DETERMINING THE EFFECT OF GENDER AND RACIAL DIFFERENCES ON MENTAL AND PHYSICAL TASKS

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UNIVERSITI TEKNOLOGI MALAYSIA
DETERMINING THE EFFECT OF GENDER AND RACIAL DIFFERENCES ON MENTAL AND PHYSICAL TASKS

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A project report submitted in partial fulfilment of the requirements for the award of the degree of Master of Engineering (Mechanical)

Faculty of Mechanical Engineering
Universiti Teknologi Malaysia

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Thanks to

God for all the given opportunities and blesses,

And My Parents.
ACKNOWLEDGEMENT

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ABSTRACT

Occupational stress has attracted the attention of many researchers during recent years. Through studies of stress the level of efficiency of work performance can be increased while the level of human error can be decreased. Investigating stress without considering human factors such as gender and race cannot be effective and reliable. Many studies investigate these factors but findings show conflicts among investigation results. The aim of this research is resulted by gender and racial differences to investigate the effects on performance of mental and physical tasks. A total of 120 (non-smoking) participants consisted of 60 males and 60 female of different races such as Malay, Chinese, Iranian and Black-African. Two tasks were considered in the experiment: i) Mental, ii) Physical. The experiment consisted of three stages. The first and second stage were held in a non-stressful situation in a library and the third stage was held in a stressful-situation in a mechanical engineering workshop. Considering energy expenditure per tasks were accomplished consecutively in each stage. Heart rate was measured once before and once during each task, each measurement taking approximately thirty seconds. Mean heart rate numbers during thirty second periods were recorded for the analysis of baseline (non-stress) and stress situations. To measure heart rate, “Oxi-meter finger pulse” was applied. To measure nicotine rate in order to determine non-smoking subjects, “Smokerlyzer” was used. A questionnaire was administered to a random group of students before stages in order to determine an appropriate reward for the winner of each skill competition in third stage. The analysis heart rate reactivity, recall task efficiency and typing task efficiency were accomplished through SPSS 18. Mean heart rate in baseline and stress per subject was calculated. Correlation and regression were SPSS methods to analyze ($P_{\text{value}} < 0.05$). Gender differences clearly influenced heart rate reactivity, and mental task in baseline and stressful situation. Results demonstrated that stress decreased mental efficiency in females more than males, also that males adapted faster than females in stressful situations.
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Chapter 1

INTRODUCTION

1.1 Introduction

This study focuses on determining the effect of gender and racial differences on mental and physical tasks among engineering workshop trainees, hence human performance. According to Bailey (1989), human performance is defined as “the result of a pattern of actions carried out to satisfy an objective according to some standard”. For designing an experiment, a good understanding of how people respond to stress and process information is like wiring a house with good understanding of the principles of basic electricity (He et al., 2005). According to the above matters, this research develops and evaluates the stressors affecting the performance of engineering work shop trainees. Indeed, it provides a basis for the study of neuroergonomic.

1.2 Background of Problem

This study focuses on physiological and psychological problems caused by stress especially for trainees. Works by Kellogg, Hopko and Ashraf (1999), Robert and Hockey (1997) shows some issues will increase this stress in different ways such as:

i) Inappropriate distribution of workload may directly affect the stress.

ii) Assigning the employees to the wrong working positions also could result in dissatisfaction and time pressure which could lead to increased psychological stressors.
According to Yerkes and Dodson’s rule (1908), performance and arousal (stress) were related to each other. In this rule, there was an optimum amount of stress which provided us the best performance and particular amount of stress. Before this optimum point, it was possible to increase the performance by increasing stress. After the optimum point, performance would decrease. Figure 1.1 shows optimum point beyond which the performance would decrease.

![An inverted U-shaped curve](Source: Yerkes and Dodson, 1908)

In order to increase the performance, administrators consider high rewards for careers. Also some researchers like Kudielka et al. (2004) and Labouvie-Vief, Lumely, Jaine and Heinze. (2003) indicated that gender and race would affect the performance of people who were in stressful situation. Improper management of reward without considering factors like gender and race would affect psychological stress. On the other hand, stress could affect the performance according to Yerkes-Dodson’s rule. Based on this rule, to reach high performance, all factors should be well-balanced. An imbalance between psychological and physiological factors may result in human error and could lead to tragic accidents such as Flixborough in 1974 (Hoiset et al., 2000) Three Mile Island (Bot, 2003) in 1979, Chernobyl (Stang, 1996) in 1986. This study focuses on effects of psychological stress on performance. In order to do that, the research investigates factors influencing stress such as gender and race-related stress.
Field et al. (1992) in “Stress and Coping in infancy and childhood” book provided information about the levels of stress. Figure 1.2 provides a graph of how stressors are able to contribute to medical-deprivation situation.

![Diagram of the relationship between stressors and health outcomes](source: Field et al., 1992)

**Figure 1.2** The relationship between stressors and health outcomes

(Source: Field et al., 1992)

Arnetz (2006) recognized the basic reason of occupational diseases as different forms of stress and as shown below:

i. Depression caused by stress
ii. Stress related headaches and migraines
iii. Stress induced sleep disturbances and insomnia
iv. Backache cause of stress
v. Heart problems
vi. Colds and other infectious illnesses
vii. Stomach ulcers caused by stress
viii. Stress related digestive disorders
ix. Chronic fatigue syndrome (CFS)
A survey had shown the incidence of stress was related to gender since 2001 until 2009 (HSE Institute. UK, 2012). Tables 1.1 (a-c) show the incidence of stress among female and male for comparison in 2002, 2005 and 2008 respectively. It is obvious from the data in respective tables that in each year the estimated incidence for females was higher compared to the males. It is obvious that the trend is the same for all years. According to the tables, it is shown that females are more influenced by stress than males. This study evaluates the stress effects on performance for female and male. Therefore, the result of the research will reveal the comparison of stress effects on performance between females and males. Using these results, it can be concluded the estimated incidence of performance among female and male.

Table 1.1(a-c) Stress-related to gender in 2002, 2005 and 2008
(Source: HSE Institute UK, 2012)

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<td></td>
<td></td>
<td>central</td>
<td>95% C.I.</td>
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<td>Males</td>
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<td>27</td>
<td>15 - 40</td>
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<td>35 - 44</td>
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<td>45 - 54</td>
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<td>55+</td>
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<td>63</td>
<td>50 - 76</td>
</tr>
<tr>
<td></td>
<td>35 - 44</td>
<td>63</td>
<td>51 - 74</td>
</tr>
<tr>
<td></td>
<td>45 - 54</td>
<td>70</td>
<td>61 - 86</td>
</tr>
<tr>
<td></td>
<td>55+</td>
<td>39</td>
<td>29 - 46</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>237</td>
<td>213 - 250</td>
</tr>
</tbody>
</table>

(a) 2002

(b) 2005
1.3 Scope

The scope of the current study covers the following:

i) Trainees whose ages range between 18 to 35 years old

ii) Trainees were selected among Universiti Teknologi Malaysia (UTM) students comprised of different races, i.e. Black-African, Malay, Iranian and Chinese.

a) Black –African
Black –African trainees’ father and mothers should be from Nigeria, Rwanda, Madagascar and Ghana.

b) Malay
Malay trainees’ father and mother should be from Malay race (Neither Malay–Chinese nor Malay-Indian were accepted)

c) Iranian
Iranian trainees’ father and mother should be from Persian race
d) Chinese
Chinese trainees’ father and mother should be from Chinese race
(neither Chinese –Malay nor Chinese-Indian were accepted)

iii) UTM graduate and non-graduate students (in Malaysia)

iv) Healthy and non-smoking students

v) Three stages comprised of two tasks; recall task and typing task.
Recall task in three stages was estimated 4min per stage (3*4min=12 min).
Typing task was estimated 10 min per stage (3*10 min=30 min).

To identify the race of trainees, some oral question could be appropriate
about their parents and their original race. This experiment was held in a single
room of the library and mechanical laboratory at UTM. To choose non-smoking
trainees, there was a device called “Smokerlyzer”. Chapter 3 shows more explanation
about this device.

1.4 Problem Statement

Various factors could influence performance such as age, gender, race,
motivation and nicotine level. In order to decrease the side effect of some factors
such as nicotine level and age, they were controlled during the experiment. This
study focused on two factors, gender (males and females) and race (Malay, Chinese,
Iranian and Black-African). The factors need to be analyzed in order to enhance or
decline performance of students while training.

Increasing the stress would influence human performance (Apesteguia and
Palacios, 2010). It could also reduce the performance and efficiency. Gender and
race are factors that could influence stress and performance.
The correlationship between some factors is the most important problem here. These factors are:

1) Gender-related stress and performance
2) Race-related stress and performance

Performance is divided into two categories:
1) Typing task as the physical task
2) Recall task as the mental task

As shown in Figure 1.3, five factors could affect input and information process. Two factors were focused on in this study; gender and race. These factors are identified as the primary area in the present investigation which is shown in Figure 1.3. In this research, the significance of gender-related stress and performance factor would be calculated. In the case of being significant, the workloads should be assigned to female and male in different ways to increase the efficiency. Also, the significance of race-related stress and performance would be calculated for both typing recall tasks.

![Diagram of Factors Affecting Stress](image)

**Figure 1.3** The factors affecting stress
In case of being significant, it would be more efficient to assign the noted task to that specific race. For example if the factor for Malay trainees in typing task is significant, it means that stress will influence less on Malay trainees in typing task so typing tasks would be more efficient if done by Malay people.

1.5 Research Objectives

i) To establish a methodological procedure for evaluating the stress influence on typing and recall tasks among engineering workshop trainees.

ii) To determine the effects of gender differences on occupational stress among trainees in engineering workshop performing typing and recall tasks.

iii) To determine the effects of racial differences on occupational stress among engineering workshop trainees.

1.6 The Developed Model

Figure 1.4 shows the factors affecting the performance. However age, gender, race and nicotine level could also affect the performance indirectly via their influence on stress. Factors affect the performance directly can be:

1) Motivation
2) Fatigue
3) Distraction
4) Stress
5) Nicotine level
6) Age, Gender and Race

The human performance can be affected positively or negatively. As it is shown in the Figure 1.4 motivation affects the performance positively. Also distraction, fatigue
and stress have negative effects on performance. But the factors included in section A and B have not been evaluated yet.

**Figure 1.4** Determination of performance level by the balance of the factors
(Source: Gaillard, 2008)

This research evaluates the effects of gender and race on performance whether they have positive or negative effects. For this purpose, a positive factor is essential for trainees to pursue them to fulfill the tasks. Although motivation in a form of reward payment is included in this project, the effects of it will not influence the results. This influence is controlled by paying each race an optimal amount. Therefore, a new model is developed specifically for this research regarding all these issues, and is shown in Figure 1.5. This model is a developed model that will investigate only race and gender. Section (A) and (B) are able to influence the performance directly and indirectly. According to Figure 1.4, these factors could influence the stress and thereby the performance. This study evaluates the effect of gender and race on stress and performance. The study focused on psychological factors. Stress is one of the factors that affect the procedure. Gender and race could influence stress. Motivation will directly affect the psychological factor. Figure 1.5 shows the developed model of the factorial issue. The study focused on psychological factors. Stress is one of factors that affect on procedure and also
gender and race could influence stress. Motivation directly affect on psychological factor. Figure 1.5 showed the developed model of factorial issue.

Figure 1.5  The developed model of factorial issue affecting trainees
1.7 Research Hypothesis

H1: Gender and mental task in stressful situation (Research Objective ii). The hypothesis provides answer of the research objective ii (Section 1.5).

H0: There is no relationship between mental task and heart rate reactivity (before doing recall task) with gender differences.

H1: There is a relationship between mental task and heart rate reactivity (before doing recall task) with gender differences.

H2: Race and mental task in stressful situation (Research Objective iii). The hypothesis provides answer of the research objective iii (Section 1.5).

H0: There is no relationship between mental task and heart rate reactivity (before doing recall task) among four races Malay, Chinese, Iranian and Black-African.

H2: There is a relationship between mental task and heart rate reactivity (before doing recall task) among four races Malay, Chinese, Iranian and Black-African.

H3: Gender and typing task in stressful situation (Research Objective ii). The hypothesis provides answer of the research objective ii (Section 1.5).

H0: There is no relationship between typing task and heart rate reactivity (during doing typing task) with gender differences.

H3: There is a relationship between typing task and heart rate reactivity (during doing typing task) with gender differences.

1.8 Conclusion

This chapter provided six sections that encompass the introduction, background, problem statement, objective, scopes, developed model, and hypothesis. Effect of age and gender-related stress on performance was indicated in background of problem. Objectives and hypothesis was obviously indicated in Chapter one. Next chapter provides literature of stress, arousal theory, effect of stress on memory, energy expenditure per task, diurnal heart reactivity and etc.
REFERENCES


Education and Internet, update 2012. (http://www.ikso.net/)


Miller, A. G. (1956). The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information. The Psychological Review, 63, 81-97


Vockell, E. L. (2001). Educational Psychology: A Practical Approach (Online Ed.)
(http://education.calumet.purdue.edu./vockell/edpsybook).


