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

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Thanks to

God for all the given opportunities and blesses,
And My Parents.

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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 ($P_{value} < 0.05$). 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.

ABSTRAK

Stres pekerjaan telah menarik perhatian ramai penyelidik dalam beberapa tahun kebelakangan ini. Daripada kajian stress, tahap kecekapan prestasi kerja boleh ditingkatkan sambil mengurangkan tahap kesilapan manusia. Menyelidik bidang stress tanpa mengambil kira beberapa faktor seperti umur, jantina, kaum dan kadar merokok, ianya tidak boleh berkesan dan berguna. Banyak kajian dibuat untuk menyelidik faktor tersebut tetapi hasil menunjukkan percanggahan dengan keputusan penyelidikan. Tujuan kajian ini adalah hasil daripada per bezaan antara untuk menyelidik kesann jantina dan kaum. pada kecekapan tugas mental dan fizikal. Seramai 120 (tidak merokok) peserta terdiri daripada 60 lelaki dan 60 wanita dari berbagai kaum seperti Melayu, Cina, Iran dan Afrika-hitam. Dua tugas dikenal pasti dalam kajian: i) Mental, (ii) Tugas Fizikal. Ujikaji dijalankan dalam tiga peringkat. Peringkat pertama dan kedua dijalankan dalam sehari (tanpa stress) seperti dalam perpustakaan sementara peringkat ke tiga dijalankan dalam situasi stres iaitu makmal kejuruteraan mekanikal. Penggunanan tenaga dianggap telah digunakan secara berturutan bagi setiap peringkat. Kadar jantung diukur sekali sebelum sda semasa tugas dilakukan, dimana setiap ukuran diambil dalam setiap 30 saat. Kadar jantung bagi setiap 30 saat di catatkan untuk analisis pada paras asasnya untuk situasi (tanpa stres) dan stres. Untuk mengukur kadar denyutan jantung, “oxi-meter finger pulse“ digunakan untuk mengukur kadar nikotin sebelum menentukan subjek yang tidak merokok “smokeanalysis“ digunakan. Soal-selidik digunakan secara rawak dikalangan subjek sebelum peringkat menentukan habuan sesuai bagi setiap pemenang dalam pertandingan kemahiran dalam peringkat ke tiga. Analisis reaktiviti bagi kadar jantung, kecekapan tugas “recall“ dan menaip dilakukan dengan SPSS versi 18. Purata kadar jantung bagi paras asas dan stres setiap subjek dikira. Korelasi dan regresi dengan kaedah SPSS versi 18 untuk analisis ($P_{nilai} < 0.05$). Perbezaan jantina denagn jelas mempengaruhi reaktiviti kadar jantung dan paras asas bagi tugas mental dan situasi yang sangat stres. Keputusan menunjukkan stres berkurangan dengan kecekapan mental dikalangan wanita melebihi lelaki, juga lelaki boleh menyesuaikan dengan cepat berbanding wanita dalam situasi sangat stres.

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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 Ashcraf (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.

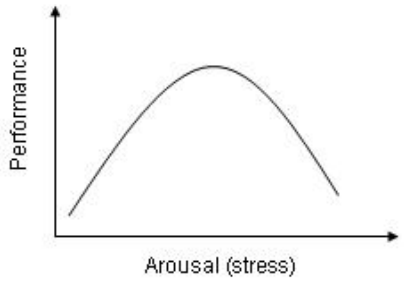

Figure1.1 An inverted U-shaped curve
(Source: Yerkes and Dodson, 1908)

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.

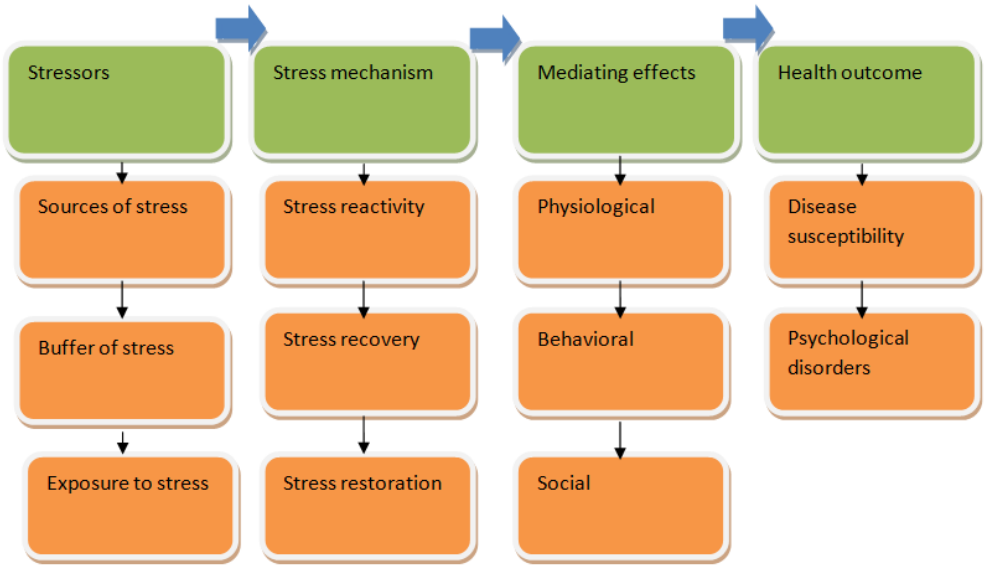

Figure 1.2 The relationship between stressors and health outcomes (Source: Field et al., 1992)

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 incident 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)

Gender	Age group	Estimated Incidence (thousands)			Rate per 100 000 employed in last 12 months		
		central	95% C.I.		central	95% C.I.	
			lower	upper		lower	upper
Males	16 - 34	***21***	*13*	*29*	***360***	*230*	*490*
	35 - 44	**26**	19	34	**660**	470	860
	45 - 54	**29**	20	37	**830**	600	1070
	55+	**21**	14	27	**690**	480	910
	Total	**97**	81	112	**600**	500	690
Females	16 - 34	**42**	31	53	**820**	610	1030
	35 - 44	**36**	28	45	**1030**	780	1280
	45 - 54	**45**	35	55	**1410**	1110	1720
	55+	**17**	11	23	**750**	490	1010
	Total	**140**	122	158	**1000**	870	1120
All persons	16 - 34	**63**	50	76	**580**	460	700
	35 - 44	**63**	51	74	**830**	680	990
	45 - 54	**74**	61	86	**1110**	920	1310
	55+	**38**	29	46	**720**	550	880
	Total	**237**	213	260	**780**	700	860

a) 2002

Gender	Age group	Estimated Incidence (thousands)			Rate per 100 000 employed in last 12 months		
		central	95% C.I.		central	95% C.I.	
			lower	upper		lower	upper
Males	16 - 34	**30**	21	40	**530**	360	700
	35 - 44	**22**	15	30	**560**	380	750
	45 - 54	**33**	25	42	**960**	700	1210
	55+	***16***	*10*	*21*	***510***	*320*	*690*
	Total	**102**	85	118	**630**	530	720
Females	16 - 34	**41**	30	52	**810**	600	1020
	35 - 44	**36**	27	45	**1030**	780	1290
	45 - 54	**32**	23	40	**990**	720	1250
	55+	**19**	13	26	**840**	560	1120
	Total	**128**	110	146	**910**	780	1040
All persons	16 - 34	**71**	57	86	**660**	520	790
	35 - 44	**58**	47	70	**780**	630	940
	45 - 54	**65**	53	78	**970**	790	1150
	55+	**35**	26	43	**650**	490	810
	Total	**230**	206	255	**760**	680	840

(b) 2005

Gender	Age group	Estimated Incidence (thousands)			Rate per 100 000 employed in last 12 months		
		central	95% C.I.		central	95% C.I.	
			lower	upper		lower	upper
Males	16 - 34	**29**	20	38	**540**	380	700
	35 - 44	**32**	24	41	**830**	610	1040
	45 - 54	**23**	16	30	**690**	490	900
	55+	**18**	12	24	**630**	420	840
	Total	**103**	88	118	**660**	560	760
Females	16 - 34	**39**	29	48	**780**	590	980
	35 - 44	**44**	34	53	**1250**	980	1510
	45 - 54	**41**	32	50	**1340**	1050	1640
	55+	**16**	10	21	**700**	460	950
	Total	**139**	122	156	**1010**	890	1140
All persons	16 - 34	**68**	55	81	**660**	530	780
	35 - 44	**76**	63	89	**1020**	850	1190
	45 - 54	**64**	53	76	**1010**	830	1180
	55+	**34**	26	42	**660**	500	820
	Total	**242**	219	265	**830**	750	910

(c) 2008

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.

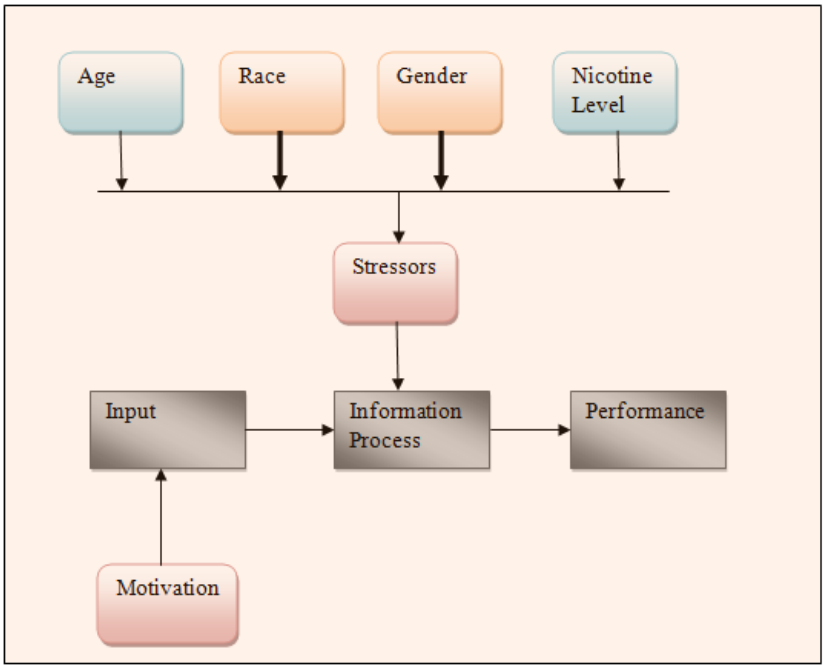

Figure 1.3 The factors affecting stress

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.

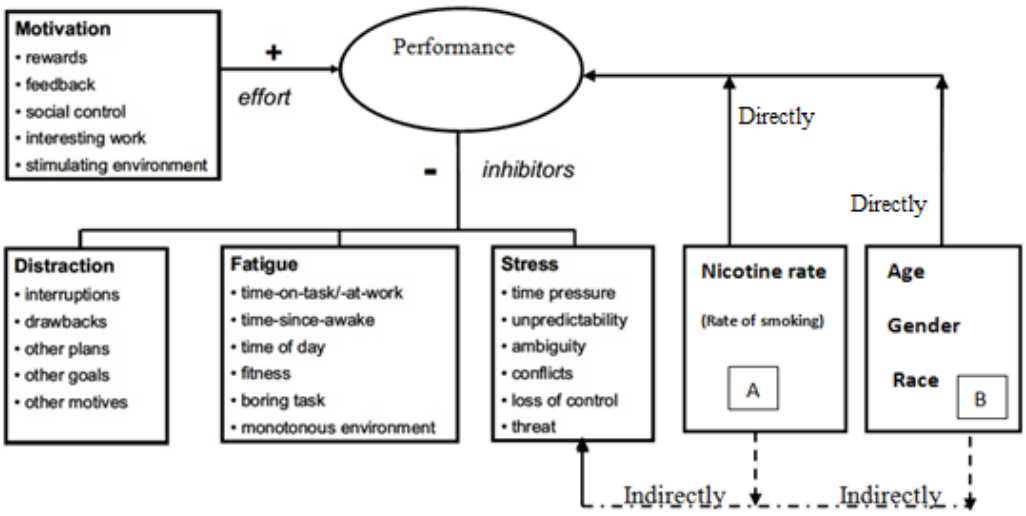

Figure 1.4 Determination of performance level by the balance of the factors (Source: Gaillard, 2008)

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 Figure1.4, 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.

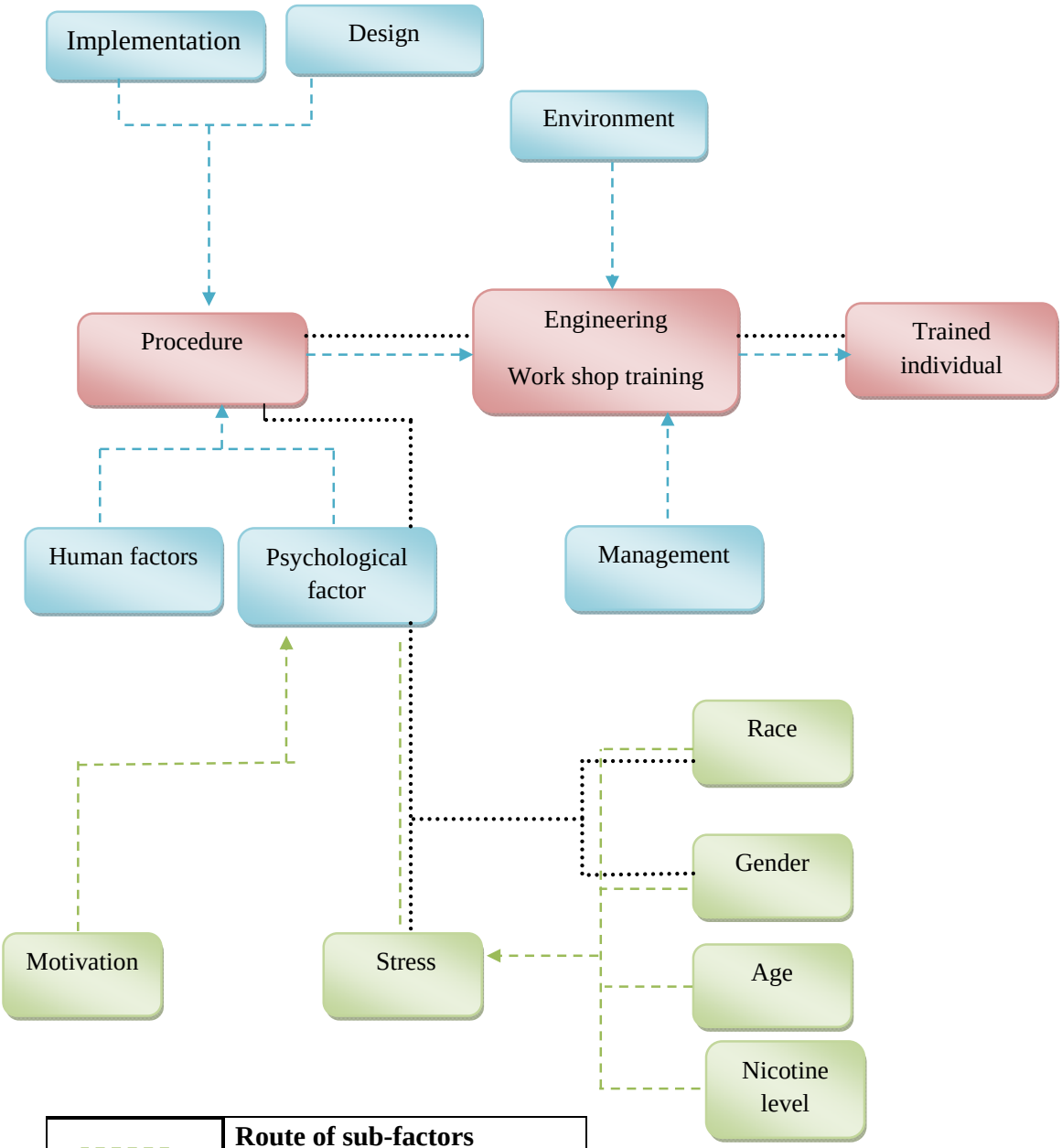

Figure 1.5 The developed model of factorial issue affecting trainees

1.7 Research Hypothesis

H 1: Gender and mental task in stressful situation (Research Objective ii). The hypothesis provides answer of the research objective ii (Section1.5).

H_0: There is no relationship between mental task and heart rate reactivity (before doing recall task) with gender differences.

H_1: 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).

H_0: There is no relationship between mental task and heart rate reactivity (before doing recall task) among four races Malay, Chinese, Iranian and Black-African.

H_2: 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).

H_0: There is no relationship between typing task and heart rate reactivity (during doing typing task) with gender differences

H_3: 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.

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