

Effect of Gender Differences on Occupational Stress among Engineering Workshop Trainees

**Bahador Keshvari and Matrebi Abdulrani
Department of Mechanical Engineering
University Technology Malaysia
Skudai, Johorbahru 681310 Malaysia**

Abstract

Occupational stress as main factor affect on performance considering in neuroergonomic. This paper focused on effect of gender differences among engineering workshop trainees in recall task. 120 (non-smokers) Participants consisted of 60 males and 60 Females. University's library (single room) and laboratory of mechanical engineering were places to do experiment. Experiment involved three stages and two tasks. First and second stages were hold in non-stressful situation in Library and third stage was hold in stressful-situation in laboratory of mechanical engineering.. Measuring heart rate was holding twice per stage; 1- before tasks 2-during tasks. Each measuring heart rate took time about thirty seconds. The analysis heart rate reactivity, recall task efficiency were accomplished through SPSS 18. Mean of heart rate in base line and stress per subject was calculated. Correlation and regression were SPSS methods to analyze. Gender differences clearly influenced heart rate reactivity and mental task in base-line and stressful situation. Results demonstrated that males adapted faster than females in stress situation. Result of mental task demonstrated also effect stress decreased mental efficiency in female as comparing males.

Keywords

Occupational stress, gender, recall task.

1. Introduction

Impact of stress on short term memory determined that some internal stressors such as time pressure, unpredictability, loss control, threat and external stressors such as age, gender and race influenced performance (Anthony W.K. Gaillard, 2008).

Researchers in the field of psychoneuroendocrinology have made substantial progress over the last decades in trying to disentangle conditions and mechanisms underlying the impact of stress on memory. The relation between gender and stress reveals several conflicting outcomes; numerous authors have determined that women find themselves in stressful circumstances more often than men (Almeida & Kessler, 1998; McDonough & Walters, 2001). Other authors have suggested that it is possible that women appraise threatening events as more stressful than men do (Miller & Kirsch, 1987; Ptacek, Smith, & Zanas, 1992). Furthermore, women have been found to have more chronic stress than men (McDonough & Walters, 2001; Turner et al., 1995; Nolen-Hoeksema, Larson, & Grayson, 1999). They are exposed to more daily stress associated with their routine role functioning (Kessler & McLeod, 1984). To date, little is known about gender differences in responses to repeated exposures to a stressor. There is a considerable amount of evidence indicating that women are both more psychologically and physiologically reactive to stressors than men. This includes greater HR (Kudielka et al., 2004; Labouvie-Vief et al., 2003; Smith et al., 1997; Stoney et al., 1987).

Current study is indicated relation between heart rate reactivity and mental performance in non-stressful (baseline) and stressful situation (stress) among male and female trainees.

2. Method

2.1 Tasks and subjects selection

Total of 120 subjects were randomly selected in library of UTM from engineering faculties as mechanical, electrical, chemical engineering. They included of four nationalities and races, such as Malay (15male and 15 female), Chinese (15male and 15 female), Iranian (15male and 15 female) and African (15male and 15 female). To evaluate short-term memory, Recall task was applied. Recall task should be consisted of number, words and combining of them. At current study, we applied 204 words which derived in to four groups as Positive, negative, neutral and arousing words (Kuhlmann et al., 2005). Figure 1 indicates 48 words was which were used in experiment.

Friendly	alive	Afraid	Insulted	Chair	Lamp	Awake	Boring
Luminous	Sure	Destroyed	Excessive	number	Blouse	Despairing	Rewarding
Fair	royal	Bankrupt	devastated	newspaper	Stone	Opposed	Amazing
Joyous	Reliable	Damaged	Harmed	Glass	Hook	charming	Anxious
Wealthy	Terrific	Down	Heartless	pot	Street	Inspired	Eager
Easy	Graceful	Pain	Grumpy	Shoe	Bridge	Interesting	Exciting
<i>Positive</i>		<i>Negative</i>		<i>neutral</i>		<i>arousing</i>	

Figure 1: list of words that used in recall task

Recall task was according to process such as; i) remembering the words during two minutes; ii) retaining the words for thirty seconds iii) writing words which are remembered. Experiment consisted of three stages.

First and second stages were hold in non-stressful situation (baseline) and third stage were hold in stressful situation (stress). 24 of 48 words which determined were applied at first stage. The rest words (24 remained words) were applied at second stage. Combining of words in first and second stages makes third stage words. There are six steps to do experiment;

First Step: Participant was asked to get relaxing. The Participant have some activity such as walking ,running ,talking and etc before attending to place of experiment. Relaxing time was selected 2 minutes. It is according to autonomic cardiac function measured (Liao, 1995).

Second step: Heart rate reactivity was measured by oximeter pluse (HR1). Participant inserts his finger inside oximeter. The device (oximeter pulse) showed some numbers. Researcher registers all heart rate numbers which is shown on screen during 30 seconds (Mariaconsuelo et al 2009).

Third Step: Participant was asked to memorize the 24 words during 2 minutes. 24 words were different at stage 2 and stage 3.

Forth step: Participant was asked to retain words that had been memorized during 30 seconds. Measuring heart rate was repeated at this step.

Fifth step: Heart rate was measured by oximeter during 30 seconds.

Sixth step: During 2 minutes Participant wrote what had been remembering.

All six steps were held in second and third stages. Experiment consists of three stages. First and second stages were held in non-stressful situation and third stage was held in stressful situation.

2.2 Calculating recall task performance and heart rate

To calculate efficiency per stage, number of words that participant was remembered and written had been counted. The number was divided in 24 words. (e.g. 14 words was written to 24 words; $14/24=58.33\%$). To calculate efficiency of performance in baseline, mean of efficiency of performance in first and second stages was considered as ($P_{BASELINE}$). It is clear that (P_{STRESS}) determined efficiency of performance in stressful situation of third stage.

Difference between Mean of heart rate in first and second stage (baseline) and third stage (stress) were determined in table 1 and 2 in section 2.3. Heart rate reactivity before recall task (HR1) was reached through;
(Mean of heart rate in baseline before recall task) – (mean of heart rate in stress before recall task) = Mean of heart rate reactivity before recall task.

Heart rate reactivity during recall task (HR2) obtained through;

(Mean of heart rate in baseline during recall task) – (mean of heart rate in stress during recall task) = Mean of heart rate reactivity during recall task

2.3 Differences in stages

Third stage was different from first and second stages. Some stressors as new environment ,reward and placebo competitors were added in third stages. First and second stage was hold at single-room in library. Third stage was hold in mechanical lab with four counterfeit competitors. In order to determine subjects who must be non-smoking, a device was applied to measure nicotine rate in body. Smokerlyzer was applied to select non-smoking subjects. Figure 2 showed three placebo competitors accompanied actual participant in order to make stress situation.



Figure 2: Actual and counterfeit participants in Mechanical Laboratory

A motivational factor (reward) could due to come over all participants during three stages. A questionnaire was distributed to determine reward per race. Relation between student cost and reward was considered per race. Ten samples of our data showed in table 1 and 2. Heart rate in stressful situation and baseline, heart rate reactivity, performance and race were determined for ten participants. Mean of heart rate before recall task and mean of heart rate during recall task is shown HR1 and HR2. Difference of performance in non-stressful and stressful situation is shown as ($P_{baseline} - P_{Stress}$). Difference heart rate in non-stressful and is shown as ($HR1_{Baseline} - HR1_{Stress}$).

This paper is focused on relation between heart rate which was measured before recall task and recall task performance.

Table 1. data collection for 7 samples before recall task

HR1 baseline	HR1 Stress	P _{baseline} - P _{stress}	Gender	HR1 _{baseline} - HR1 _{stress}
56.36	62.35	-12.00	Male	-5.99
62.15	69.25	-28.00	Male	-7.10
57.00	66.35	-10.00	Male	-9.35
59.21	77.31	-13.00	Male	-18.10
63.87	67.23	-12.00	Male	-3.36
63.58	79.23	-36.00	female	-15.65
58.14	64.68	-10.00	female	-6.54

Table 2. Measuring heart rate data during task and performance differences (7samples of 120 data)

HR2 baseline	HR2 Stress	P _{baseline} - P _{stress}	Gender	HR2 _{baseline} - HR2 _{stress}
69.24	71.02	-15.32	Male	-1.78
65.58	79.35	-26.34	Male	-13.77
65.10	82.35	-32.21	Female	-17.25
66.93	69.32	-10.00	Male	-2.39
66.32	75.23	-15.00	female	-8.91
68.79	81.23	-29.00	Male	-12.44
69.35	64.68	-10.00	female	4.67

3. Data Analysis

Correlation between heart rate, performance and gender is evaluated by SPSS 18. Correlation and Pearson coefficient was applied and also p-value <0.05. Mean of P_{baseline} is determined mean of performance in first stage and second stage. P_{stress} is demonstrated performance in third stage.

Table 3: Relation between heart rate (HR1), performance and gender before task

gender	variables	relationship	P-value
male	(Mean of P _{baseline}) - P _{stress}	-0.21*	0.05
	(Mean of HR _{baseline}) - HR _{stress}		
female	(Mean of P _{baseline}) - P _{stress}	-0.40**	0.001
	(Mean of HR _{baseline}) - HR _{stress}		

**Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

As presented in Figure 4, relationship between (Performance in baseline=P_{baseline}) - (performance in stress=P_{stress}) and (Heart rate in stress=HR_{stress}) - (heart rate in baseline =HR_{baseline}) which was measured in two situation stressful and baseline.

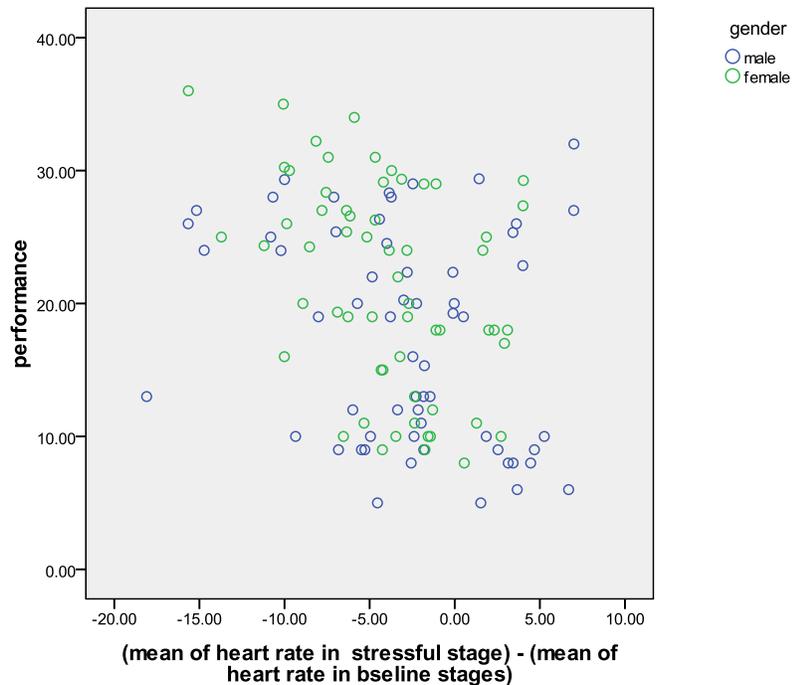


Figure 3: relationships between performance and differences of heart rate

Table 3, Table 4 and figure 3 indicate P_{value} for females is more significant than males although R coefficient is not more than 0.5. One of the reasons that caused to insignificant R coefficient is number of participants (120 participants). If this number increases more than 1000 participants, R coefficient could be more than 0.5.

Table 4: Regression analysis results

P	T	β	R^2	R	P	F	Criterion variable	Predictor variable	gender
0.05	-1.976	-0.17	0.06	0.21	0.05	3.904	(HR _{base line} – HR _{stress})	performance	male
0.001	-3.371	-0.22	0.16	0.40	0.001	11.364	(HR _{base line} – HR _{stress})	performance	Female

Regression analysis results (table 4) is indicated that the regression correlation coefficient between two variables 1-performance 2-Mean of heart rate reactivity for male gender are 0.21 and for female gender 0.40. Influence coefficient (B) in male gender determine that if performance increase one-unit, difference base line – stress decrease 0.17% and also if female gender performance increase one unit, difference baseline-stress decrease 0.22%.

By considering Table 4, R square (determination coefficient) for male is 0.06 and for female is 0.16. One of the reasons is to induces inappropriate determination coefficient is number of our experiment sample. Sample number is 120 participants who attended to the experiment.

4. Discussion

This paper was determined effect of gender on short memory. According to previous finding, stress influences short-term memory in female more than male. Stress also influences retrieval memory which is more significant in females (Joels et al., 2006; Lupien and McEwen, 1997).

Joels et al (2006) and Kim JJ et al (2002) determined stress has an impact on how much we remember, especially on the quantity of memory. And Zorawski and his team (2006) indicated that participants have better

consolidation of memory when their stress was accompanied by high cortisol level. In the other side, Buchanan and Iovino (?), Cahill et al (2003) and Jelicic et al (2004) showed that cortisol elevation more than physiological range result in impairs memory retrieval in humans. Zorawski and his team determined that there is positive relationship between elevation of cortisol level and better consolidation of memory which are more significant in males. It is obvious that the elevation of cortisol level is not more than physiological range. It can be understood that dosage of cortisol among males in stressful situation is more appropriate variation than females. Stroud and his team (2002) determined that cortisol variation in females (ΔC_F) is greater than its males.

Considering last paragraph, it could be understood that variation of cortisol in certain time for females is greater than males. It could be presented like;

$$\frac{\Delta C_F}{\Delta C_T} \geq \frac{\Delta C_M}{\Delta C_T}$$

(1)

The finding of this research which was presented in last sentence is demonstrated by Kirschbaum et al (1996) and Lepore et al (2000). They detected there is a significant correlation between cortisol and memory. It means that high cortisol variation result in poorer memory.

According our findings in chapter 4, Males showed greater performance of recall task than females during stressful situation. And also females showed greater heart rate reactivity than males during stressful situation. These findings was demonstrated by researchers such as Kudielka et al (2004), Smith et al (1997), Stoney (1997) which presented in chapter 2. It could be presented that heart rate reactivity in certain time among females is greater than males;

$$\frac{\Delta H_F}{\Delta C_T} \geq \frac{\Delta H_M}{\Delta C_T}$$

(2)

Combining the equation (1) and (2) result in equation (3) where this research finding is formed.

$$a = \frac{\Delta C_F}{\Delta H_F} > \frac{\Delta C_M}{\Delta H_M} = b$$

(3)

As presented in equation (3), if proportion of cortisol variation to heart rate reactivity in females is greater than its proportion in male, it could be understood that males shows higher performance level than females. It can be concluded that if amount of (a) is greater than (b), males' performance in recall task is greater than females.

$$\text{If } a = \frac{\Delta C_F}{\Delta H_F} > \frac{\Delta C_M}{\Delta H_M} = b \implies \text{Then Mental performance}_{\text{Female}} < \text{Mental performance}_{\text{Male}}$$

(4)

Based on physiology findings, Stroud (2002) determined that women showed greater cortisol reactivity than men. Other hand, Kirschbaum (1996) a strong correlation was detected that a more pronounced cortisol response was associated with poorer memory. The results determined previous findings of researchers such Kuhlmann (2005). The result indicates efficiency of mental task and physical task in stressful situation more degraded than baseline situation. The finding justified researchers such as 'Stroud' and 'Kirschbaum' that gender differences influence recall task efficiency in stress and baseline situation. Results determined female efficiency is less than male efficiency in stressful situation. Our findings confirm the previous finding. It also demonstrated males adapted with stressful situation faster than females. Current study is determined that memory consolidation in men will due to increase efficiency in stressful situations.

Current experiment does not limited to special groups, small or huge company. It encompasses all companies which gender difference interacts with work-load. Stressors could influence efficiency such as fatigue, work-overload and time pressure. Based on the research findings, gender difference should be considered to design workload. Tasks which relate short term memory show effect of stress between male and female significantly. Human resource managers could use the results in order to choose the fittest candidate among those who volunteer for tasks with high level of occupational stress.

5. Conclusion

According to analysis data of experiment, the results demonstrated effect of stress on mental task in engineering workshop training among non-smoking trainees. Finding of the experiment shows effect of stress on mental performance is more significant in female as comparing male. Results demonstrated that males adapted faster than females in stress situation. Result of mental task demonstrated also effect of stress decreased mental efficiency in female more than males.

Acknowledgement

Author, Bahador Keshvari was supported by medical center of university Technology of Malaysia.

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