

Considering the within subjects factor on the VLS fatigue scale, the arising variable resulted in a significant effect. This variable revealed that respondents were less fatigued when they first awoke from their main sleep, and more fatigued at the end of the day before they went to sleep. Fatigue is often viewed as a variable that is highly correlated with time on the task in the workplace, and is primarily a result of physical activity (Paley & Tepas, 1994). Figure 2 reveals that the night shift workers demonstrate a higher level of fatigue when they awaken from their main sleep as compared to day shift workers who demonstrate a lower level of fatigue when they first awaken. However, there is a rapid increase in fatigue for day shift workers at the end of the day, where as the fatigue level for night shift workers is definitely higher at the end of the day, but more consistent with respect to their overall level of fatigue.

t tests on the VLS scale indicated that the weekend days were significantly different from each of the weekdays, but not from each other. This pattern was found with two other variables by Hawkins & Shaw (1992). This implies that respondents experienced

less fatigue over the weekend, and their level of fatigue appeared to increase during the course of the week. Weekends usually are the best time for individuals to relax, unwind and completely detach themselves from the world of work. They are able to spend more time with their families and are able to do things which they seldom find time to do during the work week. Individuals are able to sleep longer hours and "catch up on their sleep" if they need to. Hence, there are changes over the day in mood, subjective and objective sleepiness and fatigue (Monk, 1987).

During the work week, the individual's level of fatigue generally appears to increase. Shift work can severely impair the so called "time-oriented body functions." Individuals who experience difficulty adjusting his/her time-oriented body functions to their work schedule feel fatigue most of the time. The individual who cannot adjust his/her sleeping habits to the demands of the shift must live in a physically unpleasant situation.

Participants who worked the night shift portrayed a slightly different pattern, wherein Sunday revealed a higher level of fatigue than the rest of the work week. Their level of fatigue declined on Saturday. This could be a result of the participants trying to adjust and ready themselves for the approaching work week. They probably do not want to completely "let go" of themselves on Sunday, because Monday will result in a difficult change of schedule, and time-oriented body functions that could affect them.

The VLS energy scale however, produced no significant results with the shift or the gender variables. This indicates that respondents on both shifts (day/night) did not reveal any significant differences on this scale. Most research studies reveal that fatigue is more of a cause for concern because of its implications for safety in the work setting. Fatigue can also, severely impair an individual's daily physical activity. Energy, on the other hand is not as much as a cause for concern, since it does not severely impair daily activity.

However, the arising and day independent variables did result in main effects on the VLS energy scale. This could be a result of the fact that as individuals first awake from

their main sleep, they are much more energetic than before they go to bed at the end of the day. Results show that respondents do have more energy over the weekend when compared to the rest of the work week. This could be a result of them not having to go to work.

According to Lee et al., (1991) on the VAS-F scale to evaluate fatigue severity, healthy subjects demonstrated significant differences between their morning and evening scores on the VAS-F scale, while patients diagnosed with sleep disorders did not demonstrate any such differences between scores.

Looking at the VAS-F scale reveals that shift has produced an effect on the energy scale, contrary to that of the VLS scale. There is an almost significant effect on the fatigue sub-scale of the VAS-F, which falls a little above the $p < .05$ level of significance. Hence, it can be said that there are differences between groups when considering the energy scale, and an almost significant difference between groups when looking at the fatigue scale.

Let us now consider the variable that gave non significant results. It is important to note that gender might be an effective variable in future related work. One possible attribute for its non significance could be the small sample size. There were only 59 fully completed questionnaires in the study, although there were 63 participants, the power of the sample was considerably reduced. With additional subjects, results that are "nearly significant" in these data, might have reached significance.

In terms of generalizability of findings, it would be necessary to replicate the study on a larger subject sample. With a larger subject pool, variables such as gender or even age may have a significant effect on type of shift. However, with a small sample size it is difficult to obtain valid findings.

As we are aware of today, the prevalence of shift work is primarily an outcome of industrialization. Approximately, one-fourth of the working population in industrialized

countries is employed on some kind of shift work system. Working at night often produces a non work life out of synchrony with the rest of the world. One of the major consequences of shift work is disrupted or changing sleep times which could result in sleep disturbances and also fatigue. Fatigue can be viewed as a variable that is positively and highly correlated with time on task in the workplace and is a result of physical activity. In most research studies, fatigue is measured either qualitatively by self-report or observation, or quantitatively by measurement of muscle cell activity or strength. The VAS-F has been shown to be a valid and reliable instrument for the quantitative assessment of fatigue and energy levels in both healthy subjects and patients who complain of poor sleep. The VLS is a relatively newer measure of evaluating fatigue and energy levels, and is found to be as sensitive as the VAS-F in measuring subgroup differences in an undergraduate population, as well as a sample of health care workers as seen in this research study.

References

Akerstedt, T. (1988). Sleepiness as a consequence of shift work. Sleep, 11 (1), 17-34.

Berry, L.M. & Houston, J.P. (1993). Psychology at work. Dubuque: IA.

Chan, O.Y., Phoon, W.H., Gan, S.L., & Ngui, S.J. (1989). Sleep-wake patterns and subjective sleep quality of day and night workers: Interaction between napping and main sleep episodes. Sleep, 12 (5), 439-448.

Chen, M.K. (1986). The epidemiology of self-perceived fatigue among adults. Preventive Medicine, 15, 74-81.

Dekker, D.K., Paley, M.J., Popkin, S.M., & Tepas, D.I. (1993). Locomotive engineers and their spouses: coffee consumption, mood and sleep reports. Ergonomics, 36 (1-3), 233-238.

Harma, M. (1993). Individual differences in tolerance to shift work: a review. Ergonomics, 36 (1-3), 101-109.

Hawkins, J., & Murthy, S. (1993). A visual rating scale for vigor-lassitude. Sleep Research, 22, 209.

Hawkins, J., & Shaw, P. (1992). Self-reported sleep quality in college students: A repeated measures approach. Sleep, 15 (6) 545-549.

Lavie, P. (1981). Sleep habits and sleep disturbances in industrial workers in Israel: main findings and some characteristics of workers complaining of excessive daytime sleepiness. Sleep, 4 (2), 147-158.

Lee, K.A., Hicks, G., & Nino-Garcia, G. (1991). Validity and reliability of a scale to assess fatigue. Psychiatry Research, 36, 291-298.

Matsumoto, K., & Morita, Y. (1987). Effects of nighttime nap and age on sleep patterns of shift workers. Sleep, 10 (6), 580-589.

Monk, T.H. (1987). Subjective ratings of sleepiness - The underlying circadian mechanisms. Sleep, 10 (4), 343-353.

Monk, T.H., & Tepas, D.I. (1985). Shift work. In C.L. Cooper & M.J. Smith (Eds.), Job stress and blue collar work (pp. 65-84). New York: Wiley.

Mott, P.E., Mann, F.C., McLoughlin, Q., & Warwick, D.P. (1965). Shift Work: The social, psychological, and physical consequences. Ann Arbor: University of Michigan.

Muchinsky, P.M. (1993). Psychology applied to work. Pacific Grove: CA.

Paley, M.J., & Tepas, D.I. (1994). Fatigue and the shift worker: Firefighters working on a rotating shift schedule. Human Factors, 36 (2), 269-284.

Rosa, R.R., Colligan, M.J., & Lewis, P. (1989). Extended workdays: Effects of 8-hour and 12-hour rotating shift schedules on performance, subjective alertness, sleep patterns, and psychosocial variables. Work and Stress, 3, 21-32.

Tepas, D.I., & Monk, T.H. (1987). Work Schedules. In G. Salvendy (Ed.), Handbook of human factors (pp. 819-843). New York: Wiley.

Yositake, H. (1978). Three characteristic patterns of subjective fatigue symptoms. Ergonomics, 21, 231-233.

Appendix I

I am trying to find out about your level of energy right now. There are 18 items I would like you to respond to. This should only take about 1 minute of your time. Thank you.

DIRECTIONS: You are asked to place an "X" through these lines to indicate how you are feeling RIGHT NOW.

For example, suppose you have not eaten since yesterday. Where would you put the "X" on the line below?

not at all **hungry** _____ extremely **hungry**

You would probably put the "X" closer to the "extremely hungry" end of the line. This is where I put it.

not at all **hungry** _____ extremely **hungry**

NOW PLEASE COMPLETE THE FOLLOWING ITEMS:

not at all **tired** _____ extremely **tired**

not at all **sleepy** _____ extremely **sleepy**

not at all **drowsy** _____ extremely **drowsy**

not at all **fatigued** _____ extremely **fatigued**

not at all **worn out** _____ extremely **worn out**

not at all **energetic** _____ extremely **energetic**

not at all **active** _____ extremely **active**

not at all **vigorous** _____ extremely **vigorous**

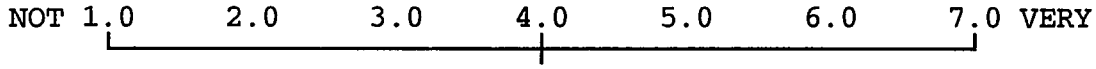
not at all **efficient** _____ extremely **efficient**

not at all	_____	extremely
lively		**lively**
not at all	_____	extremely
bushed		**bushed**
not at all	_____	extremely
exhausted		**exhausted**
keeping my eyes open is no effort at all	_____	**keeping my eyes open is a tremendous chore**
moving my body is no effort at all	_____	**moving my body is a tremendous chore**
concentrating is no effort at all	_____	**concentrating is a tremendous chore**
carrying on a conversation is no effort at all	_____	**carrying on a conversation is a tremendous chore**
I have absolutely no desire to close my eyes	_____	**I have a tremendous desire to close my eyes**
I have absolutely no desire to lie down	_____	**I have a tremendous desire to lie down**

Appendix II

MORNING — Give these responses when you first get up.

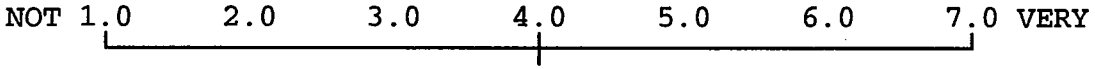
Use the line to to rate each word between 1.0 (NOT at all) and 7.0 (VERY much) according to how you feel RIGHT NOW:



Day	Tired	Sleepy	Drowsy	Fatigued	Worn out	Energetic	Active	Vigorous	Efficient	Lively
Sunday										
Monday										
Tuesday										
Wednesday										
Thursday										
Friday										
Saturday										

NIGHT — Give these responses just before you turn the lights off to go to sleep.

Use the line to to rate each word between 1.0 (NOT at all) and 7.0 (VERY much) according to how you feel RIGHT NOW:



Day	Tired	Sleepy	Drowsy	Fatigued	Worn out	Energetic	Active	Vigorous	Efficient	Lively
Sunday										
Monday										
Tuesday										
Wednesday										
Thursday										
Friday										
Saturday										

Figure Captions

Figure 1. Fatigue level measured by the arising variable for the day and night shift.

Figure 2. Relationship between type of shift and the Fatigue scale score over the days of the week.

Figure 3. The mean Fatigue scale score across the days of the week.