Stress, Sleep Deprivation, and Vigilant Attention: A Study on Workload of Postgraduate Learning Task

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Abstract
In cognitive ergonomics, study on sleep deprivation has received considerable attention in the literature. Researchers studied length and timing of sleep and its relationship with several variables. Present study aimed to examine student’s stress level, sleep debt, and vigilance in doing Master study at university. Life stress questionnaire, sleep diary, NASA task load index and psychomotor vigilance test were used to measure the variables. A 10-days observation shows that duration of sleep did not have significant linear correlation with vigilant attention. However, the postgraduate learning task was perceived to be stressful and ‘mental demand’ contributed to be the most weight factor in NASA workload index. Moreover, it was also perceived as a ‘temporal demand’ in the workload rate rating. Critical review, limitations, suggestion and reflection were also discussed in the present study.

Keywords: Stress, Sleep Deprivation, Vigilant Attention, Post Graduate Learning

INTRODUCTION
Studying at university, especially in postgraduate level, is associated with huge change, and for most people change brings stress (Palmer & Puri, 2006). At university there is a need for students to be more proactive in studies, social life, and ability to manage their own. It is commonly known that students in postgraduate level often experience sleep deprivation due to work and mental load in their learning activity.

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It has been generally assumed that the primary function of sleep is to restitute certain physiological process which deteriorates during periods of wakefulness (Taub & Berger, 1973). However, chronic sleep deprivation is endemic in modern society (Belenky, et al., 2003). Therefore, national sleep foundation (as cited in Belenky et al., 2003) recommends that optimum duration of sleep is 8 hours per night.

Moreover, study on sleep deprivation has received considerable attention in the literature. Researchers studied length and timing of sleep and its relationship with other variables i.e. performance (Taub & Berger, 1973; Axelsson et al., 2008), mood (Taub & Berger, 1973), stimulant to counteract sleepiness (Anderson & Horne, 2008), socio-economic status & behavioral problems (Arman, et al., 2011), obesity (Calamaro, Park & Mason, 2010), workload of professional ballet dancers (Fietza et al., 2008) and so forth.

Cristie, Kenna, & Connoly (2008) conducted study on sleep restriction in the rat and found that 24 hours of sleep deprivation increases sleepiness and decreases vigilance. Similar result was also found by Fafrowicz et al. (2010). They found that sleep deprivation affected performance on a sustained attention task and manifested itself in a higher number of omission errors.

OBJECTIVE
Present study aimed to examine stress level, task load level and the relationship between length of sleep and vigilance in the postgraduate study environment.

METHODS
Participant
Participant is a male, healthy, non-smoker, non-obese, non-alcohol consumer and drug free. Moreover, he is right handed and has corrected-to-normal vision. Participant is a student at International Islamic University Malaysia, in postgraduate study (master level), and in first semester study with 12 credit hours study.

When experiment was being performed, participant was in 10th week study period, took four subjects or courses. Each course has 2.5 hours learning in class (weekly), and 3-4 individual assignment as task load.

Study design
To examine the correlation of sleep length to vigilant attention, subject performed the psychomotor vigilance task daily, every morning after wake up, with varied duration of sleep during experiment. Observation was performed ten days to get varied length of sleep. Subject performed daily similar learning activities
during observation such as study in class, discussion, and doing individual assignment. In experiment period, subject was not allowed to travel to another city, work either part or full time, and there was no daytime napping. The illustration of study design can be seen in Table 1.

Participant was also required to complete the life stress questionnaire once before experiment period. After the study, participant was also required to complete the subjective NASA Task Load Index to measure the perception about workload in doing master at university.

Table 1: Study design: Record the daily sleep durations and PVT score for ten days observation

<table>
<thead>
<tr>
<th>Day</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
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<tbody>
<tr>
<td>varied sleep duration</td>
<td>sleep 1</td>
<td>sleep 2</td>
<td>sleep 3</td>
<td>sleep 4</td>
<td>sleep 5</td>
<td>sleep 6</td>
<td>sleep 7</td>
<td>sleep 8</td>
<td>sleep 9</td>
<td>sleep 10</td>
</tr>
<tr>
<td>PVT</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>10</td>
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</tbody>
</table>

**Study procedures**

On an initial day, before the study, participant was required to complete initial session on the PVT, to overcome practice effects. During experiment period, participant recorded the length of sleep in sleep diary.

Daily psychomotor vigilance test performed 1 hours after wake from sleep. Before the test, subject was performed the same regular activities such as taking ablution, performing *qiyamu lail* prayer, and drinking mineral water. Doing these regular activities before PVT was assumed to make the participant in fresh condition.

**Measures**

**Life stress**

To examine the stress level, we used Cooper’s the life stress questionnaire (adapted from Palmer & Puri, 2006). Subject was requested to think of a problem he was finding difficult in dealing with workload of postgraduate study. A five-point rating scales was used in the questionnaire. If the score less than 58 it would appear that many of his behaviors to deal with stress are not always very helpful, whilst a score of a 116 or over would indicate that his behaviors are conducive to dealing with stressful situations.

**The psychomotor vigilance test (PVT)**
The Psychomotor Vigilance Test (PVT) has become arguably the most widely used measure of behavioral alertness, with more than 150 peer-reviewed publications demonstrating its high sensitivity to acute total and chronic partial sleep restriction and circadian misalignment (Basner, Mollicone, & Dinges, 2012). Specifically, the PVT is a sustained-attention, reaction-timed task that measures the speed with which subjects respond to a visual stimulus. Participant performed the PVT online through the http://www.sleepdisordersflorida.com/pvt

**NASA Task Load Index**
The NASA Task Load Index is a multi-dimensional rating procedure that provides an overall workload score based on a weighted average of ratings on six subscales: Mental demands, physical demands, temporal demands, own performance, effort, and frustration. Moreover, the degree to which each of the six factors contribute to the workload of the specific task to be evaluated from the raters perspectives is determined by their responses to pair-wise comparisons among the six factors. Magnitude ratings on each subscale are obtained after each performance of a task or task segment. Ratings of factors deemed most important in creating the workload of a task are given more weight in computing the overall workload score. In the present study we used NASA Task Load Index (NASA TLX) version 1.0

**Data Analysis**
To examine the correlation, author used Pearson product moment formula. Therefore, SPSS version 16.0 was used to analyze the data.

**RESULT**
**Stress level**
Participant gained score 118 in life stress mark. Whilst a score of a 116 or over would indicate that his behaviors are conducive to dealing with stressful situations (Palmer and Puri, 2006). The rank of life stress score can be seen in Figure 1.

![Figure 1. Score of Life Stress](http://joew.discinternational.org)
Length of sleep and PVT
From the 10-day observation, we got varied sleep durations (hours) and PVT scores (millisecond). Figure 3 depicts the durations of sleep which are ranged from 3.5 hours until 7 hours (mean= 4.9) and the response time at 411ms until 452ms (mean= 432). Although subject performed varied duration of sleep and experienced sleep debt, he did not report any bad condition and feeling during the observation period. He reported that he was in good and fresh condition in the morning during the experiment. Specifically, descriptive statistics and the correlation score of these data can be seen in table 2 and table 3 respectively.

![Chart](image)

Figure2. Length of Sleep (h) and Response time (ms)

<table>
<thead>
<tr>
<th>Table 2: Descriptive Statistics</th>
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<tr>
<td>sleep duration (h)</td>
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<td>----------------------</td>
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<td></td>
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<tr>
<td>response time (ms)</td>
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<td>Valid N (listwise)</td>
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| Table 3: Correlations of Sleep Duration and Response Time |
From the correlation analysis (as can be seen in the table 3) we got 0.192 for correlation score between sleep duration and response time. Therefore, it does not show a significant linear relationship (p=0.595). Hence the vigilance attention is not correlated with duration of sleep. For instance, if the duration of sleep is high it does not mean that the PVT score will be low or vice versa.

**NASA Task Load Index**
The NASA Task Load Index is a multi dimensional rating procedure that provides an overall workload score based on a weighted average of ratings on six subscales: Mental demands, physical demands, temporal demands, own performance, effort, and frustration. Participant got 62.7 for overall workload score.

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**WORKLOAD SCORE**

![Figure 3. NASA Workload Score](https://joew.discinternational.org)
Figure 3 provides information regarding the weight and rate rating on six subscales of NASA task load index. According to subject’s evaluation, “effort” subscale has been placed to the highest factor contributed to workload of postgraduate learning task with weight score 5. The second most contributed factor to the workload is “mental demand” which received weight score 4. Moreover, “temporal demand” came third on the list with weight score 3. Next, “physical demand”, “performance”, and “frustration” followed temporal demand with the same score, 1 for each subscales.

In rate rating, ‘temporal demand’ came in the first place with 80 points, followed by other subscales: ‘mental demand’, ‘effort’, ‘frustration’, ‘physical’ and ‘performance’ with rating 70, 60, 60, 30, 30, respectively.

**DISCUSSION**

**Critical review**

Although participant perceived that learning task in postgraduate environment is stressful, the stress level score indicated that subject could deal with the stressful workload of postgraduate learning task. Stress is also about perception and adapting ability. We can refer back to the stress definition. One of the most commonly used definitions of stress is by Dr. Richard Lazarus (as cited in Palmer & Puri, 2006):

“Stress arises when individuals perceive that they cannot adequately cope with the demands being made on them or with threats to their well being.”

Thus, if person can perceive that they are able to deal with the demands being made on him, he will not fall in an excessive bad situation and condition in his well being. Positive thinking and high self-efficacy could be one of the strategies to defend against stress.

Moving to discuss the length of sleep and PVT, as the p-value is 0.595, it can be safely said that there is no significant linear correlation between duration of sleep and PVT score. Therefore, if the duration of sleep is high it does not mean that the PVT score will be low. Hence the vigilance attention is not significantly correlated with duration of sleep either positive or negative.

It is not merely about the quantity of sleep, but also the quality of sleep directly affects the quality of waking life, including mental sharpness, productivity, emotional balance, creativity, physical vitality, and even weight (Smith, Robinson, and Segal, 2012).
According to National Institutes of Health and National Heart, Lung and Blood Institute (as cited in Stibich, 2009), there are five phases of sleep: stages 1, 2, 3, 4 and REM (rapid eye movement). Usually when we are sleeping, we begin at stage 1 and go through each stage until reaching REM sleep, and then we begin the cycle again. Each complete sleep cycle takes from 90 to 110 minutes. Our brain acts differently in each stage of sleep. In some of the stages, our body may make movements, but in others our arms and legs will be immobile. The sleep stages are explained below:

“Stage 1 sleep is light sleep. We experience a drifting in and out of sleep. We can be easily woken up. Our eye movement and body movements slow down. We may experience sudden jerky movement of your legs or other muscles. These are known as hypnic myoclonia or myoclonic jerks. These “sleep starts” can give a sensation of falling. They are caused by the motor areas of the brain being spontaneously stimulated. Next, we enter into stage 2 sleep. Around 50 percent of our time sleeping is spent in stage 2 sleep. During this stage, eye movement stops and our brain waves (a measure of the activity level of the brain) become slower. There will also be brief bursts of rapid brain activity called sleep spindles. Stage 3 is the first stage of deep sleep. The brain waves are a combination of slow waves, known as delta waves, combined with faster waves. During stage 3 sleep it can be very difficult to wake someone up. If we are woken up during this stage, you may feel groggy and disoriented for several minutes. The next stage 4 sleep is the second stage of deep sleep. In this stage the brain is making the slow delta waves almost exclusively. In this stage it is also very difficult to wake someone up. REM sleep is the sleep stage in which dreaming occurs. When we enter into REM sleep, our breathing becomes fast, irregular and shallow. Our eyes will move rapidly and our muscles become immobile. Heart rate and blood pressure increase. REM sleep is also the phase of sleep in which we dream. This sleep phase begins about 70 to 90 minutes after we fall asleep. The first sleep cycle has a shorter phase of REM sleep. Toward morning, the time spent in REM sleep increases and the deep sleep stages decrease.”

(Source: National Institutes of Health and National Heart, Lung and Blood Institute as cited in Stibich, 2009)
All sleep is not created equal. Sleep unfolds in a series of recurring sleep stages that are very different from one another in terms of what’s happening beneath the surface. To be more specific, the sleep stages can be seen in figure 4.

![Figure 4. Sleep Stage](source: cited from Smith, Robinson, and Segal, 2012)

This study shows that the length of sleep is not correlated with vigilant attention. We may presume that the key factor of sleep effectiveness is the number of completed sleep cycles by participant, or he could wake up not in the REM stage. Thus, although he only slept with a little duration of sleep, he still could feel fresh in the morning during observation period.

CONCLUSION AND LIMITATION

Present study demonstrates that learning task in postgraduate environment is stressful. However, we can deal with a lot of helpful behavior to gain good health condition both physically and mentally. Present study also shows non-significant liner correlation between the length of sleep and vigilant performance. There are several limitations in this Study. First and foremost, the participant is only one subject with self-observed and reported study design. It may cause bias in a certain level of observation. Second, present study was held in simple setting without any sophisticated sleep experiment tools to gain more accurate data related sleepiness, circadian, and vital sign during experiment. Due to the limitations, author suggested to enlarge the number of sample, independency, and the equipment used in next experiment.

REFERENCES


