EFFECTS OF MOTIVATIONAL MUSIC ON PSYCHOPHYSIOLOGY MEASUREMENTS DURING MODERATE INTENSITY EXERCISE

by

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CERTIFICATE

This is to certify that the dissertation entitled

"EFFECTS OF MOTIVATIONAL MUSIC ON PSYCHOPHYSIOLOGY MEASUREMENTS DURING MODERATE INTENSITY EXERCISE"

Is the bona fide record of research work done by

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During the period from **July 2010** to **April 2011**

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TABLE OF CONTENT

LIST OF TABLES

LIST OF FIGURES

Effects of Motivational Music on Psycho-physiological Measurements during Moderate Intensity Exercise

ABSTRACT

The purpose of this study was to examine the effects of motivational music during moderate intensity exercise on psycho-physiological measurements including heart rate, recovery time, rate of perceived exertion (RPE), duration of exercise and post exercise feeling (EFI). A total of ten healthy male subjects of Universiti Sains Malaysia students (22.6 ± 0.7 years old) were involved in this study. Brunel Motivational Rating Inventory-2 (BMRI-2) was used to determine the list of motivational musics. In pre-experiment, subjects performed two preliminary test, which are sub-maximal running test and maximal oxygen test the determination of 65% of VO_2 max intensity exercise. Experiment involved three different exercise conditions were performed by the subjects; exercise with motivational music, exercise with oudeterous music and exercise with no music. Measurements on heart rate and RPE were recorded during experiment, while recovery time, exercise duration and feeling were assessed after experiment completed. The findings revealed a significant difference (p=.011) for exercise duration in exercise with motivational music compared to the other groups. There was also significant result (p=.029) for feeling (positive engagement) in exercise with motivational music compared to Control group. There was no significant difference for recovery time, heart rate, RPE and three others subscale of EFI (tranquillity, revitalization and physical exhaustion) among the three exercise conditions. The results supported most of the previous findings on the positive effect of music especially on physiological

changes and performance. Selecting music with motivational quality is essential to reduce perception of effort, promote endurance exercise and enhance positive engagement with the activity, leading to continuity in performing exercise

Kesan Muzik Bermotivasi ke atas Pengukuran Psikofisiologi semasa Senaman Berintensiti Sederhana

ABSTRAK

Tujuan kajian ini dijalankan adalah untuk mengenal pasti kesan musik bermotivasi semasa senaman berintensiti sederhana ke atas denyutan jantung, masa pemulihan , RPE, masa senaman dan perasaan selepas senaman. Sejumlah sepuluh orang subjek yang belajar di USM (Umur: 22.6 ± 0.7 tahun) telah terlibat dalam kajian ini. *Brunel Motivating Rating Inventory (BMRI-2)* telah digunakan untuk pemilihan muzik bermotivasi. Dalam pre-ujian, subjek melakukan dua ujian awal iaitu ujian larian sub-maximal dan ujian oksigen maksimal bagi menentukan 65% daripada VO_2 max intensiti senaman. Kajian melibatkan tiga ujian berbeza yang dilakukan oleh kesemua subjek iaitu senaman bersama muzik motivasi, senaman bersama muzik *oudeteous* dan senaman tanpa muzik. Pengukuran denyutan jantung dan RPE telah direkod semasa ujian, sementara masa pemulihan, masa senaman dan perasaan direkod selepas ujian tamat. Keputusan ujian telah menunjukkan terdapat perbezaan yang signifikan (p=.011) bagi masa senaman untuk senaman bersama muzik bermotivasi berbanding kumpulan lain. Perbezaan yang signifikan (p=.029) juga dilaporkan pada perasaan EFI (komponen penglibatan positif) antara senaman yang menggunakan muzik bermotivasi dengan tanpa muzik. Keputusan juga telah menunjukan tiada perbezaan signifikan bagi pemulihan masa, denyutan jantung, RPE dan tiga lagi sub-skala bagi EFI

(kesejahteraan, pengembalian tenaga dan keletihan fizikal) antara ketiga-tiga ujian. Keputusan kajian ini telah menyokong kebanyakan kajian lepas yang mendapati terdapat perbezaan kesan positif muzik terutama bagi perubahan fisiologi dan prestasi. Pemilihan kualiti lagu bermotivasi tinggi amat diperlukan terutamanya untuk mengurangkan keinginan keupayaan, meningkatkan daya tahan senaman dan mengukuhkan kesan positif ke atas aktiviti yang dilakukan dan akhirnya mengekalkan prestasi berterusan dalam melakukan senaman.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Music has become a standard addition in most health and leisure activities and it is common for exercisers to listen to their favourite music while exercising. Music has the capacity to capture attention, lift spirits, generate emotion, change or regulate mood, evoke memories, increase work output, reduce inhibitions, and encourage rhythmic movement. Music has being used to accompany exercise such as jogging and cycling to entertain and develop a feel to keep goings with the activities by focusing or changing the attention to the music. With the different harmonies, types, and styles of music (i.e., rock, dance, jazz, hip hop, etc), it makes music can suit to the different types of person.

Many people believe that music simply takes ones mind off during activity performance and help to decrease the perceived effort. Since not all people enjoy exercising, so any method to make the activity more pleasurable will enhance the exercise behaviour. With the current technology, radio is not only the source of music, many types of portable music such as MP3, MP4 and iPod are used and it can take to any places without feel of burden because the size is small.

Music is the art of tonal-rhythmic sound, which provides symbolic representation of feeling. It reflects the way human's expression through non-verbal communication. Its abstract forms helps in releasing tension, triggering movement and enhancing feeling of rest. Music consists of rhythm, melody, harmony, timbre, space, and direction, where the combination determines the type of music and its expressive properties. Music involves the connection of sound and mind and functions in emotional expression.

Additionally, music is a well known relaxation technique used for various purposes. Listening to music is a complex phenomenon, involving psychological, emotional, neurological and cardio-respiratory changes (Orem, 1994 and Shea, 1996). Recent studies emphasize the value of music in lowering stress (Lee et al., 2004; Szmendra et al., 1998) and its role in enhancing the exercise performance (Mackey et al., 1994; Szabo et al.,1999)

Many studies have been conducted on the potential effects of music on psycho physiology responses during exercise performance. The use of various types of music have shown positive findings in enhancing exercise performance and other parameters related to psychological effects and physiological state. The current concept of selecting music for exercise emphasizes on music with motivational quality. Motivational music appears to improve affective states and reduce perceptions of effort during sub maximal exercise (Karageorghis and Jones, 2000). The conceptual framework for predicting psychophysiology effects of music has been developed which focus on four factors including rhythm response, musicality, cultural impact, and association (Karageorghis et al., 1999) Rhythm response relates to the natural responses to musical rhythm,

especially tempo (speed of music as measured in beats per minute [bpm]). Musicality refers to pitch related elements such as harmony (how the notes are combined) and the melody (the tune). Cultural impact is the pervasiveness of the music within society or sub-cultural group. Association pertains to the extra-musical associations that music may evoke. Music can influence exercise enjoyment and participant retention, and has the potential to contribute to improved public health, which is one of the implication of the conceptual model. Conceptual framework for the benefits of music in sport and exercise context is presented in Figure 1.1.

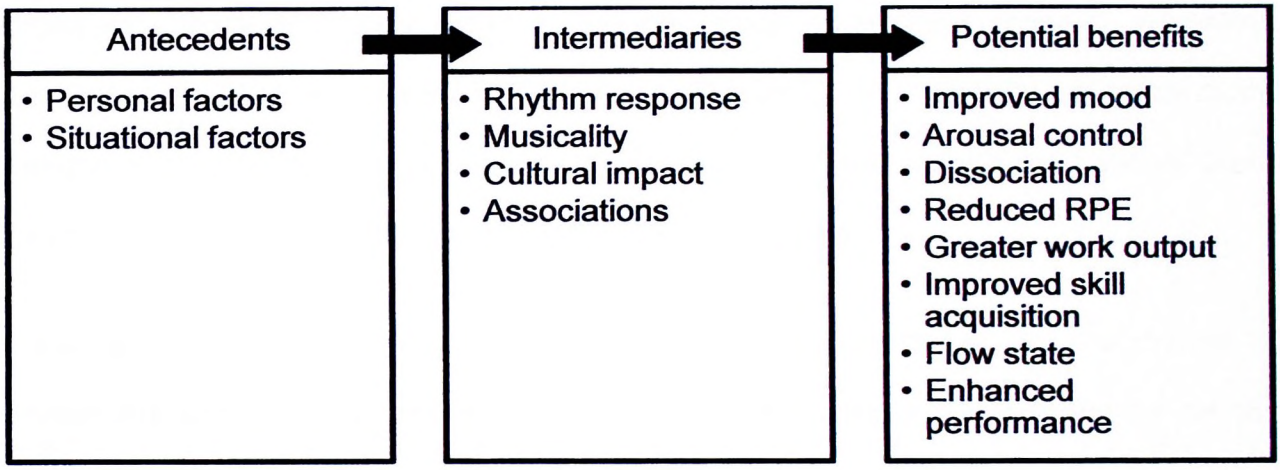

Figure 1.1: Conceptual framework for the benefits of music in sport and exercise context (Terry and Karageorghis, 2006)

By considering this conceptual framework, exercise with music will lead to desired benefits especially on physiological changes during exercise. Additionally, it is important to keep exercisers motivated with the exercising task and able to spend longer duration without experiencing early fatigue. Thus, selecting appropriate music types is crucial since most of practitioners in sport and exercise tend to select music in arbitrary manner

without full consideration on its motivational characteristics. This present research focus on the recommendation given while considering local music as the lyrics is believed to have cultural impact on the local participants.

Moderate intensity exercise was applied in this study. Exercise can be defined as physical activity that is planned, structured, repetitive, and purposive, and aim to improve or maintain physical fitness. Physical fitness is the ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capability of maintaining such ability throughout life (ACSM., 1990). Exercise is a healthy life style, which can promote various benefits. Exercise such as walking, jogging, swimming, running and cycling is the most popular form of exercise. In this study, participants will perform moderate intensity running as it is more applicable among recreational group for its safeness, comfortable and effects on health benefits.

Running employs large-muscle groups where the movement is maintained in continuous and rhythmic motion. It is one of the most effective exercises for aerobic training. Most of the previous interventions with music used the continuous exercise such as walking and cycling. For example, Karageorghis et al. (1999) assessed affective and psychophysical responses to motivational and oudeterous music during sub maximal treadmill running at 50% of VO_2 max. Szmedra et al. (1998) investigated the physiological process underlying the benefits of music during treadmill running at 70% of VO_2 max. These few examples of applying music with exercise highlight the importance for practitioners to engage with the potential benefits of music in order to seek the psychophysical and ergogenics properties on moderate intensity exercise.

1.2 Objectives of the study

The objectives of this study are:

1. To examine the effect of motivational music during moderate intensity exercise on heart rate, rate of perceived exertion (RPE) and recovery time.
2. To determine the effect of motivational music during moderate intensity exercise on running performance measured by running duration.
3. To determine the effect of motivational music during moderate intensity exercise on post-exercise feeling state.

1.3 Significance of the study

In promoting healthy life style, observing people's behaviors in exercise bring to ideas on strategies that can be implemented to enhance exercise engagement. The ability of music to improve affective responses has proved to be more encouraging. Research on the effects of music in sport and exercise to psycho physiological responses will give input on how music can influence the exercise participants. From local perspective, studies on this application are considered scanty, and selection of the types of music used to accompany with exercise was not taken seriously. Since motivational music contains specific elements that may improve performance of exercisers, investigation on the use of motivational music is important to add support on previous findings for its positive influence.

1.4 Operational definitions

1. Music

   A series of melody that contains pitch, rhythm, dynamics, and the sonic qualities of timbre and texture.

2. Motivational music

   Music that contains inspiring lyrics that can motivate listeners to work on task they are performing.

3. Oudeterous music

   Neutral music that lacks in motivational qualities (non-motivational music)

4. Moderate intensity exercise

   Types of exercise involve vigorous workout able to raise heart rate and break a sweat, but still being able to carry on a conversation. The recommended intensity is between 50-80% of VO_2 max.

5. Psychophysiological responses

   Feedback on psychological and physiological parameters as the measures of changes from intervention given including the heart rate, perceived effort and feeling state.

6. Feeling state

   A state of consciousness, which reflects emotional experience, perceived during exercise workout. It is measured within four dimensions; physical exhaustion, tranquility, revitalization and positive engagement.

CHAPTER 2

REVIEW OF LITERATURE

2.1 Impact of music on physiological functions

Effects of using music during exercise had been popular research topic over the decades. It had been used clinically as a therapy among patients with illness and as strategy to enhance any possible changes related with health. In order to understand the physiological processes underlying the benefits of music, Copeland and Frank (1991) conducted a study on college students exercising on treadmills and reported that heart rate was significantly lower in the music condition as compared to heart rate in the non-music condition. Other studies conducted by Szmendra and Bacharach (1998) indicated that background music was associated with reduced heart rate, systolic blood pressure, exercise lactate, norepinephrine production, and RPE during treadmill running at 70% VO_2 max. They also suggested that music will allow participants to relax, reducing muscle tension, and thereby increasing blood flow and lactate clearance while it will decreasing the production of lactate in a working muscles.

Boutcher and Trenske, (1990) reported that perceived exertion was reduced during exercise when music was introduced. One study has been conducted by Potteiger et al., (2000) about the effect of music on perceived exertion by instructing subjects to ride a cycle ergometer for four twenty-minute sessions on different days. During each session, the subjects either listened to one of three types of music (fast, classical, or self-selected) or exercised without music, and rated their peripheral, central and overall

physical exertion on Borg's scale every five minutes throughout the cycle ride. They were also monitored for heart rate throughout each session. As a result, there was no significant effect of music distraction on heart rate and rating of perceived exertion was significantly lower for sessions with music than those without. Nethery (2002) conducted a study on young adult males performing a cycling exercise and reported that RPE was significantly lower during the high-and low-intensity bouts of exercise when self-selected upbeat music was used, as compared to the condition in which no music was used. Hayakawa et al. (2000) had opposite results than these previously mentioned studies. In their study, which conducted on a bench stepping exercise session has reported that the RPE of the middle-aged women was significantly higher when exercising to synchronous music as compared to exercising to no music.

One of the studies conducted by Karageorghis et al., (2009) showed that music conditions impacted significantly only upon time to exhaustion. Motivational music led to the greatest endurance and the oudeterous music to lesser endurance. Finding from Ghaderi et al., (2009) suggested that exercise with motivational music was effective for endurance performance compared to relaxation and no music treatment. Although this positive result was found among non-elite athletes, this research proved that exercise with motivational music gave better result on aerobic performance as well as decreasing RPE.

2.2 Impact of music on psychological functions

Effects of music on psychological functions had been widely investigated in various research settings. In clinical, music was used as a therapy to treat patient with depression and other psychiatric problems. In sport and exercise, athletes use music as a strategy to relieve their anxiety and helping them to achieve optimal emotion state in performance. Music is a powerful force, affecting body and mind in positive ways. It affects people cognitively, physically, emotionally and socially.

A study conducted in Japan among 16 middle-aged females participating in three bench-stepping exercise sessions, with two music conditions – aerobic dance and traditional Japanese folk music – as well as a metronome-only control condition. This study utilized a pre- and post-exercise Profile of Mood States-Short Form to measure mood. A significant increase in vigor for aerobic dance music condition and an increase in fatigue for the control condition were found (Hayakawa, Takada, Miki, and Tanaka, 2000).

Zilonka (1999) indicated that music during a walking activity allowed the participants to experience more enjoyment while exercising. Tenenbaum et al., (2004) found that although motivational asynchronous music did not influence perceptions of effort, it did shape participants' interpretations of fatigue symptoms during a hill running task at 90% VO_2 max. It is similar with several research that has confirmed the effectiveness of background music as a strategy for mood enhancement (e.g ., Hewston, Lane, Karageorghis, & Nevill 2005 ; Terry, Dinsdale, Karageorghis, & Lane, in press)..

Bishop et al (2007) have recently extended the study on music and performance providing a rationale for the manipulation of emotional responses to music in junior tennis players. It was suggested that the correct music selection can be used as a tool to 'psych up' in preparation for performance (arousal regulation), shift attentional focus (association/dissociation), boost self efficacy and encourage psychological skills usage (e.g. mental imagery). More specifically, positive aspects of mood such as vigor and happiness become heightened, while negative aspects such as tension, depression, and anger were reduced.

Several findings also indicated that music did not give positive effect to the psychological aspect. For example, Lee (2001) conducted a study that used fast, slow, and natural music and reported that the no-music condition gave positive effect on the feeling states among the older adult participants Rendi et al. (2008) suggested that high-tempo music may only facilitate arousal during high intensity exercise performance with no change in attention processing.

According to the literatures, it is believed that music is useful to create enjoyment during exercise. This may be because music can divert a person's attention from feelings of fatigue. Music can have a positive effect on the way people perceive the process of exercise. Enjoying exercise can increase the likelihood of repeating the exercise on a consistent basis, which makes working out much more effective.

CHAPTER 3

METHODOLOGY

3.1 Subjects

A total of 10 healthy male subjects 19-24 years old who were currently USM student were recruited in this study. All of them were regularly exerciser, engaging in activity at least three times per week. All subjects were injury-free and reported for not have any serious illness.

During the recruitment, participant information and consent form approved by USM Research and Ethical Committee were provided to the subjects for their perusal. All the details of the study such as purposes, testing procedure, benefits, risks, discomforts and freedom of participation were included in the consent form. Subjects were required to fill up the consent form before they were participating in this study. Subjects were also recommended that their participant in this study is voluntarily and they are able to withdrawn at any time of study period.

3.2 Research Instruments

Throughout this study, various Instruments had been used for the process of data collection. The information on each instruments are as follows.

3.2.1 Omron Karada (weight)

Omron Karada Scan (Japan) weight machine were used to measure the body composition of the subject. The scale was set at 2 decimal places.

3.2.2 Casio Stopwatch

Casio Hs-30 (Japan) digital stopwatch was used to measure the running time during the test and the recovery time after the test. The same stopwatch was used throughout the test to standardize all measurements.

3.2.3 Polar Heart rate monitor

Polar transmitter RS 100 and polar wrist receiver 3710 (Finland) was used throughout the tests to monitor subject's exercise heart rate. The transmitter was fitted onto subject's chest to transmit the data to the wrist receiver and consequent recording for further analysis. Heart rate monitor also was used as a manipulation check of intensity of exercise.

3.2.4 Treadmill

The entire test, which is involved running, was done on Motorized treadmill (h/p cosmos, German). The acquired speed and gradient can be automatically set on the instrument. The running treadmill is also fixed with monitor, which records the time for exercise (min), running distance (km), heart rate (bpm) and running speed (km/h).

3.2.5 Rate of Perceived Exertion (RPE)

Perceived exertion was measured using Borg's RPE scale (Borg, 1977), which requires subjects to rate on a 6 to 20 point category scale. The scaled ranged from 6 (no exertion at all) until 20 (maximal exertion). Ratings of perceived exertion was assessed every 2 min.

3.2.6 Exercise Induced Feeling Inventory (EFI) questionnaire

EFI questionnaire (Gauvin & Rajeski, 1993) contains 12 items under 4 subscales Revitalization (e.g., "refreshed"), Tranquility (e.g., "peaceful", Positive engagement (e.g., "happy") and Physical exhaustion (e.g., "tired"). Responses are provided on a 5- point Likert scale anchored by 0 (do not feel) and 4 (feel very strong). Gauvin and Rajeski reported satisfaction psychometric properties for the EFI, which included the Cronbach alpha coefficients: revitalization= .77, tranquility= .78, positive engagement= .72, and physical exhaustion= .81 (Karageorghis et al., 2009).

3.2.7 MP3 player

Music is played using MP3 player (NWZ-B152F, Sony, China) through the ear phone. The list of top 10 selected songs was arranged based on the highest to lowest score. The volume was standardized to level 70% of maximum. (Elliot et al, 2005)

3.3 Research protocol

This research is a cross over study design, which tends to seek the psycho physiological changes on the subjects attending three different exercise treatments (motivational music, oudeterous music and no music). Prior to intervention, subjects were brief about the nature and risk of testing protocols. Each subject was required to sign the informed consent form as an approved to participate in this study.

3.3.1 Selection of motivational music

One week before experimental trial, subjects were required to attend a session selecting motivational music. The procedure was done by using Brunel Music Rating Inventory-2 (BMRI-2; Karageorghis, Pries et al., 2006) where the subjects need to rate the list of motivational music provided by researcher. The questionnaire consists of 6items with rating scale from 1 (strongly disagree) to 7 (strongly agree). 20 lists of music titled in Malay language was provided and subjects were required to give the score after each music was played.

From the lists 10 songs with the highest score were selected and approved forits motivational qualities. Among the selected songs are "Fikirkan Boleh (Metropolitan)", "Standing In The Eyes of The World (Ella)" and "Gemuruh (Faizal Tahir)"

3.3.2 Determination of 65% of VO_2 max exercise intensity

All the subjects went thought familiarization exercise protocol before they were introduced to intervention program. In order to determined the speed o running at 65% of VO_2 max, subjects were required to attend sub-maximal and maximal test designed

using the motorised treadmill. The protocols used for the sub-maximal oxygen uptake test is Bruce protocol while maximal oxygen uptake test used modified Astrand protocol. The protocols of each test described as follows.

3.3.2.1 Sub-maximal Oxygen Uptake Test

Sub-maximal oxygen uptake test was done to determine the relationship between running speed and VO_2. Before the test, the subject was asked to warm up for a minute or two minute at a slow speed on the motorized treadmill (h/p cosmos, German). After that, the head gear, mouthpiece, nose clip, and a heart rate monitor (RS100, Polar, Finland) were fitted onto the subject. When the pre-calibrated gas analyzer system reached the steady state, the test was initiated.

This 4 – stages speed incremental test was carried out by setting the speed of the motorized treadmill at 6, 7, 8, and 9 kilometers per hour ($km.h^{-1}$). Subjects need to run at each speed for four minutes after which the speed was increased by 1 km at the end of each 4 minutes increment. The automated gas analyzer was set to measure the expired air for every twenty seconds. Heart rate and rate of perceived exertion were recorded during the final minutes of each 4 minutes increment because the first three minutes of any speed was the time of adjustment where the response was not at a steady state yet (McArdle et al., 1991). All the data collected were recorded in the sub-maximal test form.

After completing the 4-stage increment test, the graph of the sub-maximal work rate (speed/workload) / VO_2 relationship was plotted.

3.3.2.2 Maximal Oxygen Uptake Test

Maximal oxygen uptake test was done to determine VO_2 max of each subject. Before the test started, subject was fitted with headgear, mouthpiece, nose clip, and a heart rate sensor as in sub-maximal test. The appropriate speed for this maximal test had been selected from the previous sub-maximal test. The test began on a motorized treadmill with the gradient of 0°. At the end of the every two minutes, the gradient was increased by 2.5° until exhaustion (0° , 2.5° , 5° , 7.5° , 10° , 12.5° , 15°).

At every 20 seconds, the expired air was measured by the analyzer. Heart rate and rate of perceived exertion were taken during the last 30 seconds of each increment. The test was terminated when the subject raised their hand to signal for the final 1 minute collection. All the data collected were recorded in the VO_2 max test form. VO_2 max value of each subject obtained from the test was accepted when two or three criteria were met : 1) a plateau in oxygen uptake despite increasing speed, 2) respiratory exchange ratio exceed 1.15, 3) heart beat within 10 beats per minute ($beats.min^{-1}$) of age predicted maximum heart rate. (American College of Sports Medicine, 2006).

The speed for running at 65% of VO_2 max was identified from the plotted graph. The calculation was made by multiplying the desired percentage of intensity (65%) with VO_2 max obtained from Maximal Oxygen Uptake Test. Result suggested that athletes will be required to run at the speed at 65% of VO_2 max.

3.4. Experimental trial

After obtaining the appropriate running speed at 65% VO_2 max for all the subjects, the researcher arranged the schedule for every subject to perform the test. Experiment trials consist of three different treatments where the subjects need to obtain the trial in the three continuous weeks. One week gap was given between each test and all subjects were reminded for not participating in any vigorous activity one day before each trial.

3.4.1 Double blind Test

The selection of experimental trial was done by double blind procedure. Subjects were not informed at the beginning to which of the experimental treatment they are going to be introduced. The selection of test was made by drawing a piece of paper from three selection of test.

3.4.2 Pre-exercise

Before the running exercise, at first, MP3 player (NWZ-B152F, Sony, China) was applied on subjects ear and the volume was set at 70%(Elliot et al, 2005) which is sufficiently loud so as not to be disturbed by the noise of treadmill. Researcher asks the subject if they feel any uncomfortable feeling. After that, Heart Rate monitor (RS 100) were attached to the chest of each subject and sensor polar wrist receiver 3710 (Finland) was held by the researcher.

3.4.3 Exercise at 65% of VO_2 max

Subject started the experiment with warm-up for 3 min. The speed for the warm-up set at 5 kilometers per hour ($5km.h^{-1}$) with no music. Following the warm-up, the music was initiated and subjects ran at 65% of VO_2 max where the speed was maintained throughout the exercise. Timing of endurance began using the hand held stopwatch. Subject's heart rate was recorded and researcher administered the RPE board. RPE was subsequently recorded every 2 min until subjects were voluntarily exhausted, or when subjects raised their hand as a signal to terminate from exercise. Heart rate was also assessed at 2 min intervals to monitor the work intensity. At the end of exercise, researcher recorded the exercise duration in minutes and the distance of running in kilometers (km). A same procedure was conducted for all three different treatments.

3.4.4 Post-exercise

After the running exercise completed, subjects performed cooling down while researcher monitored their heart rate to measure recovery time of the subject. The speed for cooling down was 3-4 $km.h^{-1}$. Recovery time was recorded until subjects reached their pre-exercise heart rate. Following the cooling down, subjects measured their post-exercise body weight. While they were resting, Exercise Induced Feeling Inventory (EFI) questionnaires (Gauvin & Rejeski, 1993) were distributed to the subject to measure their perceived feeling after exercise.

3.5 Statistical Analysis

All the statistical analysis was computed by using the Statistical Analysis for the Social Sciences (SPSS) version 18.0. All the data reported were expressed in mean and standard deviation (Mean ± SD). One way ANOVA was used to compare the results in all variables measured between three different treatments.

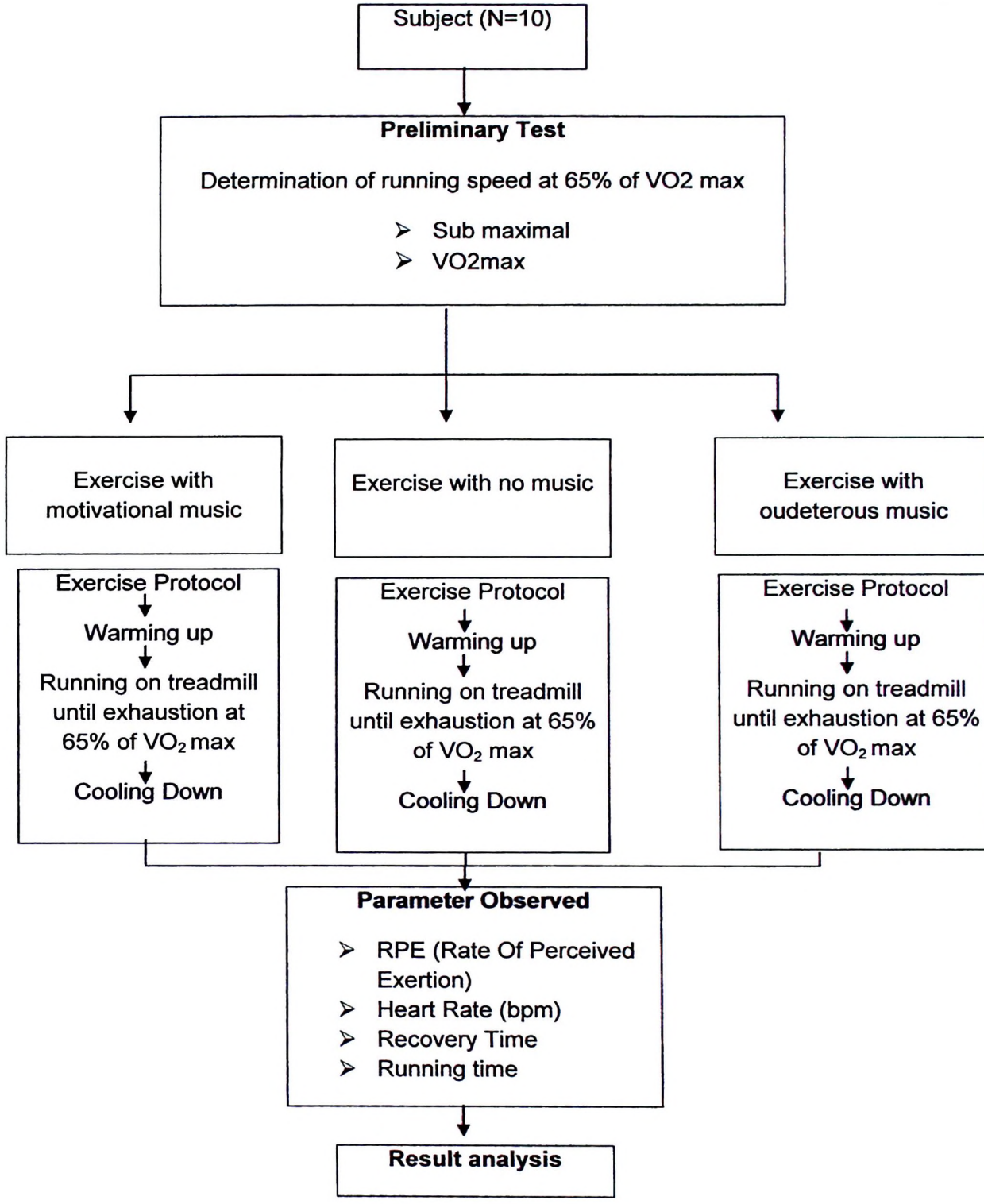

Figure 3.1: Flow chart for the research protocol

CHAPTER 4

RESULTS AND ANALYSIS

4.1 Characteristics of the subjects

A total of ten male students from Universiti Sains Malaysia, Health Campus were recruited in this study. Table 4.1 shows the physical and physiological characteristics of the subjects including age, height, and weight. Subjects were involved in regular physical activities and exercise for at least three times per week.

Table 4.1: Physical and physiological characteristics of subjects (n=10)

Physical Characteristics	Mean± S.D.
Age (years old)	22.6±0.7
Height (cm)	167±5.1
Weight (kg)	61.2±9.3
Maximal oxygen consumption ($ml.Kg^{-1}.Min^{-1}$)	51.28±3.63
Maximal heart rate ($beats.min^{-1}$)	197±0.7
Resting heart rate ($beats.min^{-1}$)	73±2.9

4.2 Rate of Perceived Exertion (RPE)

Figure 4.1 shows the changes of RPE at different time stages at 2 minutes after start, trial mid point and 2 minutes before end in three exercise conditions (motivational music, oudeterous music and no music).

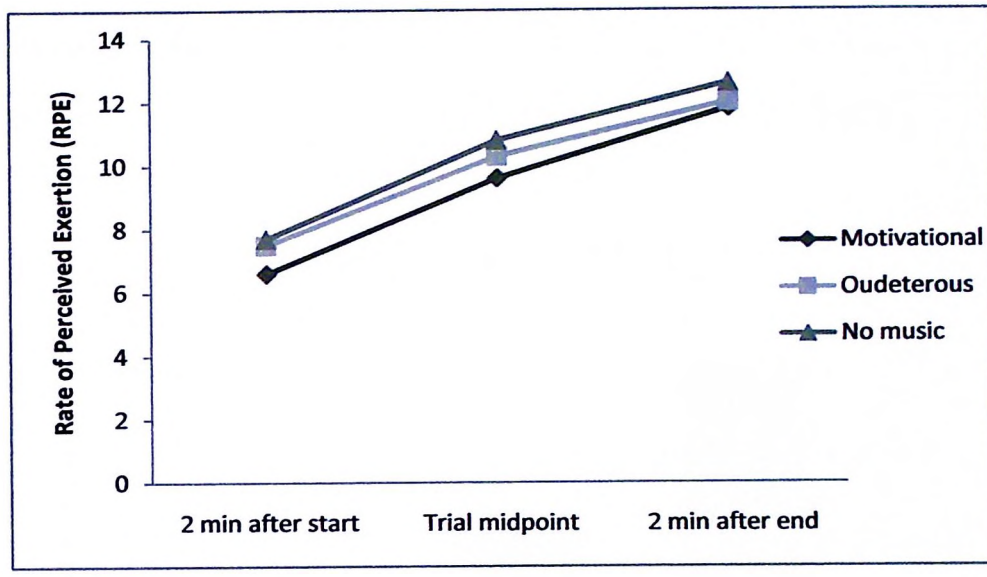

Figure 4.1: Changes of RPE in three exercise conditions

The result revealed no significant difference ($p>0.05$) for mean RPE when subjects underwent three different exercise conditions (motivational music, oudeterous music and no music). The mean±SD of RPE in three exercise conditions are reported in Table 4.2. The mean scores for RPE among the three exercise conditions are presented in Figure 4.2.

Table 4.2: Mean±SD of RPE

Exercise condition	Mean±SD
Motivational music	12.00±3.37
Oudeterous music	12.10±3.25
No music	12.40±3.53

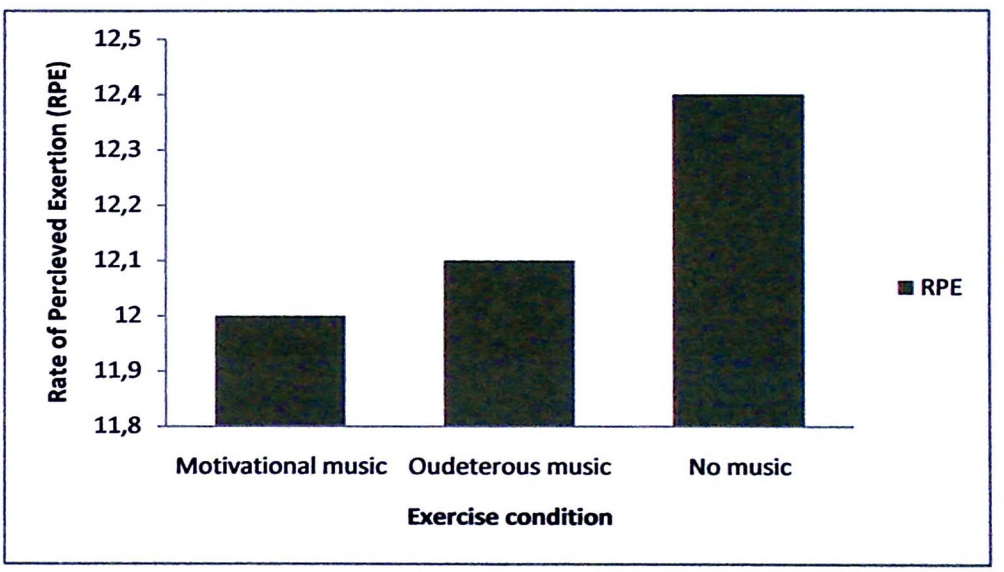

Figure 4.2: Mean score for RPE in three exercise conditions

4.3 Heart rate

Figure 4.3 shows the changes of heart rate at different time stages at 2 minutes after start, trial mid point and 2 minutes before end in three exercise conditions (motivational music, oudeterous music and no music).

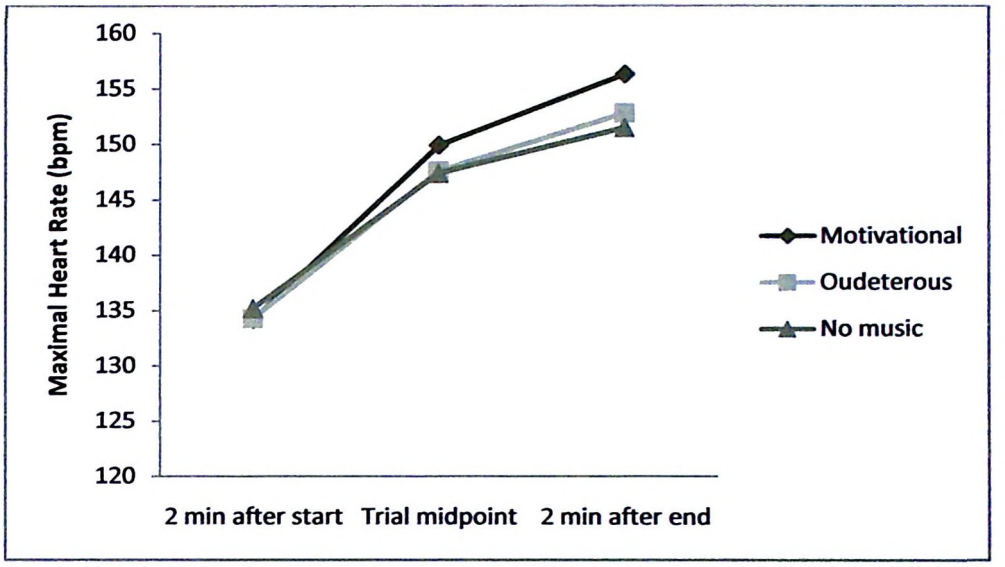

Figure 4.3: Changes of heart rate in three exercise conditions

The result revealed no significant difference ($p>0.05$) for maximal heart rate among the three different exercise conditions. The mean±SD of maximal heart rate in three exercise conditions are reported in Table 4.3. The mean scores for maximal heart rate among the three exercise conditions are presented in Figure 4.4.