EFFECTS OF 20 MINUTES NEURO-PRIMING WITH AND WITHOUT PRE-TASK MOTIVATIONAL MUSIC ON SWIMMING PERFORMANCE AMONG MALE STATE SWIMMERS

SOON YE XANG

SCHOOL OF HEALTH SCIENCES

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by

SOON YE XANG

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TABLE OF CONTENT

APPENDICES

PAGE

LIST OF TABLES

PAGE

LIST OF FIGURES

ABSTRAK

KESAN NEURO-PRIMING DENGAN DAN TANPA MOTIVASI MUSIK DALAM MASA 20 MINIT TERHADAP PRESTASI KEMAHIRAN PERENANG LELAKI PERINGKAT NEGERI

PENGENALAN: 'Neuro primig' merupakan suatu proses dimana ia menggunakan stimulasi 'transcranial direct current' (tDCS) untuk meningkatkan keplastikan otak sebelum menjalankani sesuatu aktiviti. Pra-tugas motivasi muzik berfungsi sebagai alat ergogenik sebelum aktiviti yang terdiri daripada irama, tempo, keharmonian dan melodi. **OBJEKTIF:** Kajian ini adalah untuk menyiasat kesan penggunaan 20 minit neuro-priming dan pra-tugas motivasi muzik terhadap prestasi renang, penguasaan kemahiran-berkaitan, kebimbangan dan efikasi kendiri dalam kalangan perenang negeri lelaki. **KAEDAH:** Empat belas perenang lelaki (berumur 15.50 ± 1.4 tahun) telah diagihkan sama rata kepada tiga keadaan kajian iaitu, kumpulan 1 keadaan 'sham', kumpulan 2 keadaan 'neuro-priming' tanpa music dan kumpulan 3 keadaan 'neuro-priming' dengan viiumma motivasi. Keadaan 'sham' merupakan keadaan yang tidak mempunyai stimulasi tDCS. Kajian ini merupakan kajian 'cross over' dengan setiap peserta dikehendaki menghadiri kesemua tiga keadaan, dipisahkan oleh satu minggu tempoh berehat. Selepas satu minggu rehat, peserta dikehendaki melalui prosedur yang sama dengan keadaan yang berbeza. . Antropometri dan profil fisiologi telah diukur untuk setiap peserta. Pada sesi pertama, ujian yang berkaitan kemahiran (berdiri lompat jauh dan lompat menegak), anaerobik (50m) dan aerobik (400m) prestasi akan dijalankan dengan kumpulan 1 atau kumpulan 2 atau Kumpulan 3 secara rawak. Sebelum anaerobik dan ujian prestasi aerobik bermula, setiap peserta dikehendaki mengisi soal selidik CSAI-2R dan tahap keberkesanan diri. Peserta dikehendaki memakai set kepala "Halo sport" selama 20 minit dengan atau tanpa muzik motivasi dan juga dalam keadaan sham. Muzik motivasi telah

dipilih berdasarkan “Brunel Music Rating Inventory-3 (BMRI-3)”. Data telah dianalisis dengan menggunakan ‘Repeated Measure ANOVA’. **KEPUTUSAN:** Terdapat perbezaan yang ketara untuk ujian anaerobik (50m) dalam keadaan ‘neuro-priming’ dengan musik motivasi. Tetapi, tiada perbezaan yang signifikasi dijumpai untuk kebimbangan kognitif, kebimbangan somatik, keyakinan diri untuk ketiga-tiga keadaan. **KESIMPULAN:** Prestasi renang anaerobik (50m) boleh dipertingkatkan dengan menggunakan ‘neuro-priming’ dengan muzik motivasi sebelum pertandingan tanpa bertambah dengan latihan fizikal.

ABSTRACT

EFFECTS OF 20 MINUTES NEURO-PRIMING WITH AND WITHOUT PRE-TASK MOTIVATIONAL MUSIC ON SWIMMING PERFORMANCE AMONG MALE STATE SWIMMERS.

INTRODUCTION: Neuro priming is a process of using the transcranial direct current stimulation (tDCS) to increase plasticity in the brain prior to an activity. Pre-task motivational music serves as an ergogenic effects prior to an activity that consists of rhythm, tempo, harmony, and melody. **OBJECTIVE:** This study investigated the effect of using 20 minutes of neuro-priming with or without pre-task motivational music on the swimming performance, skill-related performance, anxiety and self-efficacy level among the male state swimmers. **METHOD:** Fourteen healthy male swimmers (age: 15.50 ± 1.4) were randomly assigned into three research conditions, Group 1 sham condition (control), Group 2 neuro-priming without music, and Group 3 neuro-priming with motivational music. This study is a cross-over study design with all participants completed all three research conditions separated by one-week of resting period in-between intervention. After the one week of resting, participants needed to go through the same procedure with different research conditions. Anthropometry and physiological profile of all participants were measured. First session involved power test (standing long jump and vertical jump), anaerobic (50m) and aerobic (400m) performance with Group 1 or Group 2 or Group 3 in random order. Before the anaerobic and aerobic swimming performance, participants were required to complete the CSAI-2R and self-efficacy level questionnaires. Participants require to wear Halo Sport neuro-priming headset for 20 minutes with or without motivational music, and during the sham condition (without any stimulation). Motivational music were selected based on BMRI-3. Data were analysed by the Repeated Measure ANOVA. **RESULTS:** There were significant changes in the anaerobic

swimming performance (50m). However, cognitive anxiety, somatic anxiety and self-confidence showed no significance changes in three research conditions. **CONCLUSION:** Anaerobic swimming performance (50m) can be improved by using neuro-priming with motivational music without any additional physical training.

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

In recent years, neuro-priming and pre-task motivational music have been a frontier technique that can be used before the training or competition for enhancing sporting performance. This method is harmless, and it also can help athletes to build their confidence level prior to the competition. A short 20 minutes of neuro-priming and listening to motivational music could influence their performance in their respective sports.

Neuro-priming is a process of using neurostimulation, which also known as transcranial direct current stimulation (tDCS). Transcranial direct current stimulation (tDCS) is a non-invasive technique that modulates cortical excitability using electrical current and has been studied extensively in humans. Through the induction of weak in intracerebral ionic current between a positively charged anode and a negatively charged cathode, tDCS has been shown to modulate the excitability of primary motor cortex, M1 (Halo Neuroscience, 2016). The uses of tDCS have slowly moved from the laboratory to the broader community (Edwards et al., 2017). Recently, a simple method of using tDCS was provided using the Halo Neurostimulation System. The Halo Neurostimulation System was used to confirm and further enhance the effectiveness of tDCS in improving motor performance. The Halo Neurostimulation System was developed as part of a program to create a tDCS device that can be self-administered outside of a lab setting (Halo Neuroscience, 2016). Noninvasive brain stimulation methods have been used to modulate cortical excitability and to perturb initial motor learning and consolidation. Anodal transcranial direct current stimulation (tDCS) delivered over the primary motor

cortex (M1) increases motor cortical excitability without direct neuronal depolarization at the low intensities used in humans. In contrast, cathodal tDCS decreases cortical excitability. A single application of anodal tDCS over M1 has been shown to induce transient performance improvements in various motor tasks (Reis et al., 2009).

Besides, listening to music is another technique that can be an ergogenic aid that is beneficial to healthy living life and athletes' performance. Music is believed to be able to motivate, spur into action, relax and lower perceptions of effort; it has become increasingly used in sports and leisure activities. Its application in these areas has been facilitated by technological developments making it possible for music to accompany professional athletes or amateurs in their daily or occasional physical activities, while its benefits have been increasingly used to improve competitive performance or make physical leisure activities more pleasant. Music is a cure for the soul even for people commonly described as not very musical or completely unmusical, for amateurs and competitive athletes (Karageorghis & Terry, 1997). There have four factors thought to contribute to the motivational qualities of a musical piece. Rhythm response refers to the effects of musical rhythm, especially tempo (speed of music as measured in beats per min [bpm]). Musicality refers to the pitch-related elements of music such as harmony (how the notes are combined when played together) and melody (the tune). Cultural impact concerns the pervasiveness of the music within society or a sub-cultural group. Finally, association refers to the extra-musical associations that may be evoked (Karageorghis & David-Lee, 2012).

In the sport of swimming, the role of motivation act as crucial, due to after a while monotony may appear among swimmers, especially in competitive ones, leading in extreme cases to their abandoning training. Motivating music is that which controls arousal, reduces the perceptions of exertion and improves mood, which also provides two

obvious benefits: increased exercise adherence among exercise participants and a more effective pre-event routine for athletes. Listening to motivational music before the training or competition may help the athlete to pay more attention and focus on their races, which also have the effect of enhancing their performance. Pre-task music has been shown to 3ummariz arousal, facilitate task-relevant imagery and improve performance in simple motoric tasks. During repetitive, endurance-type activities, self-selected, motivational and stimulative music has been shown to enhance effect, reduce ratings of perceived exertion, improve energy efficiency and lead to increased work output (Karageorghis & David-Lee, 2012).

This study aimed to identify the effect of using 20 minutes of neuro-priming by adding pre-task motivational music or without music on swimming performance, which is aerobic (50 meters) and anaerobic (400 meters), power test (standing long jump and vertical jump) and psychological state (self-confidence and anxiety level). This study focuses on male state swimmers, age between 15-18 years old. The field of interest in this research is to study the physiological and psychological effects after using the neuro-priming with or without adding pre-task motivational music. Neuro-priming and pre-task motivational music is a frontier field of study, and we found a limited study conducted from the literature review. Therefore, this study is designed in an attempt to fill the gap in knowledge.

1.2 Problem statement

Swimming athletes rely on technique, strength and endurance to propel themselves down the line lap after lap. In order to improve these substances, the use of Neuro-priming with Halo Sport, with or without pre-task motivational music could demonstrate some ergogenic effect on their swimming performance. Although there are limited studies conducted on the effects of motivational music with swimming performance; Neuro-priming with and without music with swimming performance is still lacking. This study is designed to examine which method showed more beneficial on swimming performance, either 20 minutes of neuro-priming or Neuro-priming with motivational music or Sham condition (without neuro-priming).

1.3 Objectives of study

Main objective

To examine the effect of using 20 minutes of neuro-priming and pre-task motivational music on the swimming performance, power test, anxiety and self-efficacy level among male state swimmers.

Specific Objectives

1. To examine the effect of using neuro-priming with or without pre-task motivational music on the power test (standing long jump and vertical jump) among male state swimmers.
2. To examine the effect of using neuro-priming with or without pre-task motivational music on anaerobic performance (50 meters swim) among male state swimmers.

3. To examine the effect of using neuro-priming with or without pre-task motivational music on aerobic performance (400 meters swim) among male state swimmers.
4. To compare the effect of using neuro-priming with or without pre-task motivational music on anxiety and self-efficacy level.

1.4 Research of Question

1. What is the effect of using neuro-priming with or without pre-task motivational music on the power test among male state swimmers?
2. How will the neuro-priming with or without pre-task motivational music affects the anaerobic performance (50 meters swim) among male state swimmers?
3. How will the neuro-priming with or without pre-task motivational music affects the aerobic performance (400 meters swim) among male state swimmers?
4. How much improvement of using neuro-priming with or without pre-task motivational music on anxiety and self-efficacy level?

1.5 Hypothesis of study

Null Hypothesis (Ho_1): There is no effect on the power test among male state swimmers using neuro-priming with or without pre-task motivational music.

Alternative Hypothesis (Ha_1): There is an effect on the power test among male state swimmers using neuro-priming with or without pre-task motivational music.

Null Hypothesis (Ho_2): There is no improvement on the anaerobic performance (50 meters swim) among male state swimmers using neuro-priming with or without pre-task motivational music.

Alternative Hypothesis (Ha_2): There is an improvement on the anaerobic performance (50 meters swim) among male state swimmers using neuro-priming with or without pre-task motivational music.

Null Hypothesis (Ho_3): There is no improvement on the aerobic performance (400 meters swim) among male state swimmers using neuro-priming with or without pre-task motivational music.

Alternative Hypothesis (Ha_3): There is an improvement on the aerobic performance (400 meters swim) among male state swimmers using neuro-priming with or without pre-task motivational music.

Null Hypothesis (Ho_4): There is no improvement on the anxiety and self-efficacy level among male state swimmers using neuro-priming with or without pre-task motivational music.

Alternative Hypothesis (Ha_4): There is an improvement on the anxiety and self-efficacy level among male state swimmers using neuro-priming with or without pre-task motivational music.

1.6 Significance of study

This study attempted to investigate the effect of using 20 minutes of neuro-priming with or without pre-task motivational music on the anaerobic and aerobic swimming performance. This study could provide insights on the pros and cons of using neuro-priming stimulation prior to training, competition or performance test. Besides, motivational music can serve as an ergogenic effect which could further improve the athlete performance by either delaying fatigue or increasing work capacity (Karageorghis & David-Lee, 2012). The combination of neuro-priming with motivational music could further produce more productive training and to help to enhance athlete performance,

such as reduce the perception of fatigue and increased in swimming performance (anaerobic or aerobic).

1.7 Operational definition

Neuro-priming: The process of using neurostimulation, which also known as neurostimulation method.

Transcranial direct current stimulation (tDCS): Technique of neurostimulation that used low levels and constant electrical current with electrodes on the brain area.

Motivational music: Factors thought to contribute to the motivational qualities of a musical piece. Rhythm response refers to the effects of musical rhythm, especially tempo, pitch-related elements of music such as harmony and melody. In this study, motivational music were selected using the BMRI-3.

Self-efficacy: Self-efficacy describes the belief one has in being able to execute a specific task to obtain a certain outcome (Bandura, 1977). It is not concerned with the skills an individual has but rather with the judgments of what one can do with whatever skills he or she possesses.

Somatic state anxiety: Somatic anxiety refers to one's perception of the affective physiological elements of anxiety, generated from an increase of autonomic arousal and unpleasant feelings such as nervousness, tension and upset (Kais & Raudsepp, 2005).

Cognitive state anxiety: Cognitive anxiety refers to negative expectations and cognitive concern about performance, the consequences of failure, negative self-evaluation, evaluation of one's ability relative to others, the inability to concentrate, and disrupted attention (Kais & Raudsepp, 2005).

Self-confidence: The term self-confidence refers to one's belief that he or she can successfully execute a desired 8ummariz (i.e., his or her belief of "T II get the job done").

Aerobic performance: Contribution of both the aerobic and anaerobic systems to the power output changes with the race distance. Aerobic contribution predominates at the 400-, 800-, and 1500-m events (Toussaint, Wakayoshi, Hollander, & Ogita, 1998).

Anaerobic performance: The anaerobic contribution is 80% or more in the 50- and 100-m events. It involved predominantly on fast-twitch muscular and energy were produced with the by-product of lactic acid.

CHAPTER 2

LITERATURE REVIEW

2.1 Transcranial direct current stimulation (tDCS)

Transcranial direct current stimulation (tDCS) is a frontier technique that stimulates brain regions by delivering weak direct currents or small currents (1-2 mA) through the skull or specific area (Tanaka, Hanakawa, Honda, & Watanabe, 2009). Through the stimulation, the human primary motor cortex is capable of eliciting intracortical excitability changes. The direction of these modulations depends on stimulation polarity: Anodal stimulation increases excitability, while cathodal stimulation diminishes it (Nitsche & Paulus, 2000). The resulting electrical field changes the resting state of neurons, depolarising or hyperpolarising the neurons in order to excite or inhibit a specific area of the brain and promote neurons firing together. By altering the resting state, tDCS changes the functionality of the target area.

Transcranial direct current stimulation (tDCS) is a noninvasive technique that modulates motor function (Halo Neuroscience, 2016). Enhancement of motor function is one exciting application for improving brain functionality. By stimulating specific areas of the motor cortex, researchers have been able to increase fine motor skills as well as modulating gross motor properties such as fatigue and explosiveness in human subjects (Halo Neuroscience, 2016a). Nitsche et al. (2005) showed that the respective changes evolve during tDCS, and this tDCS effects could remain up to one hour after the stimulation, and the effects last sufficiently long enough for most performance enhancement if applied for 9 minutes or longer by using 0.3 – 2mA of the current intensity. Cuypers et al. (2013) and Vines et al. (2008) found improved motor skills and motor

learning using tDCS and a finger-tapping task. In addition, tDCS can enhance motor learning (Reis et al., 2009), thereby increasing the benefit of practice and promoting better performance.

2.2 Application of tDCS

Previous research has shown that tDCS facilitates the learning of fine motor skills in both healthy and clinical populations. tDCS delivered via the Halo Neurostimulation System was observed to facilitate motor skills learning, motor performance, leading subsequently to faster, more synchronised execution, and may be valuable in the treatment of depression and stroke or disease (Halo Neuroscience, 2016). Based on some of the researches results, they examined that the use and benefits of tDCS during athletic training; specifically, strength, power, and explosiveness training of elite athletes, to enhance the effects of training and competitive performance (Halo Neuroscience, 2016a).

One possible application of tDCS is in sports, where stimulation has shown promising results in the form of increased training efficiency, improving both motor skills and raw power. Halo Neuroscience (2016a) showed that athletes training for strength and power-intensive sports received neurostimulation treatment in the form of transcranial direct current stimulation (tDCS) from the Halo Neurostimulation System during their regular training routine. For athletes who received stimulation showed significantly higher improvement in their jumping ability compared to non-stimulation athletes. The sport includes the US Olympic ski team (Reardon, 2016), top-tiered NBA team (Mansfield, 2016) and gamers (Falcone & Parasuraman, 2012; Jarrett, 2016).

2.3 Improvement in maximal force

Many studies have shown that tDCS has an improvement in the maximal force. Previous research has also indicated that tDCS over the motor cortex (M1) can enhance motor performance of a variety of muscle groups in both healthy and clinical populations. For example, Hummel et al. (2010) found improved performance on the Jebsen-Taylor Test (JTT) after anodal tDCS over the left primary motor cortex in healthy right-handed subjects. The Jebsen-Taylor Test is a seven-part test that evaluates the speed of hand functions used in daily activities. In this study, subjects maintained functional gains during, immediately after, and for at least 30 minutes after stimulation. In another research, Okano et al. (2015) studied the effects of 20 min of tDCS with the anode over the left temporal cortex (T3) on trained cyclists during an incremental cycling test. They found significantly improved peak power, as well as reduced heart rate and perception of effort at submaximal workloads.

In a different study, it was found that anodal tDCS over M1 increased maximal pinch force (PF) and shortened reaction time (RT) in stroke patients performing simple hand motor tasks (Hummel et al., 2006). Besides, Tanaka et al. (2009) found that anodal tDCS transiently enhanced maximal leg PF during its application. A variety of papers have shown that anodal tDCS over M1 increases time to task failure during fatiguing contractions with the elbow flexors (Cogiamanian et al., 2007; Williams et al., 2013). Strengthened neural drive plays a particularly important role in increasing the rate of force development (RFD) during a contraction (Aagaard et al., 2002). RFD, also known as explosive strength, is defined as the speed at which peak force is produced. Besides, the stimulation ultimately improved the athletes' jumping force by 70% and their coordination by 80%, compared with the sham group, Halo announced in February (Reardon, 2016). However, there are still some controversial results reporting that there

is no additional increase in maximal voluntary force during specific tasks involving elbow flexion (Lampropoulou & Nowicky, 2013) or wrist extension (Hendy & Kidgell, 2013).

2.4 Improvement in aerobic endurance

Some of the studies also showed that tDCS could improve aerobic endurance of athletes. Other research suggests that targeted brain stimulation can reduce an athlete's ability to perceive fatigue, which means the athlete can sustain longer during the training or competition. Fatigue contributes not only to reduced muscular endurance, but it also can impair decision making, response time and skill (Okano et al., 2015). Another study, which presented on 7 March at the Biomedical Basis of Elite Performance meeting in Nottingham, UK, suggests that tDCS may reduce the perception of fatigue. Sports scientist Lex Mauger of the University of Kent in Canterbury, UK, and his colleagues found that stimulating the motor-cortex region that controls leg function allows cyclists to pedal longer without feeling tired (Reardon, 2018).

Vitor-Costa et al. (2015) suggested that the mechanisms of longer exercise tolerance that is mediated by anodal tDCS are related to an increase in intracortical facilitation and motor cortex excitability (Vitor-Costa et al., 2015). tDCS allows to cycle for longer periods, because intracortical facilitation correlates with the total workload when doing pull-ups (Tergau et al., 2000). To this end, a facilitation system for the motor cortex during exercise until exhaustion has also been proposed by Taylor et al. (2011) and Tanaka et al. (2008) in different sports. In contrast, Flood et al. (2017) noted that while high definition tDCS (HD-tDCS) targeting the sensorimotor cortex reduced perception of pain during fatiguing lower limb exercise in 12 subjects, showed no significant effect on muscle endurance or maximal production of force (Flood et al., 2017).